

添付資料10: オンライン・ トレーニング

10-1: 研修レポート

10-2: 日本の廃棄物管理概要

10-3: ダイオキシン分析

10-4: WTEに関する日本の経験・知見

10-5: 東京都におけるWTE施設事例

10-1: 研修レポート

1. 研修目的

本研修の目的は、廃棄物管理（SWM）とダイオキシン（DXN）分析に関する日本の技術や経験を本プロジェクト活動に携わる研修生と共有することである。この研修にて習得した知識は、今後のプロジェクト期間中の活動に大いに役立つことが期待される。

2. 研修プログラム

本オンライン研修のプログラムを表 1 に示した。研修は 2021 年の 11 月中旬から 12 月中旬にかけて実施し、「廃棄物管理コース」と「ダイオキシン分析コース」のコース区分を設けた。当初計画では、本邦にて実施する予定であったが、COVID-19 の感染拡大による渡航制限のためオンライン形式にて実施する方針とした。

日時: 11/15-18, 26 12/3, 6, 10

研修コース: 廃棄物管理コース、ダイオキシン分析コース

実施ツール: Microsoft Teams

言語: 日本語と英語（逐次通訳）

表 1 オンライン研修日程表

日時	区分	内 容	講師	参加数
11 月 15 日（月）	SWM	日本の廃棄物管理／法体系、各主体の役割	日本工営	38
11 月 16 日（火）	DXN 分析	捕捉/吸着材料とサンプリングトレイン前処理	ユーロフイン日本環境	24
11 月 17 日（水）		サンプリングトレインからのサンプル回収手順	ユーロフイン日本環境	20
11 月 18 日（木）		GC/HRMS および DIOK 操作の初期設定	ユーロフイン日本環境	19
11 月 26 日（金）	WTE	廃棄物処理事業の実施行程と PPP	エイト日本技術開発	24
12 月 3 日（金）		地方自治体の WTE 施設の概要 オンライン施設見学（杉並清掃工場）	東京 23 区清掃 一部事務組合	26
12 月 6 日（月）		地方自治体の廃棄物管理の概略、WTE における環境配慮 地方自治体の WTE 事業における役割		22
12 月 10 日（金）		廃棄物焼却技術と廃棄物焼却事業の要件	エイト日本技術開発	25

出典：JICA 専門家チーム

3. 事後アンケート結果の概要

本業務における活動向上・改善のため、各研修区分の事後アンケートを実施した。アンケート結果の概要について以下に示した。また、結果の詳細については添付に示す。

(1) 廃棄物管理（SWM）講義

研修の運営、講師・講義内容に関して多数の方が高評価を示した。また、講義内容について多数が高い理解度を示した。回答者が興味を示した講義テーマについては「日本の廃棄物に関する法制度」、「日本の廃棄物に関する歴史」などの意見があった。

(2) ダイオキシン（DXN）分析講義

研修の運営、講師・講義内容に関して多数の方が高評価を示した。また、講義内容について多数が高い理解度を示した一方で、内容の一部理解できなかったと回答する参加者も散見された。回答者が興味を示した講義テーマについては「排ガスサンプルの捕集・吸着剤に関わる準備」などがあった。

(3) 廃棄物発電（WTE）講義（東京 23 区清掃一部事務組合）

研修の運営、講師・講義内容に関して多数の方が高評価を示したが「質疑応答の時間が短い」などの意見もあった。また、講義内容について多数が高い理解度を示した。回答者が興味を示した講義テーマについては「杉並工場の環境社会配慮」、「実際の工場運営方法」などの意見があった。

(4) 廃棄物発電（WTE）講義（株式会社エイト日本技術開発）

研修の運営、講師・講義内容に関して多数の方が高評価を示した。また、講義内容について多数が高い理解度を示した。本講義のアンケートについては幾つかの詳細質問を追記し、それらの結果として回答者の約 8 割が「日本のような廃棄物処理施設整備への補助金制度が必要」との考えであった。さらに、その補助金の資金源は中央政府であるべきとの意見が多数であった。回答者が興味を示した講義テーマについては「WTE 施設整備に必要な要件」、「施設で用いる化学物質」などの意見があった。

4. 研修参加者

各研修コースの参加者を表 2、表 3 に示した。関係各機関から SWM/WTE コースに 47 名、ダイオキシン分析コースに 29 名が参加した。

表 2 廃棄物管理コースの参加者名簿

No.	氏名	所属・組織	役職
1	Ms. Charisse Jane D. Pascual	Department of Energy - REMB	Senior Science Research Specialist
2	Ms. Sarah Sharmaine T. Gabriel	Department of Energy - REMB	Science Research Specialist II
3	Ms. Gemmalyn G. Galang	Department of Energy - REMB	Science Research Specialist I
4	Mr. Luis Sabater	QC Task Force Solid Waste Management	Planning Officer III
5	Mr. Christoper Ador	QC Task Force Solid Waste Management	Project Development Officer
6	Ms. Jodell Robiso	QC Task Force Solid Waste Management	Planning and Research Assistant

No.	氏名	所属・組織	役職
7	Ms. Elmie Sanchez	QC Task Force Solid Waste Management	Clerk
8	Ms. Glory Rose C. Manatad	Cebu City Environment and Natural Resources Office	Environmental Management Specialist II
9	Ms. Marilou T. Calado	DENR - EMB - Project Preparation Division - FASPS	DMO III
10	Mr. Conrado A. Bravante, Jr.	DENR - EMB - Project Preparation Division - FASPS	Chief
11	Ms. Isabel D. Salas	DENR - EMB - Project Preparation Division - FASPS	DMO III
12	Ms. Alma P Ferarez	EMB NCR	Sr. Environmental Management Specialist
13	Ms. Myra Tansengco	DOST - ITDI - Environment & Biotechnology Division	Supervising Science Research Specialist
14	Ms. Gee Maurene G. Manguera	PPPC	Project Development Officer
15	Mr. Aaron Gabrielle M. Tanyag	PPPC	Project Development Officer
16	Mr. Erwin James G. Caluag	PPPC	Project Development Officer
17	Mr. Lakandiwa Orcullo	Davao City Environment and Natural Resources Office	Engineer
18	Ms. Elvira Pausing	EMB - SWMD - PMO	Supervising EMS
19	Ms. Roxanne Barcen	EMB - SWMD - PMO	Technical Assistant
20	Mr. Alwin Jay D. Robel	DENR - EMB	Environmental Management Specialist I
21	Ms. Raquel Rosario A. Reyes	DENR - EMB	Sr. Environmental Management Specialist
22	Ms. Rodeth Antonio	DENR - EMB - SWMD	Monitoring Officer
23	Mr. Eric Nagum	DENR - EMB - SWMD	Site Engineer
24	Mr. Ronald Ewa	DENR - EMB R11	Environmental Management Specialist II
25	Ms. Patricia Rose Orante	QC Task Force Solid Waste Management	Sr. Environmental Management Specialist
26	Ms. Mary Ash Day O. Malimit	NEDA Infrastructure Staff	Chief Economic Development Specialist
27	Mr. Edgar Basilio	NEDA Infrastructure Staff	Chief Economic Development Specialist
28	Mr. Kevin Gilbert M. Manzano	NEDA Infrastructure Staff	Supervising EDS
29	Mr. Bernie C. Magtalas	NEDA Infrastructure Staff	Senior EDS
30	Ms. Roselyn Ann P. Obrique	NEDA Infrastructure Staff	EDS II
31	Mr. Ronelle S. Yuag	NEDA Infrastructure Staff	EDS II
32	Ms. Arianne Rose A. Santos	NEDA Infrastructure Staff	EDS I
33	Ms. Wyona Kay Rativo	EMB - AQMS	Engineer II
34	Mr. Edmundo Escubio	EMB - AQMS	Engineer II
35	Mr. Paul Nathan Vallar	EMB - AQMS	Environmental Management Specialist II

No.	氏名	所属・組織	役職
36	Ms. Mariam Salemizadeh	EMB - AQMS	Environmental Management Specialist II
37	Mr. Arnon Brix Faustino	EMB - AQMS	Monitoring Officer
38	Mr. Felix Brylle Domingo	EMB - AQMS	Site Engineer
39	Ms. Mae Ann Gatchallan	EMB - AQMS	Site Engineer
40	Mr. Rey John Esquivel	DENR - EMB - SWMD	Environmental Management Specialist I
41	Mr. Jay Christoffer F. Bawi-in	DENR - EMB R11	Chief, Ecological Solid Waste Management Section
42	Ms. Rocelle Estoya	EMB - SWMD	Project Support Officer
43	Ms. Gee Maurene G. Manguera	PPPC - PDS	Project Development Officer
44	Mr. Aaron Gabrielle M. Tanyag	PPPC - PDS	Project Development Officer
45	Ms. Marla Clarisol Agas	DILG	Project Development Officer III
46	Ms. Elle Pancho	DILG	Project Development Officer III
47	Engr. Danilo Gonzales	DENR-EMB R11	

* 廃棄物管理コースの講義に少なくとも 1 つ以上に参加された方は参加者とする

表 3 ダイオキシン分析コースの参加者名簿

No.	氏名	所属・組織	役職
1	Mr. Sammy L. Aytona	DENR - EMB - ERLSD	Sr. SRS
2	Mr. Roger C. Evangelista, Jr.	DENR - EMB - ERLSD	Sr. SRS
3	Mr. Lyle Shane G. Dichoso	DENR - EMB - ERLSD	Chemical Technician
4	Mr. Khennyie-Ar G. Peroja	DENR - EMB - ERLSD	Chemist
5	Mr. Alex Avel P. Romero	DENR - EMB - ERLSD	Chemist
6	Mr. Luis Sabater	QC Task Force Solid Waste Management	Planning Officer III
7	Mr. Christoper Ador	QC Task Force Solid Waste Management	Project Development Officer
8	Ms. Jodell Robiso	QC Task Force Solid Waste Management	Planning and Research Assistant
9	Ms. Elmie Ranchez	QC Task Force Solid Waste Management	Clerk
10	Ms. Menchie M Alanis, PhD	EMB NCR	Chief, Laboratory Services Section
11	Ms. Myra Tansengco	DOST - ITDI - Environment & Biotechnology Division	Supervising Science Research Specialist
12	Mr. Lakandiwa Orcullo	Davao City Environment and Natural Resources Office	Engineer
13	Ms. Elvira Pausing	EMB - SWMD - PMO	Supervising EMS
14	Ms. Roxanne Barcenas	EMB - SWMD - PMO	Technical Assistant
15	Mr. Alwin Jay D. Robel	DENR - EMB	Environmental Management Specialist I
16	Ms. Rodeth Antonio	DENR - EMB - SWMD	Monitoring Officer

No.	氏名	所属・組織	役職
17	Mr. Ronald Ewa	DENR - EMB R11	Environmental Management Specialist II
18	Mr. Ronelle S. Yuag	NEDA Infrastructure Staff	EDS II
19	Ms. Arianne Rose A. Santos	NEDA Infrastructure Staff	EDS I
20	Ms. Wyona Kay Rativo	EMB - AQMS	Engineer II
21	Mr. Angelo Villegas	EMB - AQMS	Site Engineer
22	Mr. Felix Brylle Domingo	EMB - AQMS	Site Engineer
23	Ms. Mae Ann Gatchallan	EMB - AQMS	Site Engineer
24	Mr. RJ Esquivel	DENR - EMB - SWMD	Environmental Management Specialist I
25	Mr. Jay Christoffer F. Bawi-in	DENR - EMB R11	Chief, Ecological Solid Waste Management Section
26	Ms. Rocelle Estoya	EMB - SWMD	Project Support Officer
27	Ms. Gee Maurene G. Manguera	PPPC - PDS	Project Development Officer
28	Mr. Aaron Gabrielle M. Tanyag	PPPC - PDS	Project Development Officer
29	Mr. Erwin James G. Caluag	PPPC - PDS	Project Development Officer

* ダイオキシン分析コースの講義に少なくとも 1 つ以上に参加された方は参加者とする

* 廃棄物管理コースとダイオキシン分析コースの両コースに参加した参加者氏名の重複がある

10-2: 日本の廃棄物管理概要



Online Training < Outline of Waste Management in Japan >

15 November 2021

Shungo SOEDA

Circular Economy Promotion Dept.
NIPPON KOEI CO., LTD.

The Technical Cooperation Project (TCP) for Capacity Development on
Improving Solid Waste Management (SWM) through
Advanced/Innovative Technologies



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2. Municipal Waste Management Facts in Japan
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Self Introduction

Name: Shungo SOEDA

Occupation:

Senior Environmental Engineer for 3R and
Solid Waste Management at NIPPON KOEI Co., Ltd.

Education:

BSc Chemical Engineering, Doshisha University 1986
MSc Environmental Sciences, University of Tsukuba 1995

Work Experiences:

Daicel Chemical Industries co., Ltd., 1986 – 1993 (Plant engineer)
City of Cambridge, MA, USA, 1996 (Assistant recycling coordinator)
Nippon Koei Co., Ltd., 1997 – (Environmental Engineer)





Major Engaged Overseas Project



- Information Collection and Verification Survey for Municipal Solid Waste Management in Ukraine (JICA, 2018)
- Technical Cooperation Project for improvement of E-waste reverse logistics in Brazil (JICA, 2014 – 2017)
- Technical Cooperation Project for promotion of sustainable 3R activities in Maputo, Mozambique (JICA, 2013 – 2017)
- Feasibility Study on the introduction of Waste to Energy Plant in Yangon, Myanmar (Ministry of Environment, Japan, 2013)
- Feasibility Study on the construction of the new sanitary landfill, decommission of the existing dumping site and procurement of the solid waste management equipment in Nairobi, Kenya (JICA, 2012)
- Solid Waste Management Holistic Decision Modeling (The World Bank, 2007)
- The Study on the Solid Waste Management in the Kathmandu Valley for the Kingdom of Nepal (JICA, 2006)
- Japanese Grant Aid Project for Improvement of Solid Waste Management in Xi'an City in the People's Republic of China (Xi'an City, 2005)
- Preparatory Study on Solid Waste Management Plan for Dhaka City in People's Republic of Bangladesh (JICA, 2002)

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Municipal Solid Waste Generation Facts/1



	Unit	Japan (FY2018)	Philippines
Total Generation	Ton/Year	42,720,000	13,114,000*
Unit Rate of Generation	gram/ d-capita	918	320-630*
Population	Capita	127 million	100 million
Area	Km ²	377,930	299,404
Pop. Density	Cap./Km ²	337	334
Waste Gen. Density	Ton/Km ²	113	43
GDP per Capita (nominal)	USD	38,214	3,294(2019,IMF)

Source: Ministry of Environment, Japan
National SWM Strategy 2012-2016, DENR

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Municipal Solid Waste Treatment Facts/2



	Quantity (ton/year)	Ratio	Note
A Total Generation	42,720,000		
B Source Recycling at Community	2,040,000		
C Total Quantity for Treatment	40,740,000	≒ A-B	
D Treatment for Volume Reduction	38,410,000	94.3%	= D/C
E Direct Landfill Quantity	440,000	1.1%	= E/C
F Overall Landfilled Quantity	3,840,000	9.4%	= F/C
G Overall Recycled Quantity	8,530,000	19.9%	= G/A

Source: Ministry of Environment, Japan (JFY 2018 Survey Data)

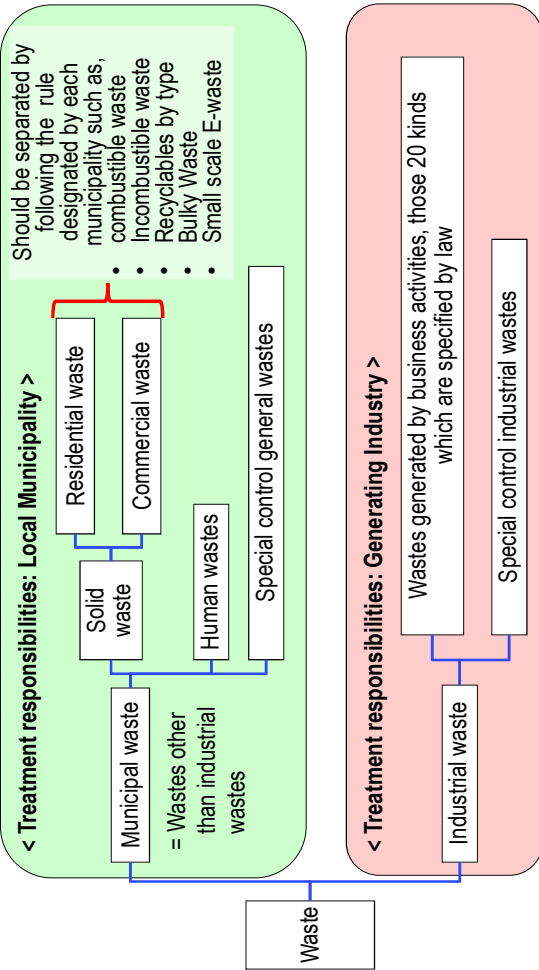
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Definition of Waste



Source: Ministry of Environment, Japan

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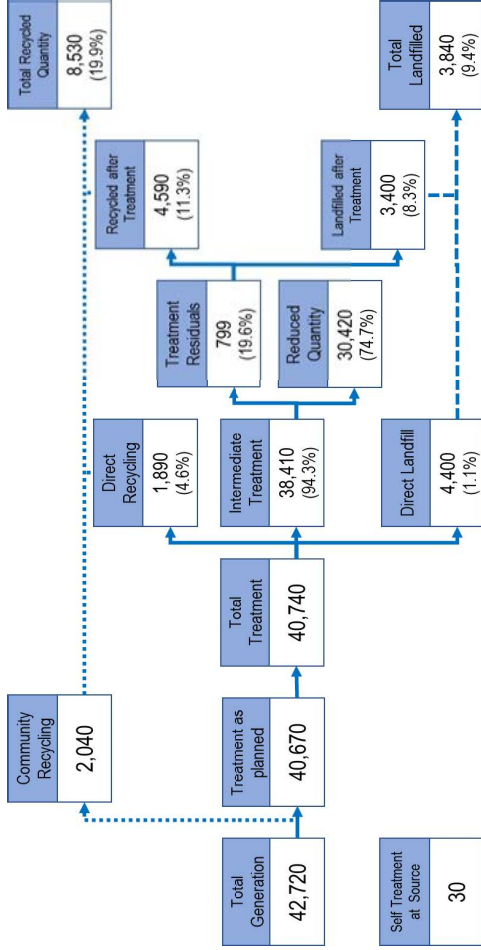
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Municipal Solid Waste Flow (2018)



unit: 1,000 ton



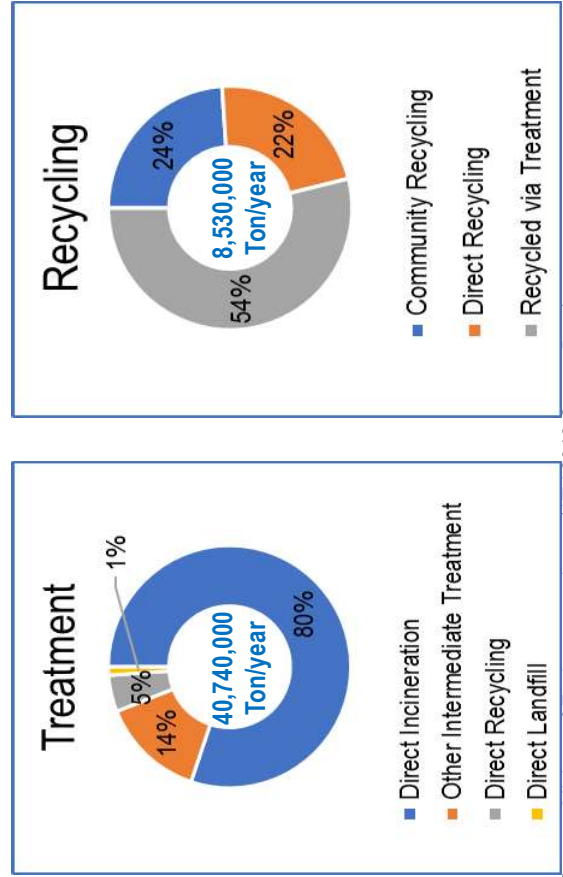
Source: Ministry of Environment, Japan (JFY 2018 Survey Data)

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Treatment and Recycling (2018)



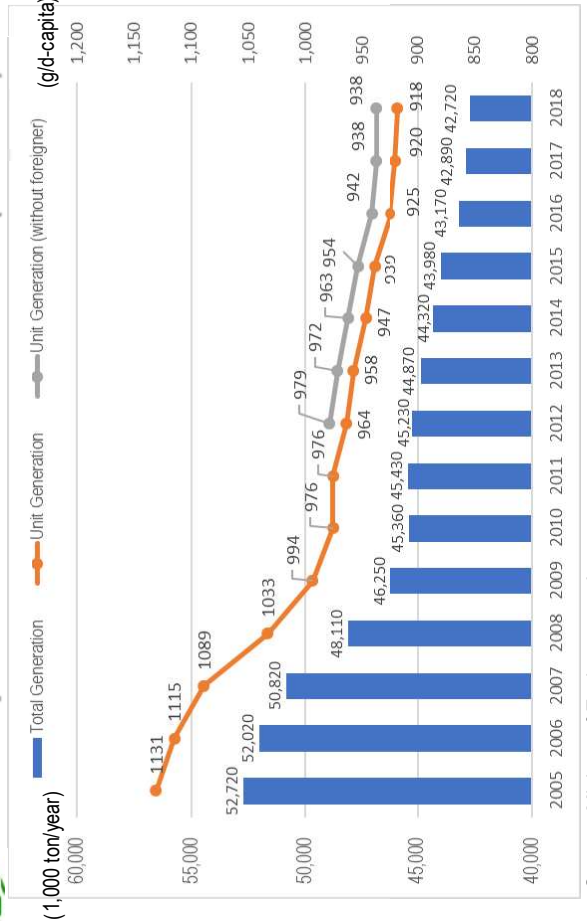
Source: Ministry of Environment, Japan (JFY 2018 Survey Data)

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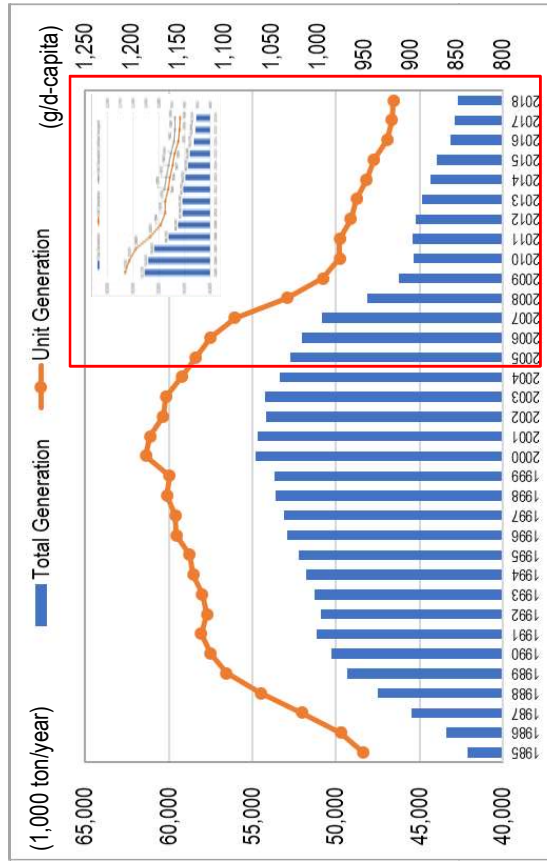
Municipal Solid Waste Generation (2005-18)



Source: Ministry of Environment, Japan

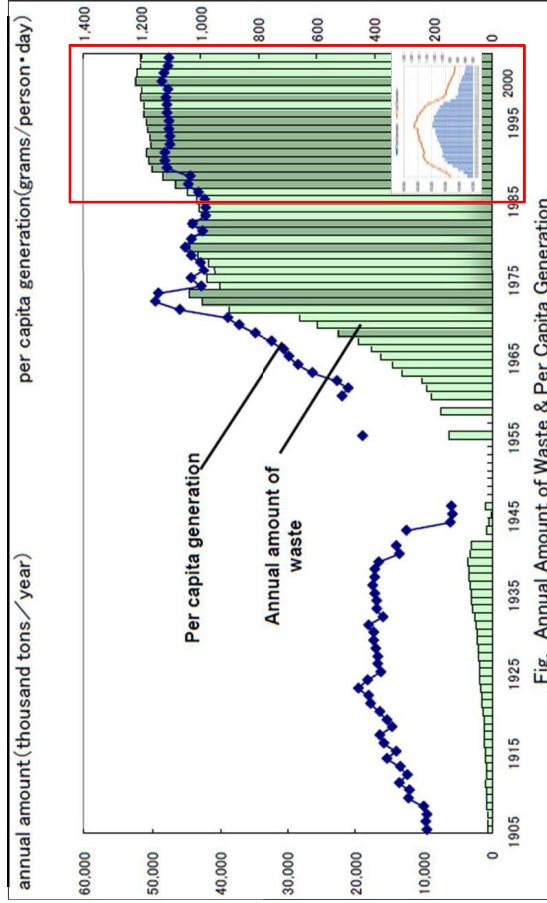
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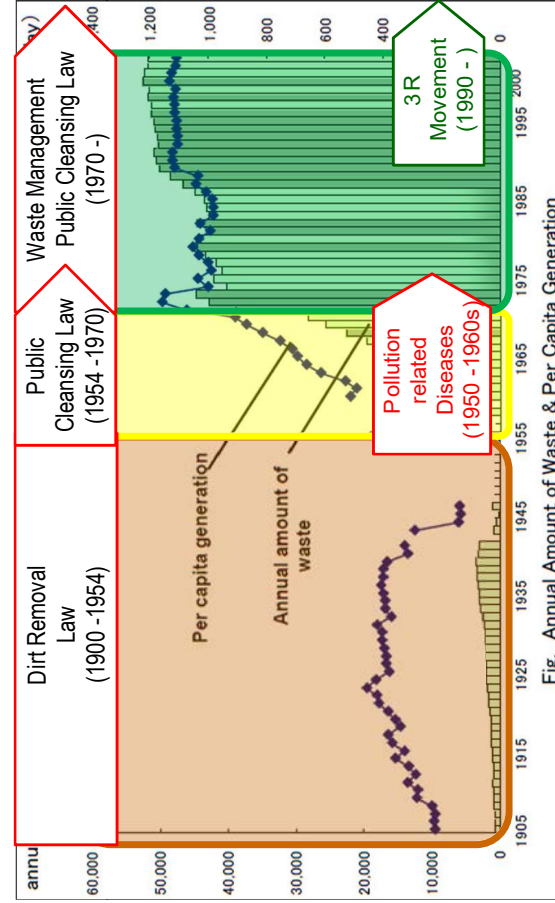


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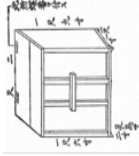


Era of Dirt Removal Law (1900-1954)

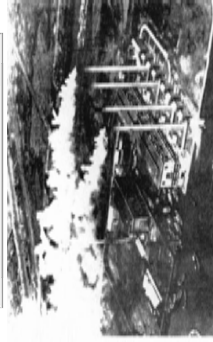


- ✓ Experienced degradation in hygienic living environment and repeated outbreak of cholera and other infectious diseases in urban area, leading to the establishment of the **Dirt Removal Law**
- ✓ Municipalities were obliged to collect waste in public place
- ✓ Collected waste was carried to designated places – required to burn subject to the regulations

- no incineration facilities in those days; open burning took place generally
- ✓ **Waste was mostly composed of food waste in those days**
 - metals, paper and textile were collected as valuables rather than garbage



Generation of new waste



Used as fertilizer or feed



Source: Ministry of Environment, Japan

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Era of Waste Management and Public Cleansing Law (1970-)



- ✓ This Law aims to secure living environment and improve public hygiene by disposing waste properly and keeping clean living environment
- ✓ Waste is largely divided into **industrial waste** and **municipal waste** to establish a disposal framework for each waste
- ✓ The principle of “responsibility of waste generator” was laid down with regard to industrial waste
- ✓ Collection, transport and disposal of waste must be implemented subject to the disposal criteria specified by Cabinet Order
- ✓ Each prefecture is asked to develop a plan for industrial waste disposal and promote the development of disposal framework in its jurisdiction
- ✓ The responsible area by municipalities was enlarged to the entire area of respective municipalities
- ✓ **Cooperation by local residents** was highly requested

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Era of Public Cleansing Law (1954-1970)



- ✓ Public Cleaning Law was enacted to address environmental degradation **caused by rapid economic growth**
 - Government was required to provide technological and financial support to municipalities while encouraging progress in science and technology
 - Municipalities were forced to take full responsibility for waste management - required to collect and dispose waste in a well-planned manner from the hygienic viewpoint in designating special cleaning area
 - People were required to keep both their house and premises clean, including the toilet, from the sanitary viewpoint
- ✓ **Construction of incinerating facilities was promoted** with subsidies by the government
 - high-speed composting was examined as another option, but incineration was adopted as more effective means, viewed from demand for compost and disposal efficiency
- ✓ Composition of waste changed – Plastics in waste increased substantially
- ✓ Active movements “Not in My Back Yard”(NIMBY) often took place



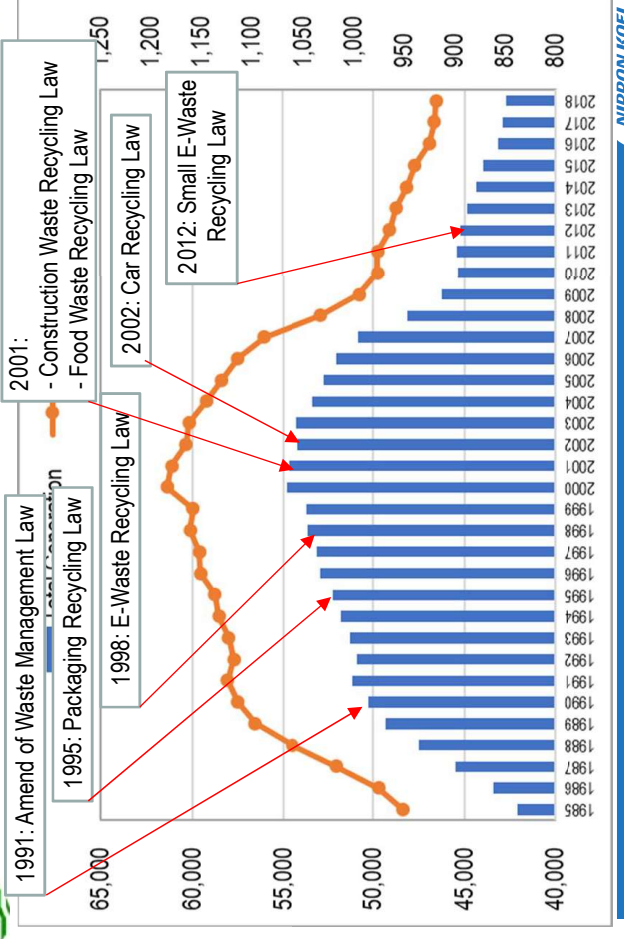
Source: Ministry of Environment, Japan

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Era of 3R (1990-)

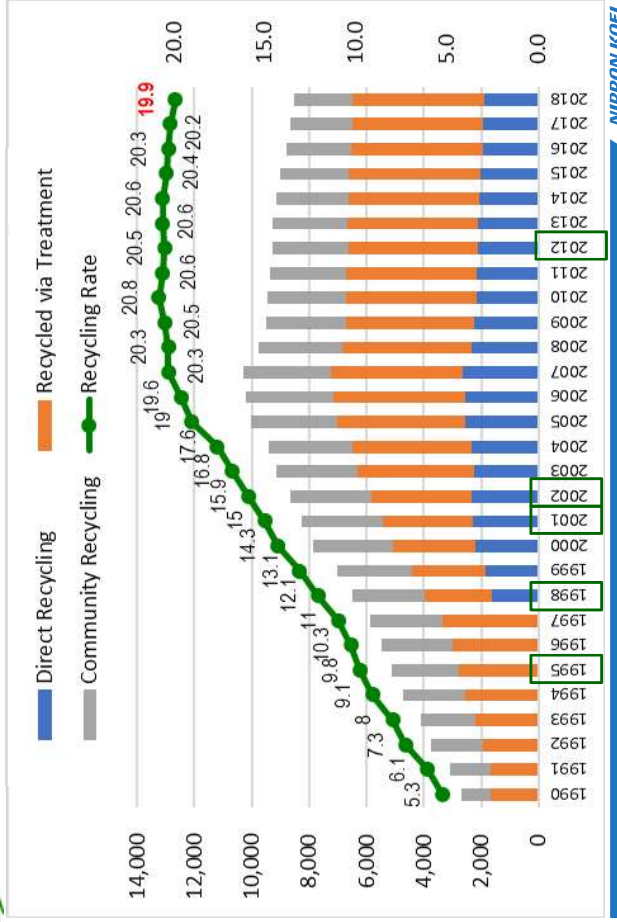


Source: Ministry of Environment, Japan

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Impact of 3R related Laws (1990-)

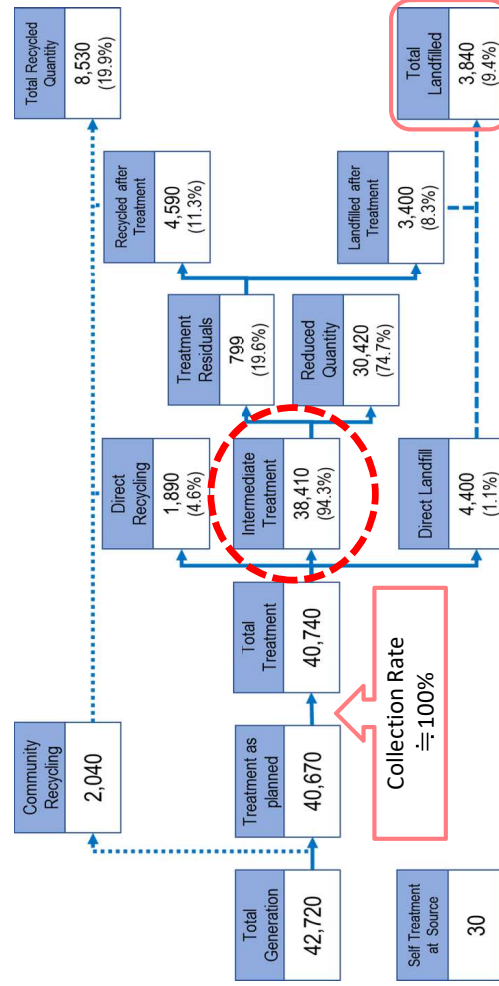


Source: Ministry of Environment, Japan

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Municipal Solid Waste Flow (2018)

unit: 1,000 ton



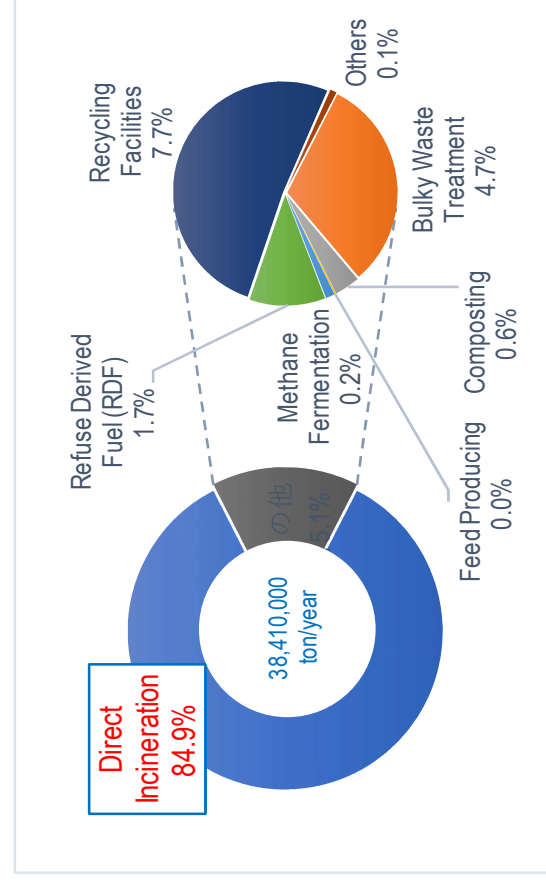
Source: Ministry of Environment, Japan

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Intermediate Treatment Options (2018)

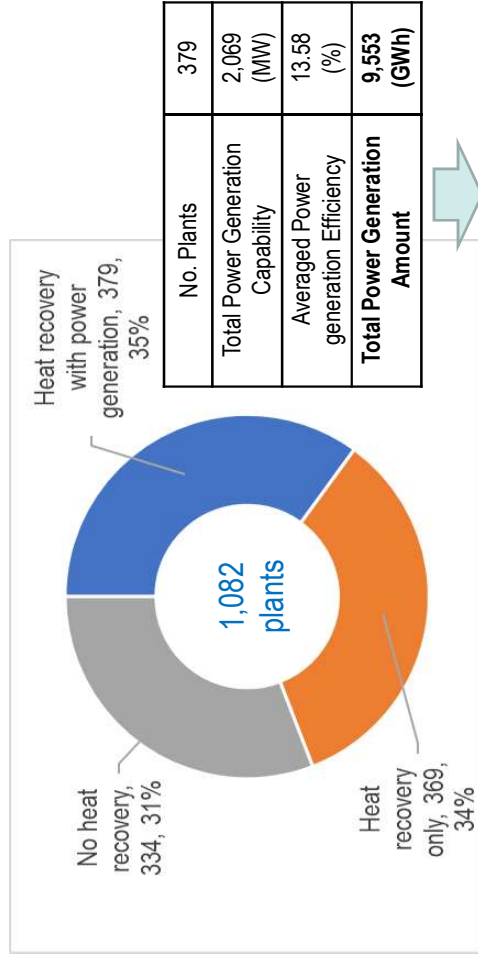


Source: Ministry of Environment, Japan

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Incineration Plants in Japan (2018)



For approx. 3.21 million households per year

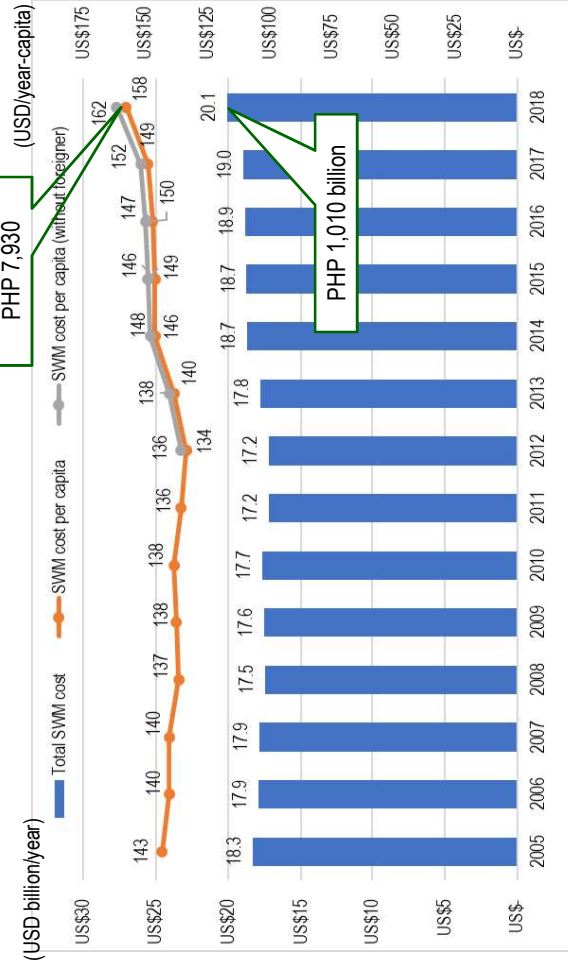
Source: Ministry of Environment, Japan (JFY 2018 Survey Data)

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Solid Waste Management Cost (2005-18)



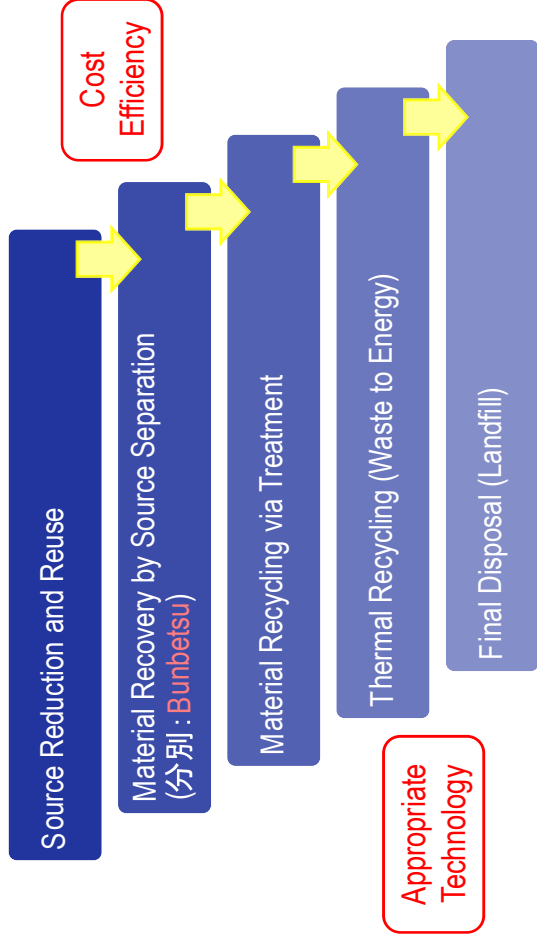
Source: Ministry of Environment, Japan

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Solid Waste Management Policy (Hierarchy)

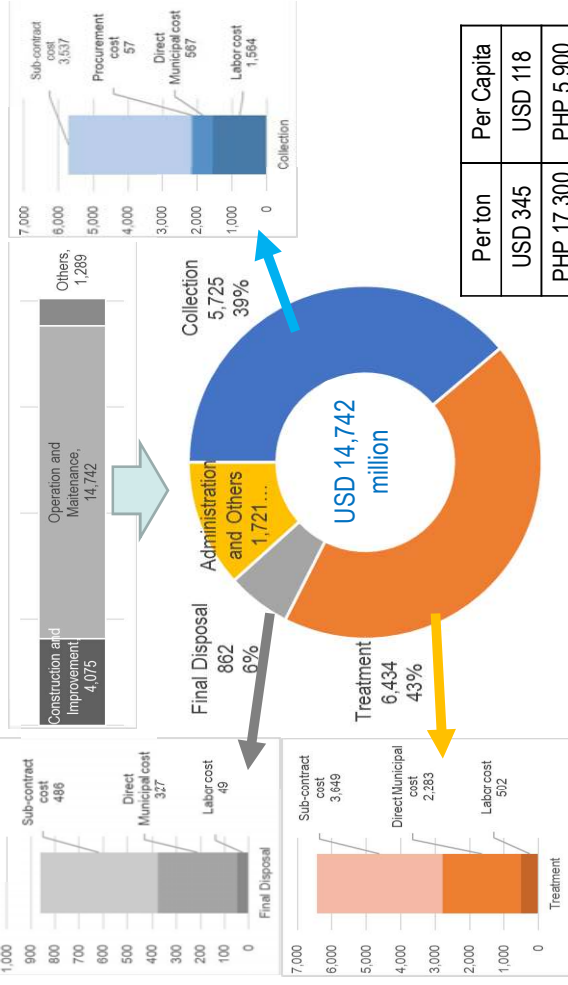


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Annual Operation Cost Breakdown (2018)



Source: Ministry of Environment, Japan (JFY 2018 Survey Data)

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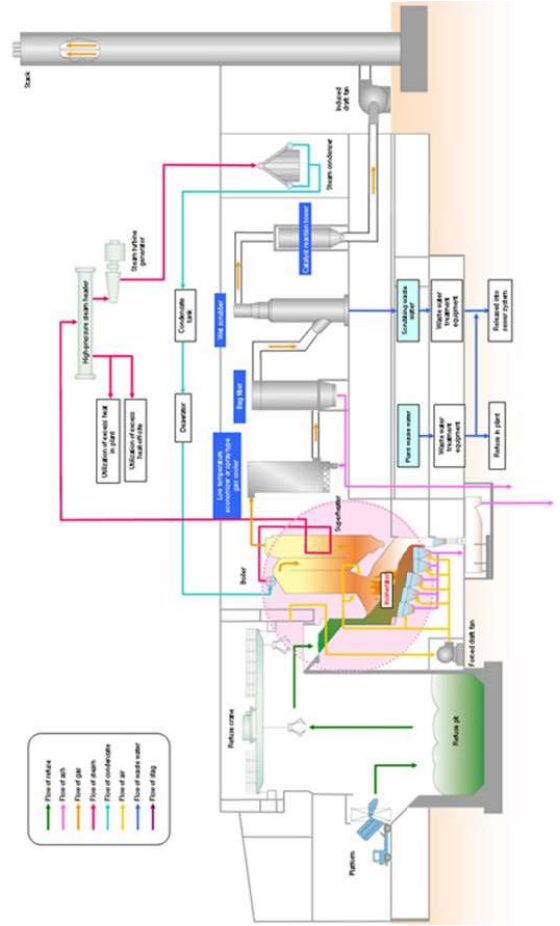
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Thermal treatment technologies in Japan

	①	②	③	④	⑤
Image					
Features	- The most conventional system in Japan - Large capacity of furnace (400 – 500t/d) is widespread	- No movable part inside furnace - Pretreatment is required for stable combustion - Generation of fly ash is larger	- High reduction rate - Slag can be utilized - Coke is necessary for ash melting	- Waste is gasified in a primary combustion chamber - Synthesis gas can be introduced to gas engine	- This is for residual ash melting - Slag can be utilized - Large amount of self electric consumption

Typical Waste to Energy Facility



Typical Waste to Energy Facility



Recreation Center

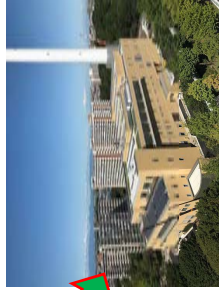
Environmental Education Center

Waste Treatment Facility

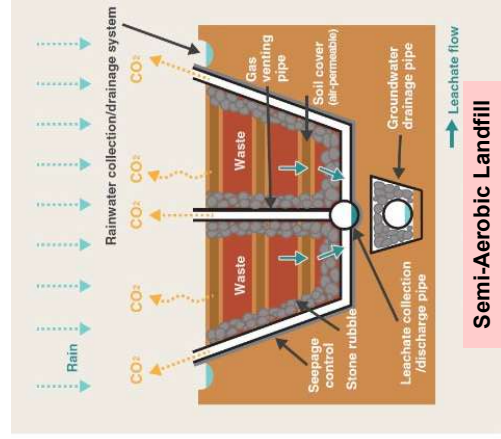
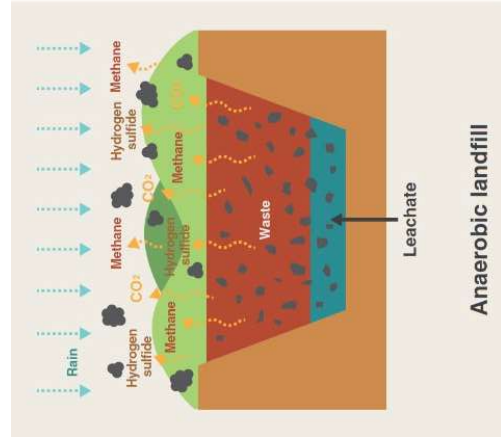
Source: <http://sakura-kc.saitama.jp/>



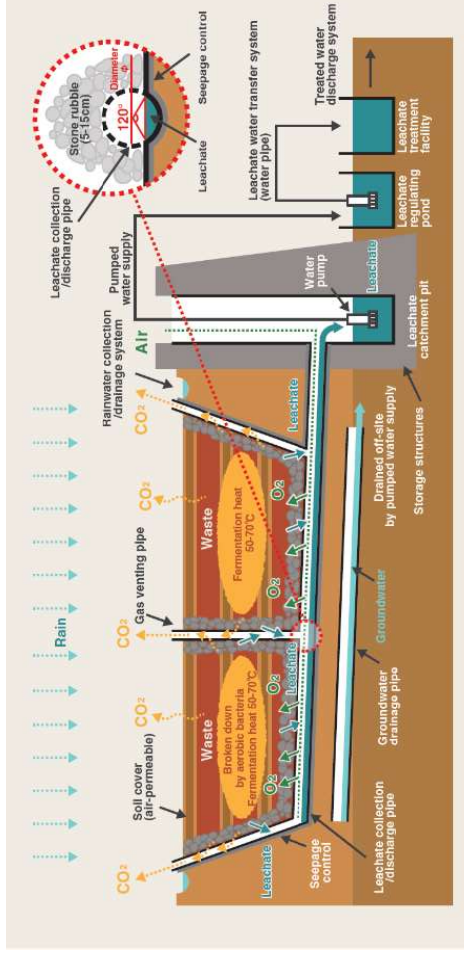
https://www.obayashi.co.jp/works/detail/work_409.html



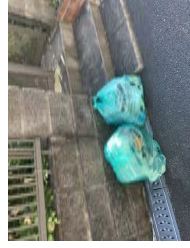
<https://www.union.tokyo23-seisou.lg.jp/kensetsu/hikarikaizenkei.html>



https://www.pref.fukuoka.lg.jp/uploaded/life/542225_60422573_misc.pdf



https://www.pref.fukuoka.lg.jp/uploaded/life/542225_60422573_misc.pdf



Combustible waste

Incombustible waste



Glass and bottles



Paper



PET bottles

Source: Norihisa Hirata (SSDI)



Public Participation and Cooperation



Kawaguchi City

https://www.city.kawaguchi.lg.jp/materian/files/group/94/wakek-ala_TAGALOG.pdf

Tachikawa City

<https://www.city.tachikawa.lg.jp/gomitasakugomicalender/documents/f01.pdf>



Q & A Discussions



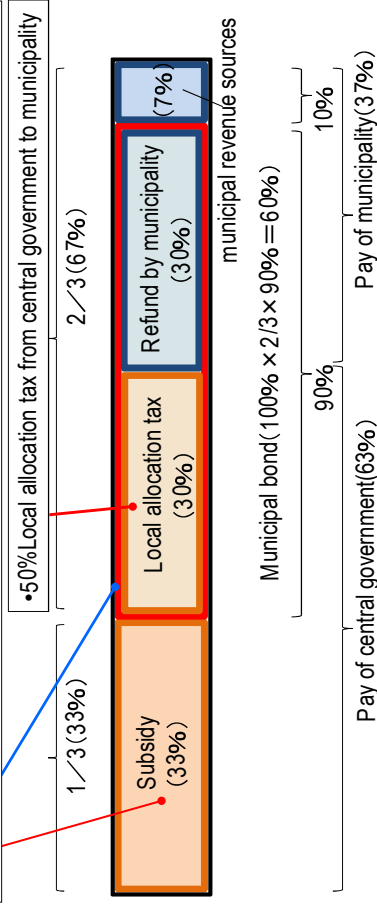
Financial Support by Central Government



- ✓ For the construction of municipal waste treatment facility, central government subsidies 1/3 to 1/2 of CAPEX, and also compensate 50% of municipal bond by local allocation tax.

- Subsidy from central government to local municipality 1/3 or 1/2

- Municipality issues municipal bond remaining 90%. Pay of municipality is 7% at the construction stage.



END

Thank you for your participation!



Online Training < Legal Structure of Waste Management in Japan >

15 November 2021

Shungo SOEDA

Circular Economy Promotion Dept.
NIPPON KOEI CO., LTD.

The Technical Cooperation Project (TCP) for Capacity Development on
Improving Solid Waste Management (SWM) through
Advanced/Innovative Technologies



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6. Recycling related Laws (Container & Packaging, WEEE)

Appendix: Waste Management and Recycling in Daily Life



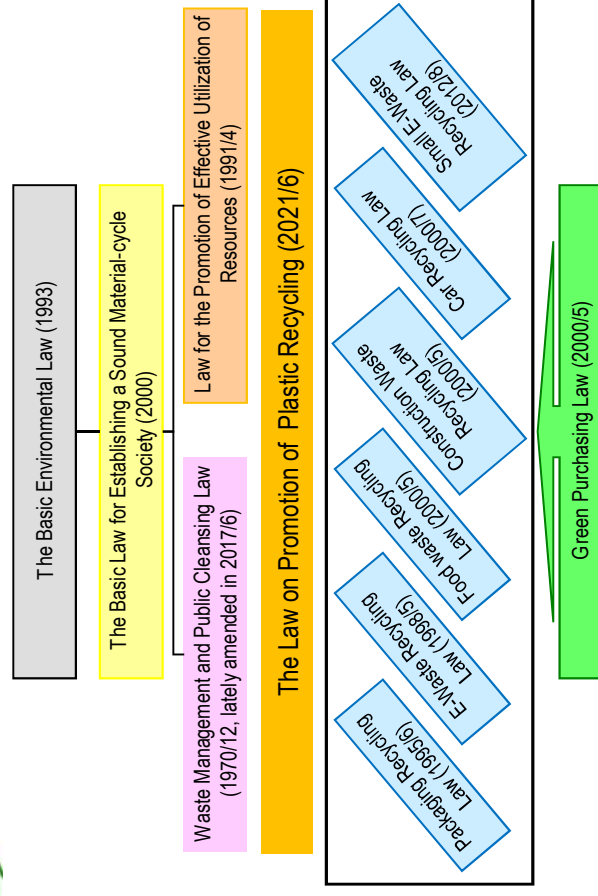
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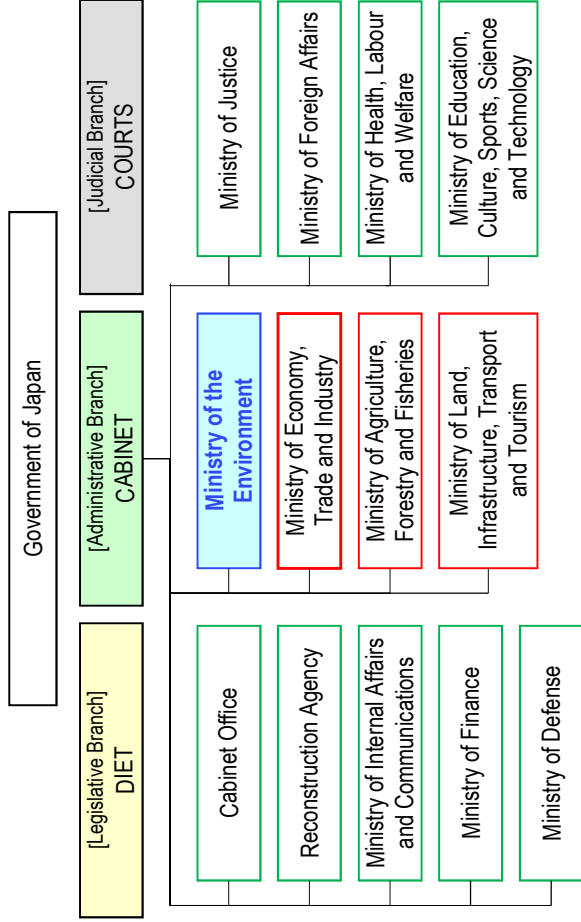
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Overall Framework of WM Related Laws





Law No.91 of 1993.
Effective on November 13, 1993.

Chapter 1 General Provisions (Articles 1-13).

Chapter 2 Basic Policies for Environmental Conservation

Section 1 Guidelines for Policy Formulation (Article 14)

Section 2 Basic Environment Plan (Article 15)

Section 3 Environmental Quality Standards (Article 16)

Section 4 Environmental Pollution Control in Specific Areas (Articles 17 and 18)

Section 5 Implementation of Policies for Environmental Conservation by the State (Articles 19-31)

Section 6 International Cooperation for Global Environmental Conservation etc. (Articles 32-35)

Section 7 Implementation of Policies by Local Governments (Article 36)

Section 8 Bearing of Costs and Financial Measures (Articles 37-40)

Chapter 3 Environment Council etc.

Section 1 Environment Council (Articles 41-44)

Section 2 Conference on Environmental Pollution Control (Articles 45 and 46)



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Basic Environment Law

Highest-level Law on Environment

Background:

Globalization of environmental issues (UN Earth Summit in Rio de Janeiro, 1992)
→ Upgraded from "Pollution Control Basic Law".

Objective (Article 1):

The purpose of this law is to comprehensively and systematically promote policies for environmental conservation to ensure healthy and cultured living for both the present and future generations of the nation as well as to contribute to the welfare of mankind, through articulating the basic principles, clarifying the responsibilities of the State, local governments, businesses and citizens, and prescribing the basic policy considerations for environmental conservation.

<http://www.env.go.jp/en/laws/policy/basic/index.html>



Basic Environment Law



Article 7 (Responsibility of Local Governments)

The local governments are responsible for formulating and implementing policies with regard to environmental conservation corresponding to national policies and other policies in accordance with the natural and social conditions of the local governments' jurisdiction, pursuant to the basic principles.

Article 8 (Responsibility of Businesses)

2. In manufacturing, processing or selling products, or engaging in other business activities, businesses are responsible for taking necessary measures for ensuring proper management of the wastes generated from products and other goods related to their activities, so as to prevent interference with environmental conservation, pursuant to the basic principles.

Article 9 (Responsibility of Citizens)

2. Besides the responsibility prescribed in the preceding Paragraph, citizens are responsible for making efforts to conserve the environment and for cooperating with the policies implemented by the State or local governments with regard to environmental conservation, pursuant to the basic principles..

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Basic Environment Law



Article 23 (Promotion of Construction of Facilities and Other Projects for Environmental Conservation)

2. The State shall take necessary measures to promote projects which contribute to prevent interference with environmental conservation, i.e. the construction public facilities such as sewerage, **public waste treatment and disposal facilities**, traffic facilities (including transportation facilities) which contribute to reduce the environmental load, and other projects such as improvement of forests.

Article 36

Local governments shall comprehensively and systematically implement and promote policies corresponding to the national policies provided for in Section 5 and other policies necessary for environmental conservation in accordance with the natural and social conditions of the local governments' jurisdiction. In this case, the prefecture shall mainly implement the policies for a large area and comprehensively coordinate the policies administered by the municipalities.

Article 39 (Financial Measures for Local Governments)

The State shall make efforts to take necessary financial measures and other measures with regard to the expenses borne by the local governments to formulate and implement policies for environmental conservation.

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Basic Law on Establishing a Sound Material-Cycle Society

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Law No.110 of June 2, 2000.

Chapter 1 General Provisions (Articles 1-14).

Chapter 2 The Basic Plan for Establishing a Sound Material-Cycle Society (Article 15-16)

Chapter 3 The Basic Policies for Establishing a Sound Material-Cycle Society

Section 1 Policies of the State (Articles 17-31)

Section 2 Policies of Local Governments (Articles 32)

循環型社会形成推進基本法

Basic Law on Establishing a Sound Material-Cycle Society

Article 2 (1) For the purpose of this Law, a "Sound Material-Cycle Society" means a society in which the consumption of natural resources will be conserved and the environmental load will be reduced to the greatest extent possible, by preventing or reducing the generation of wastes from products, by promoting proper cyclical use of materials from products when these products become circulative resources, and by ensuring proper treatment and disposal of resources which are potentially circulative but could not be put into cyclical use

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Fundamental Policy on resource circulating and appropriate waste management

Background:

Aiming to achieve "Sustainable Society" from the aspect of effective material circulating, together with establishing "Low-carbon society" and "Nature harmonizing society".

Objective (Article 1):

The purpose of this Law is to promote comprehensively and systematically **the policies for the establishment of a Sound Material-Cycle Society** and thereby help ensure healthy and cultured living for both the present and future generations of the nation, through articulating the basic principles on the establishment of a Sound Material-Cycle Society, in conformity with the basic philosophy of the Environment Basic Law, **clarifying the responsibilities of the State, local governments, businesses and citizens**, and articulating fundamental matters for making policies for the formation of a Sound Material-Cycle society, including those for establishing **the Basic plan for Establishing a Sound Material-Cycle Society**.

<https://www.env.go.jp/recycle/circul/kihonho/law.html> (Japanese)

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Article 4 (Proper Role Sharing, etc.)

The establishment of a Sound Material-Cycle Society must be undertaken by having necessary measures carried out **under the proper sharing of roles among the State, local governments, businesses and citizens, and with the costs of such measures shared appropriately and fairly among them.**

Article 7 (Basic Principles of the Cyclical use and Treatment of Circulative Resources)

The cyclical use and treatment / disposal of circulative resources **must be undertaken to the extent technologically and economically possible**, taking it into full consideration that, for the reduction of environmental load, it is necessary to proceed under the provisions of the **following items.**

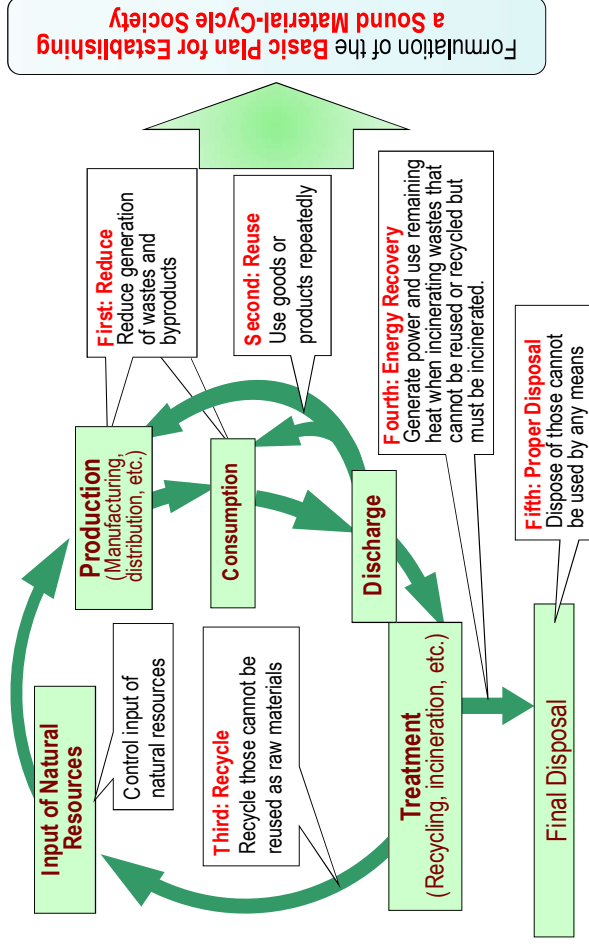
(1. Reduce > 2. Reuse > 3. Recycle > 4. Energy Recovery > 5. Proper Disposal)

Article 19 (Promotion of Use of Recycled Products)

In order to contribute to the increase in demand for recycled products, **the State shall take the lead in making use of recycled products and take necessary measures so that the use of recycled products by local governments, businesses and citizens may be promoted.**

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Article 15 (Formulation, etc. of the Basic Plan for Establishing a Sound Material-Cycle Society)

The Government shall establish a **Basic Plan for establishing a Sound Material-Cycle Society** for the purpose of comprehensive and systematic promotion of the policies and measures for establishing a Sound Material-Cycle Society.

→ The 4th Basic Plan was issued in 2018

http://www.env.go.jp/recycle/recycle/circul/keikaku/pam4_E.pdf

Article 26 (Financial Measures, etc. towards Local Governments)

The State shall make efforts to **take necessary financial and other measures regarding the costs for local governments** to make and implement policies for establishing a Sound Material-Cycle Society.

Article 27 (Promotion, etc. of Education and Learning on the Establishment of a Sound Material-Cycle Society)

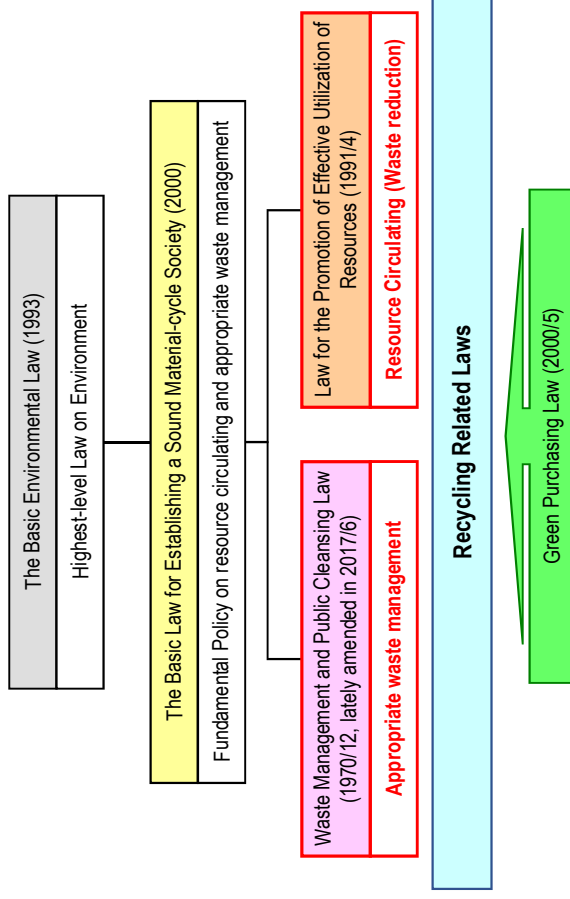
The State shall take necessary measures for the improvement of publicity and the promotion of education and learning on the establishment of a Sound Material-Cycle Society, in view of the fact that it is **indispensable to gain the understanding and cooperation of businesses and citizens** in order to facilitate the transformation into a Sound Material-Cycle Society.

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Overall Framework of WM Related Laws



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Law for the Promotion of Effective Utilization of Resources



Law No.48 of April 26, 1991.

- Chapter 1 General Provisions (Articles 1-2).
- Chapter 2 Basic Policy, etc. (Articles 3 to 9)
- Chapter 3 Designated Resources-Saving Industries (Articles 10 to 14)
- Chapter 4 Designated Resources-Reutilizing Industries (Articles 15 to 17)
- Chapter 5 Specified Resources-Saved Products (Articles 18 to 20)
- Chapter 6 Specified Reuse-Promoted Products (Articles 21 to 23)
- Chapter 7 Specified Labeled Products (Article 24 and Article 25)
- Chapter 8 Specified Resources-Recycled Products (Articles 26 to 33)
- Chapter 9 Specified By-products (Articles 34 to 36)
- Chapter 10 Miscellaneous Provisions (Articles 37 to 41)
- Chapter 11 Penal Provisions (Articles 42 to 44)

Outline of the law:

The law provides for measures to be taken by businesses, such as 3R-related measures in the production stage, 3R consideration in the product designing stage, labeling for separated collection, and development of a system for self-collection and -recycling by manufacturers.

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Law for the Promotion of Effective Utilization of Resources



Fundamental Policy on 3Rs (Reduce, Reuse and recycling)

Background:

Aiming to change from "Mass-producing, Mass-consuming and Mass-discharging society", based on "**Circular Economy Vision**" proposed by "Industrial Structure Council" under Ministry of Economy, Trade and Industry in 1999.

Objective (Article 1):

The purpose of this Law, in light of the circumstances in Japan, a country largely dependent on imports for major resources and where, along with the recent development of the national economy, the heavy use of resources generates an enormous amount of Used Products, etc. and By-products, a considerable part of which are disposed of while a considerable part of the

Recyclable Resources and Reusable Parts are not utilized but also disposed of, is to ensure the effective utilization of resources and to take necessary measures to reduce the generation of Used Products, etc. and By-Products and **promote the utilization of Recyclable Resources and Reusable Parts in order to contribute to waste reduction and environmental preservation**, thereby contributing to the sound development of the national economy.

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Designated Resources-Saving Industries
Required to reduce generation of by-products

Designated Resources-Recutilizing Industries
Required to use recyclable resources and reusable parts

Specified Resources-Saved Products
Required to ensure rational use of raw materials, prolong product life and reduce generation of used products

Specified Reuse-Promoted Products
Required to promote the use of recyclable resources or reusable parts (designing and manufacturing products that can be easily reused or recycled)

<http://www.env.go.jp/en/laws/recycle/06.pdf> (Outline)

<https://www.meti.go.jp/policy/recycle/main/data/pamphlet/pdf/handbook2010-eng.pdf> (Handbook)

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Specified Labeled Products
Required to be labeled to facilitate separated collection

Specified Resources-Recycled Products
Required to promote self-collection and recycling

Specified By-products
Required to promote the use of by-products as recyclable resources

<http://www.env.go.jp/en/laws/recycle/06.pdf> (Outline)

<https://www.meti.go.jp/policy/recycle/main/data/pamphlet/pdf/handbook2010-eng.pdf> (Handbook)

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Waste Management and Public Cleansing Law

Law No.137, 1970.

Chapter 1 General Provisions (Articles 1 to 5).

Chapter 2 Municipal Solid Waste

Section 1 Municipal solid waste Management (Article 6)

Section 2 Municipal Solid Waste Management Service (Article 7)

Section 3 Municipal Solid Waste Treatment / Disposal Facility (Article 8 to 9(7))

Section 4 Special Provision on Treatment of Municipal solid waste (Articles 9(8) to 9(10))

Section 5 Export of Municipal solid waste (Articles 10)

Chapter 3 Industrial Waste (Articles 11 to 15(4))

Chapter 3-2 Waste Management Center (Articles 15(4) to 15(16))

Chapter 3-2 Changes of shape and nature of the land where waste is underground (Articles 15(17) to 15(9))

Chapter 4 Miscellaneous Provisions (Articles 16 to 24)

Chapter 5 Penal Provisions (Articles 25 to 34)

Outline of the law:

The law provides the definition of waste, responsibility for treatment and disposal, and the standards for treatment methods, treatment facilities, and treatment industries.



Waste Management and Public Cleansing Law

Fundamental Policy on Appropriate Waste Management

Background:

- ✓ Increase in the amount of, and change in of the quality of the waste derived from economic activities, as a result of Japan's high economic growth
- ✓ Responding to environmental conservation measures related to waste management

Objective (Article 1):

This law is enacted for the purpose of preserving the living environment and improving public health through the restriction of waste discharge, appropriate sorting, storage, collection, transport, recycling, disposal, or other handling of waste and conservation of a clean living environment.

Under this law, Cabinet Order (No. 300, 1971) and Ministerial Ordinance (regulation: No.35, 1971) are also established for more details.

https://www.env.go.jp/en/recycle/basel_conv/files/Waste_Management_and_Public_Cleansing.pdf

<https://www.env.go.jp/en/laws/recycle/02.pdf>

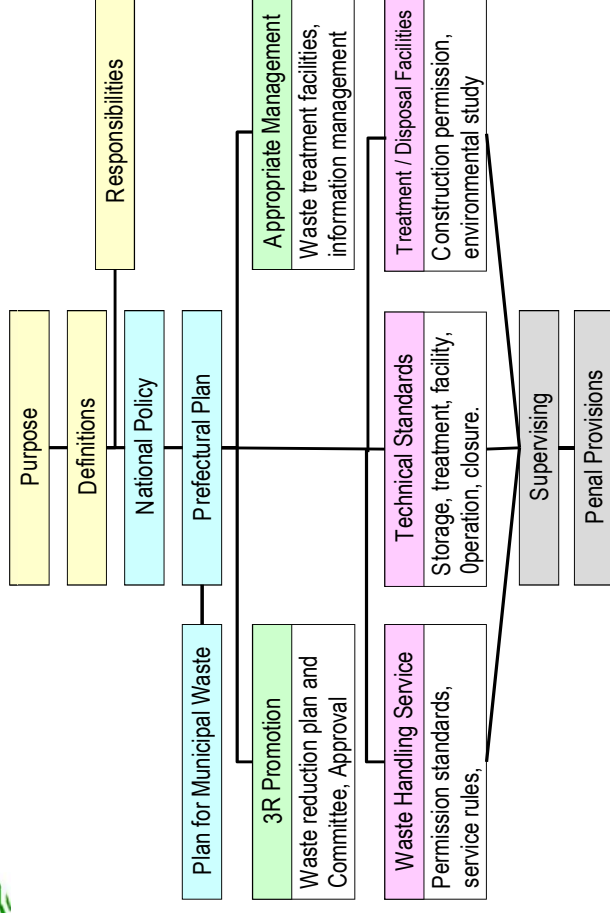
<https://www.env.go.jp/en/laws/recycle/03.pdf>

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Waste Management and Public Cleansing Law

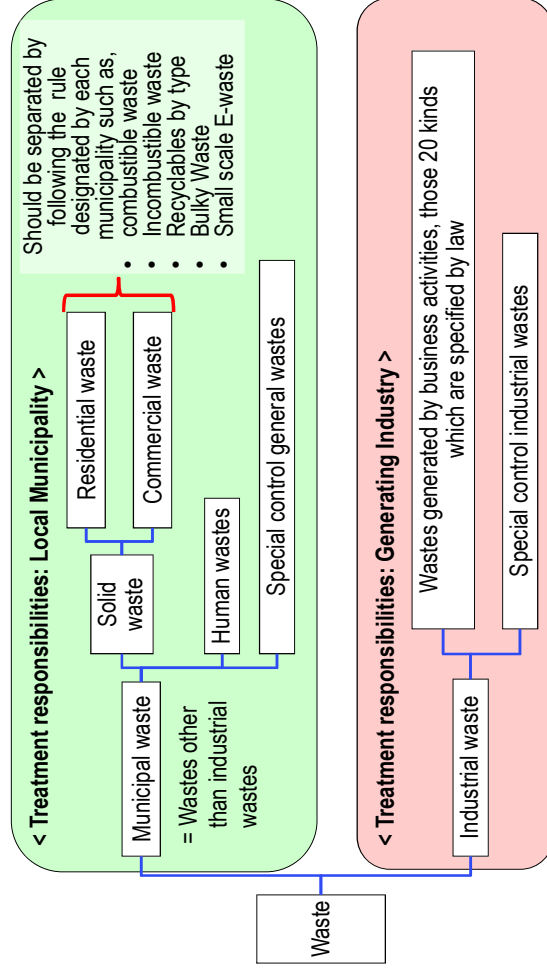


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Waste Management and Public Cleansing Law



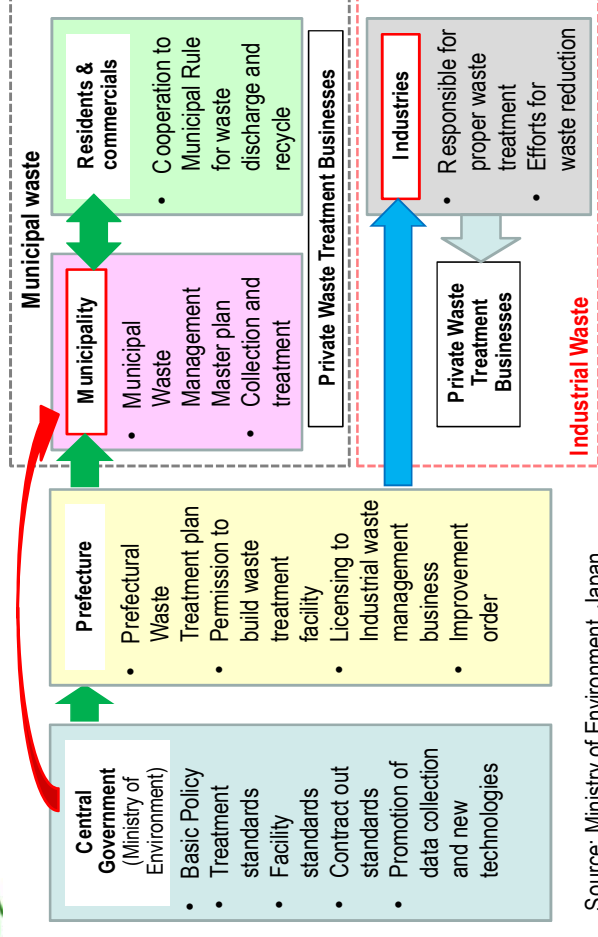
Source: Ministry of Environment, Japan

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Waste Management and Public Cleansing Law



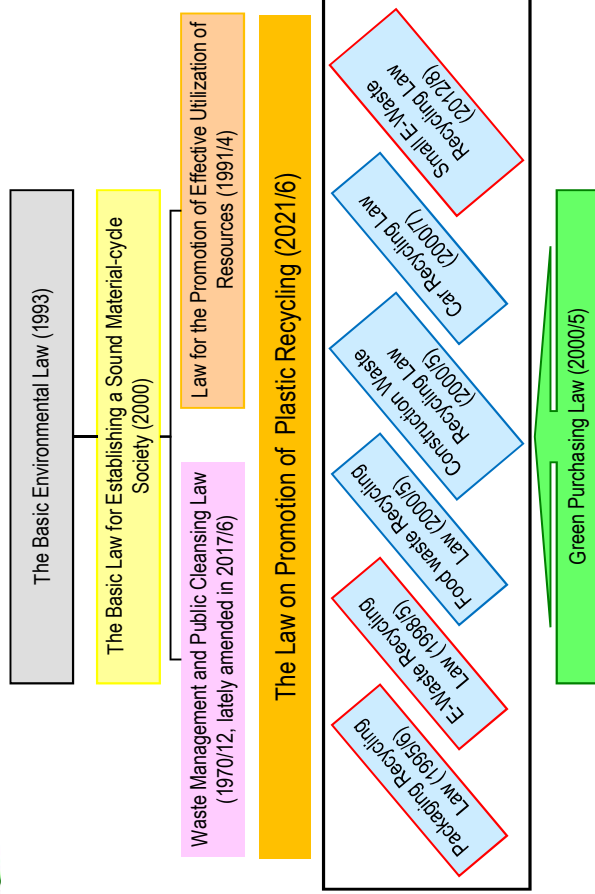
Source: Ministry of Environment, Japan

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Overall Framework of WM Related Laws



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Containers and Packaging Recycling Law



Law for the Promotion of Sorted Collection and Recycling of Containers and Packaging

Law No. 112 of June 16, 1995

- Chapter 1 General Provisions (Articles 1 to 2).
- Chapter 2 Basic Policy, etc. (Article 3 to 6)
- Chapter 3 Recycling Plan (Articles 7)
- Chapter 4 Reduction of Discharge (Articles 7(2) to 7(7))
- Chapter 5 Sorted Collection (Articles 8 to 10)
- Chapter 6 Implementation of Recycling (Articles 11 to 20)
- Chapter 7 Designated Juridical Person/Organization (Articles 21 to 32)
- Chapter 8 Miscellaneous Provisions (Articles 33 to 45)
- Chapter 9 Penal Provisions (Articles 46 to 49)

Outline of the law:

The law provides for a collection and recycling system in which municipalities take charge of collecting sorted containers and packaging (sorted and discarded by consumers) and businesses take charge of recycling such collected containers and packaging

<https://www.env.go.jp/en/laws/recycle/07.pdf>

https://www.icpra.or.jp/Portals/0/resource/association/pamph/pdf/law2003_eng.pdf

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Containers and Packaging Recycling Law



Fundamental Policy on Recycling of Containers and Packaging

Background:

- ✓ Remaining capacity of the final disposal site for municipal waste is being filled up
- ✓ Containers and packaging accounted for approximately 60% of municipal waste by volume

Objective (Article 1):

The purpose of this Law is, by taking measures to promote reduction of **waste containers and packaging** discharged and the sorted collection thereof as well as the recycling of waste containers and packaging which are obtained through sorted collection, etc., that conform to the sorting standards, to ensure proper management of waste and effective use of resources through **reduction of municipal solid waste and adequate use of recyclable resources**, thereby contributing to the preservation of the living environment and the sound development of the national economy.

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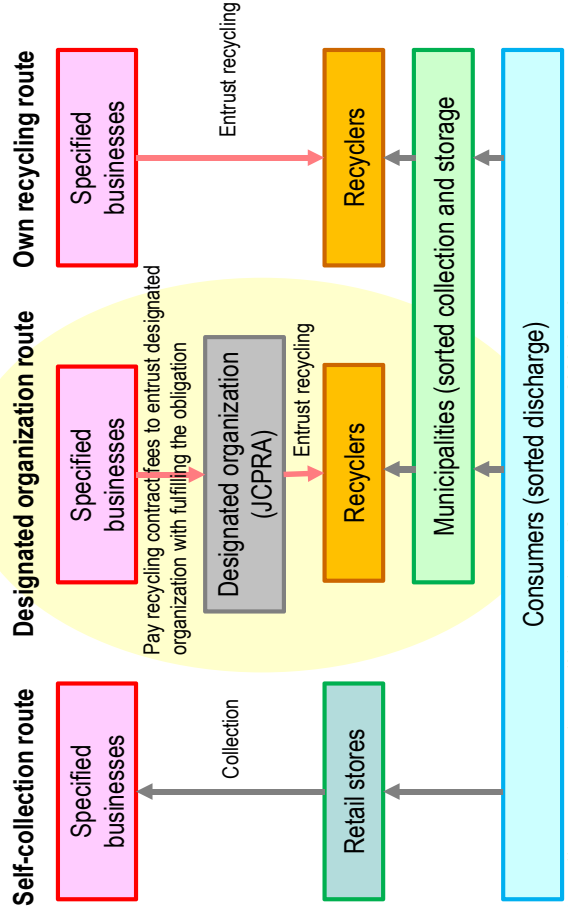


Source: Ministry of the Environment

<https://www.jppra.or.jp/Portals/0/resource/eng/JCPRAdocuments202012.pdf>

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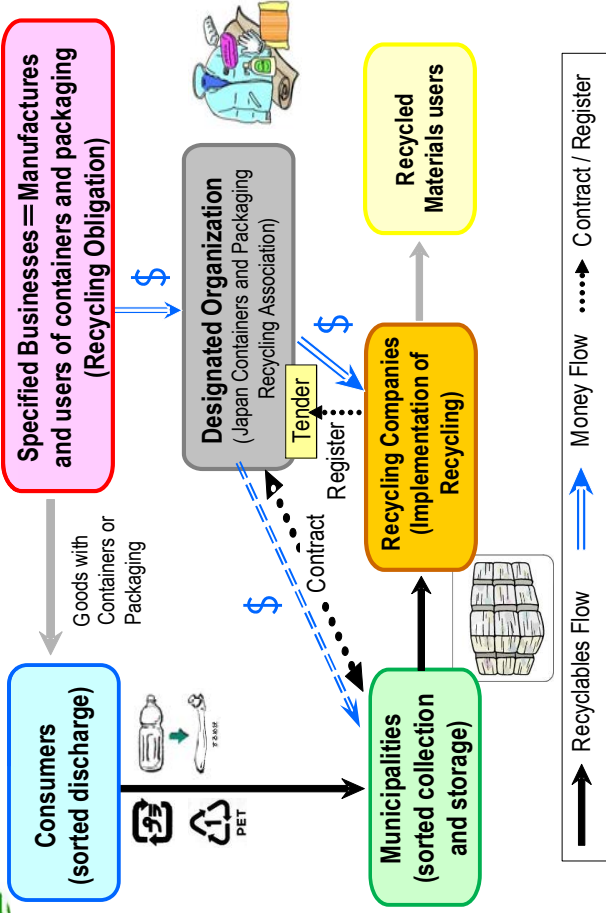
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<https://www.jppra.or.jp/Portals/0/resource/eng/JCPRAdocuments202012.pdf>

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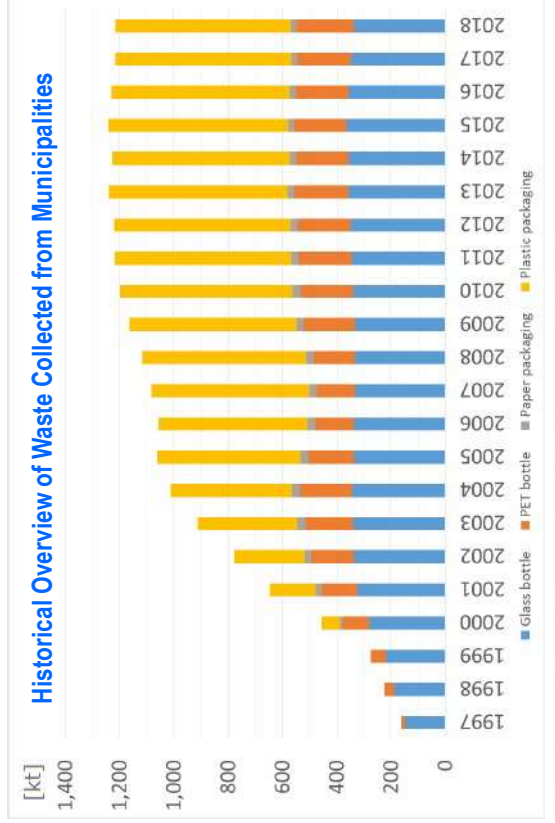
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Historical Overview of Waste Collected from Municipalities



<https://www.jppra.or.jp/Portals/0/resource/eng/JCPRAdocuments202012.pdf>

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E-Waste (home appliance) Recycling Law

Law for Recycling of Specified Kinds of Home Appliances

Law No. 97 of June 5, 1998

Chapter 1 General Provisions (Articles 1 to 2).

Chapter 2 Basic Policy, etc. (Article 3 to 8)

Chapter 3 Collection and Transportation by Retail Traders (Articles 9 to 16)

Chapter 4 Implementation of Recycling by Manufacturers (Articles 17 to 31)

Chapter 5 Designated Bodies (Articles 32 to 42)

Chapter 6 Miscellaneous Provisions (Articles 43 to 57)

Chapter 7 Penal Provisions (Articles 58 to 62)

Outline of the law:

The law provides for a collection and recycling system in which home appliance retailers take charge of collecting used home appliances and home appliance manufacturers take charge of recycling collected appliances

Home appliances: air conditioners, television sets, refrigerator/freezers, and washing machines

https://www.meti.go.jp/policy/it_policy/kaden_recycle/en_cha/pdf/english.pdf (outline)

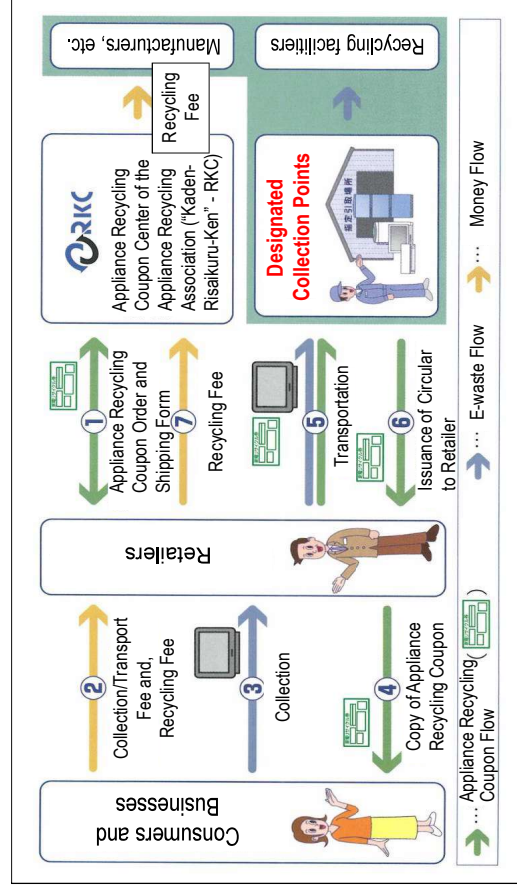
<http://www.env.go.jp/en/laws/recycle/08.pdf> (outline)

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E-Waste (home appliance) Recycling Law



Source and (C) Copyright: Association for Electric Home Appliances, All Right Reserved.

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E-Waste (home appliance) Recycling Law

Fundamental Policy on Large Home Appliances Waste Recycling

Background:

- ✓ The remaining capacity of the final disposal site for domestic waste is being filled up
- ✓ Post-consumer home appliances contain useful resources such as iron, aluminum, plastics, or glasses which can be recycled

Objective (Article 1):

The purpose of this law is to take measures to appropriately and smoothly collect, transport, recycle, etc. **specified kinds of home appliances** by entities including retailers, manufacturers and importers, then **to secure the appropriate management of waste and utilization of natural resources**, and consequently to contribute to preservation of life environments and sound development of the national economy



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E-Waste (home appliance) Recycling Law

Recycling Fee (as of 2020)

Types of Appliance	Recycling Fee	Types of Appliance	Recycling Fee
Air Conditioner	JPY 990 (PHP 433)	TV (CRT)	JPY 2,420 – 2,970 (PHP 1,059 – 1,299)
washing machine	JPY 2,530 (PHP 1,108)	Small	JPY 1,320 – 1,870 (PHP 577 – 818)
Refrigerator Freezer	JPY 4,730 (PHP 2,069)	Large	JPY 1,870 (PHP 818)
Small	JPY 3,740 (PHP 1,636)	Small	JPY 2,970 (PHP 1,299)

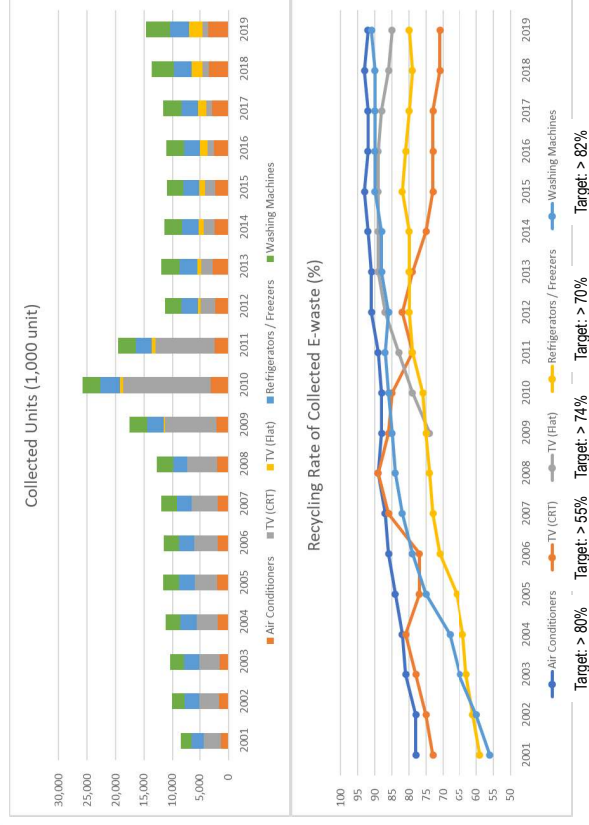
Source: Association for Electric Home Appliances

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E-Waste (home appliance) Recycling Law



Source: Association for Electric Home Appliances

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Small E-Waste Recycling Law



Fundamental Policy on Small Home Appliances Waste (WEEE) Recycling

Background:

- ✓ There was no sufficient recovery of resources from small end-of-life electronic equipment, which contains many valuable metals and other recyclables that municipalities treat as the municipal waste.

Objective (Article 1):

In light of the circumstances where a considerable portion of metals or other useful materials used in small waste electrical and electronic equipment is disposed of without being recovered, this Law aims to take measures for **promoting the recycling of small waste electrical and electronic equipment**, thereby ensuring proper management of waste and effective use of resources and contributing to the preservation of the living environment and the sound development of the national economy.

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Small E-Waste Recycling Law



Law on Promotion of Recycling of Small Waste Electrical and Electronic Equipment

Article 1 Purpose	Law No. 57 of August 10, 2012
Article 2 Definition	
Article 3 Basic Policy	
Article 4 Responsibilities of the National Government	Article 13 Special Provisions of the Waste Management Law Regarding Approved Businesses
Article 5 Responsibilities of the Local Government	Article 14 Special Provisions of the Law on Promotion of Development of Specified Facilities for the Management of Industrial Waste
Article 6 Responsibilities of Consumers	Article 15 Guidance and Advice
Article 7 Responsibilities of Businesses	Article 16 Collection of Reports
Article 8 Responsibilities of Retailers	Article 17 On-site Inspection
Article 9 Responsibilities of Manufacturers	Article 18 Inquiries to Relevant Administrative Organs
Article 10 Approval of a Recycling Business Plan	Article 19 Competent Ministers
Article 11 Alteration of Recycling Business Plans	Article 20 Delegation of Authority
Article 12 Obligation to Collect Small WEEE	Article 21 Penal Provisions

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Small E-Waste Recycling Law



Outline

- ✓ Since recovering of small E-waste which contains rare and useful resources in wider area and through more efficient way will make the system profitable, this system was created as a **promotion-type system where the people involved cooperates voluntarily**.
- ✓ Regarding those who intend to start a small electronic equipment recycling business, they must prepare **the business plan for recycling** to obtain the certification from the competent Minister **that the license for waste treatment becomes unnecessary**.

Target E-Waste

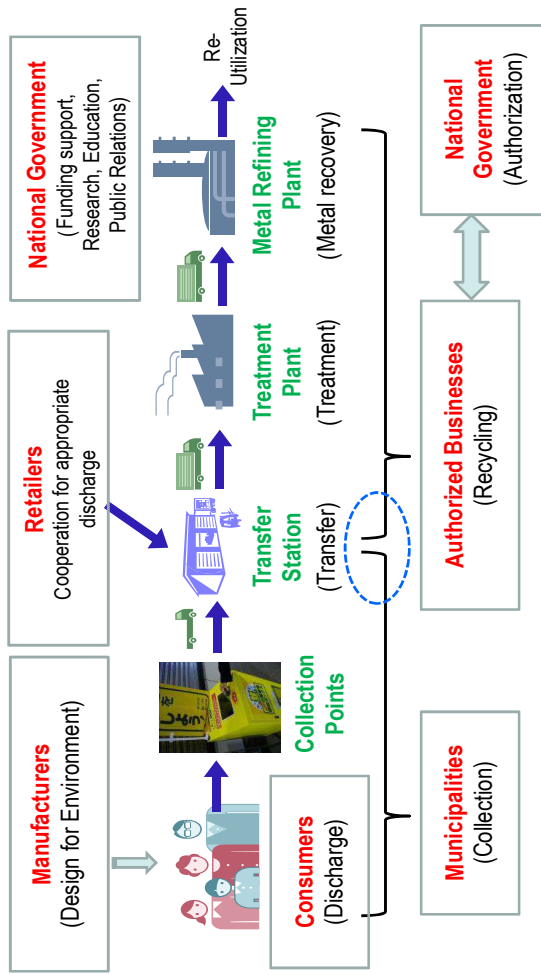
- ✓ 28 items are designated as target E-waste, which exclude 4 large home appliances, by the Cabinet Order for this Law, by considering their recyclability and transportability
 - ✓ telephone, mobile phone, radio, camera, video, DVD recorders, audio players, printers, displays, electric sewing machines, calculators, rice cookers, microwave ovens, room fans, irons, vacuum cleaners, clock, musical instrument, game machine, hair dryers, etc.

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Small E-Waste Recycling Law



Source: Ministry of Environment Japan

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Contents of the Presentation

1. Overall Framework
2. The Basic Environmental Law
3. The Basic Law for Establishing a Sound Material-cycle Society
4. Law for the Promotion of Effective Utilization of Resources
5. Waste Management and Public Cleansing Law
6. Recycling related Laws (Container & Packaging, WEEE)

Appendix: Waste Management and Recycling in Daily Life

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Small E-Waste Recycling Law



GETTING A MEDAL FOR RECYCLING: HOW OLD DEVICES ARE TURNED INTO OLYMPIC MEDALS FOR TOKYO 2020



IOC/GREG MARTIN

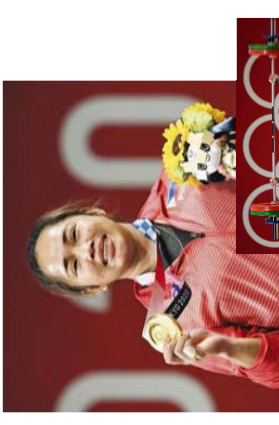
DATE: 28 NOV 2018 TAGS: OLYMPIC NEWS, IOC NEWS, TOKYO 2020, SUSTAINABILITY

<https://www.j-cast.com/2021/07/28/417095.html>

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<https://www.olympic.org/news/finishing-line-in-sight-for-tokyo-2020-medal-project>

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<https://www.tokyo-np.co.jp/article/120382>



Q & A Discussions



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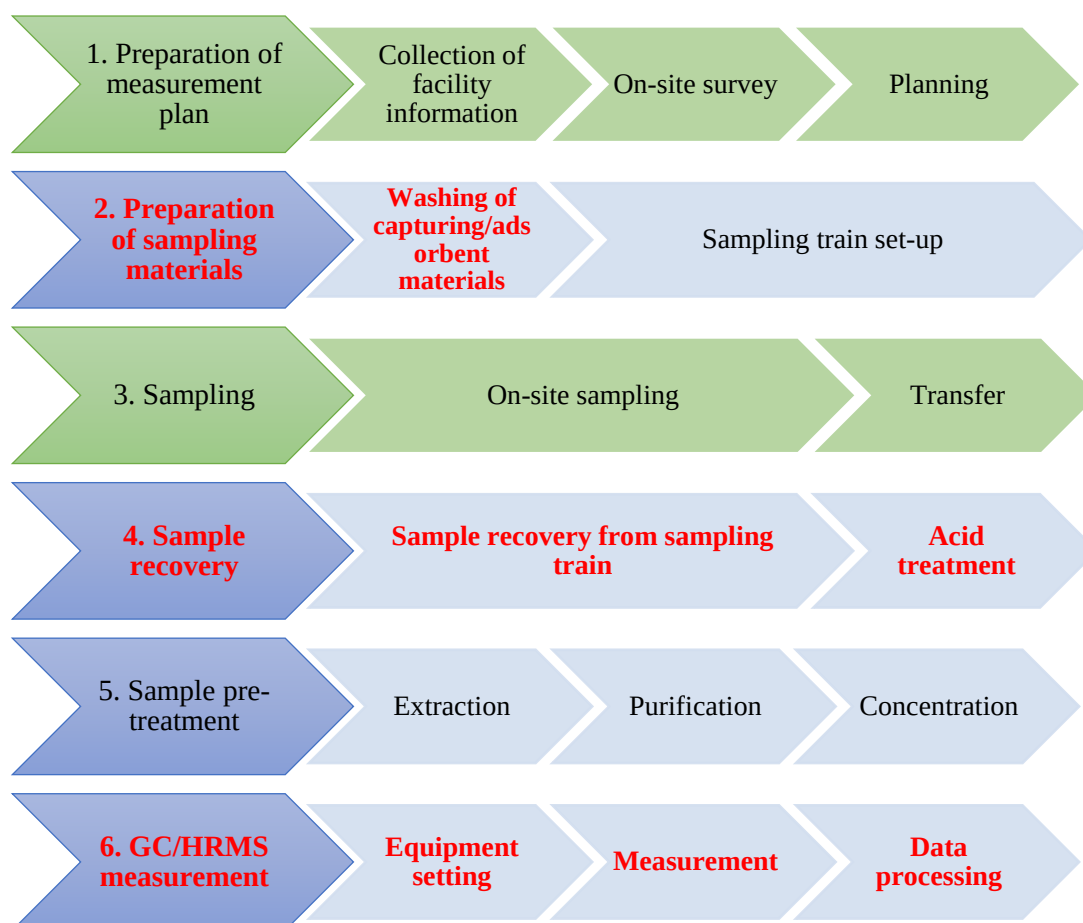
10-3: ダイオキシン分析

November 16-18, 2021

The Project for Capacity Development on Improving Solid Waste Management through
Advanced/Innovative Technologies in The Republic of Philippines
Overview of Online training for Dioxins Analysis

1. Introduction

The procedures for measuring Dioxins in stack gas, including the preparation step, are as follows.



In the above chart, green parts (sampling) are to be conducted by the sampling organization, and the rest are to be conducted by the analysis organization. “4. Sample recovery” may be conducted on site by the sampling organization in some cases, for example, when shipment by air is restricted, but generally, the step is to be conducted at the analysis laboratory by a person in charge of the analysis to prevent sample contamination.

Since the same operation is likely to be adopted at EMB, training materials were prepared on the assumption that sample recovery from sampling train will be conducted by ERLSD.

2. Contents of training materials

For this online training, the following 3 textbooks, corresponding to the parts indicated in red letters in the above chart, were prepared.

- Preparation of stack gas and ambient air sample capturing/adsorbent materials
- Sample recovery from sampling train
- GC/HRMS measurement and Data processing by Diok

Of the tasks to be conducted by ERLSD, “5. Sample pre-treatment” has many parts in common with POPs analysis, so ERLSD has abundant experience conducting similar tasks. The pre-treatment operation was included in World Bank’s training held in Australia, so it should be relatively easy for ERLSD to imagine the details of operation.

Meanwhile, since sampling train for Dioxins is quite special and ERLSD has no experience in analyzing Dioxins in stack gas yet, it is probably difficult to imagine the details of operations for the preparation of capturing/adsorbent materials and recovery after sampling.

In addition, GC/HRMS measurement and data processing by Diok require the use of devices and software specialized for Dioxins analysis and result calculation, and it can be seen from past activities that ERLSD has difficulties in operating Diok.

Due to time restrictions, this online training will focus on the tasks specific to Dioxins measurement (i.e. those that are difficult to imagine without actually experiencing the operations) and the tasks with which ERLSD is having issues. There will be a question-and-answer session at the end of training each day, so please feel free to ask any questions regarding Dioxins analysis.

End

November 16-18, 2021

The Project for Capacity Development on Improving Solid Waste Management through
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Preparation of stack gas and ambient air sample capturing/adsorbent materials

1. Examples of facility and equipment

1-1. Capturing/adsorbent materials preparation room

To prevent contamination, there is a room dedicated for washing, drying, etc. of the capturing/adsorbent materials. To prevent contamination, samples are not allowed to be brought into this room. Instruments preliminarily washed in the pre-treatment room are brought into this room, where filter papers are burned, and XAD resins and PUFs are washed and packed into the sampling train.



1-2. Devices and equipment

Representative devices and equipment are introduced below.

- 1) Large Soxhlet extractor: for Polyurethane foam (PUF) only



2) Soxhlet extractor for washing XAD resin (2L size)



3) Large muffle furnace: for preparation of filter paper

It is equipped with an exhaust fan and a duct to facilitate air circulation and prevent retention of air inside the furnace. It is large enough to hold several large filter papers for high volume air sampler. Including those used for Soxhlet extraction, glass fiber filter papers used for

the projects are heated in this device.



4) Vacuum dryer: used for drying XAD resins and PUF after washing.



- 5) Cage for storing washed materials: Washed filter papers are stored in dedicated cages.



2. Method for preparing stack gas capturing/adsorbent materials

2-1. Filter paper

- 1) Place thimble filter for stack gas sampler on aluminum plates and put them in a muffle furnace for burning filter papers.



- 2) Close the door of the muffle furnace and set the temperature to 450°C.
- 3) Confirm that the temperature has reached 450°C and burn for 18 hours.
- 4) Stop heating the muffle furnace and wait until the temperature drops to about 150°C.
- 5) Transfer the filter papers to a dedicated desiccator with tongs and wait until they cool to room temperature.
- 6) Wrap the filter papers with aluminum foil and store them in dedicated cages.



2-2. XAD resin

- 1) Use dedicated instruments. The instruments must be washed with acetone and dried immediately before use.

- 2) Instruments used are as follows.

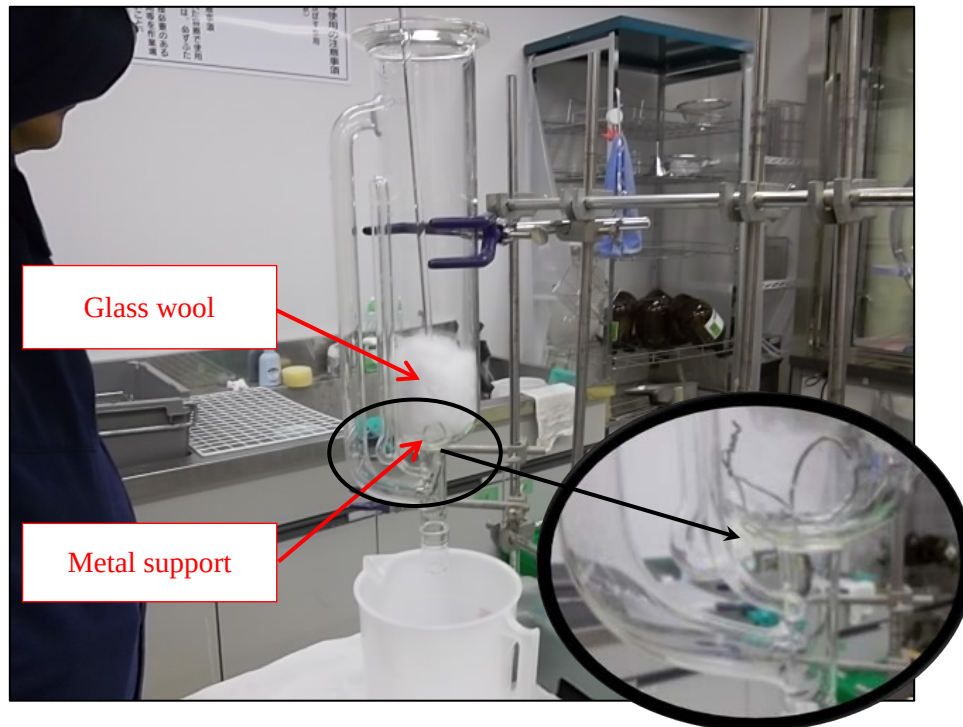
Stainless scoop, beaker (1L), Soxhlet extractor, metal support, glass rod, glass funnel, glass wool (washed), Buchner funnel, beaker (500 ml, two for drying)

- 3) Transfer XAD resin to 1L beaker with a stainless scoop. (800ml~1000ml)

(After use, XAD resin is attached to the scoop, so rinse the scoop with acetone, dry the scoop and brush off the remaining XAD resin before storing.)



- 4) Secure the siphon tube of the Soxhlet extractor onto the holder and place a metal support in the extractor. Put some washed glass wool on top of the metal support and stuff it into the siphon tube using a glass rod. Be careful not to stuff the glass wool too tightly. Also be careful not to block the hole to the siphon tube part with the glass wool.

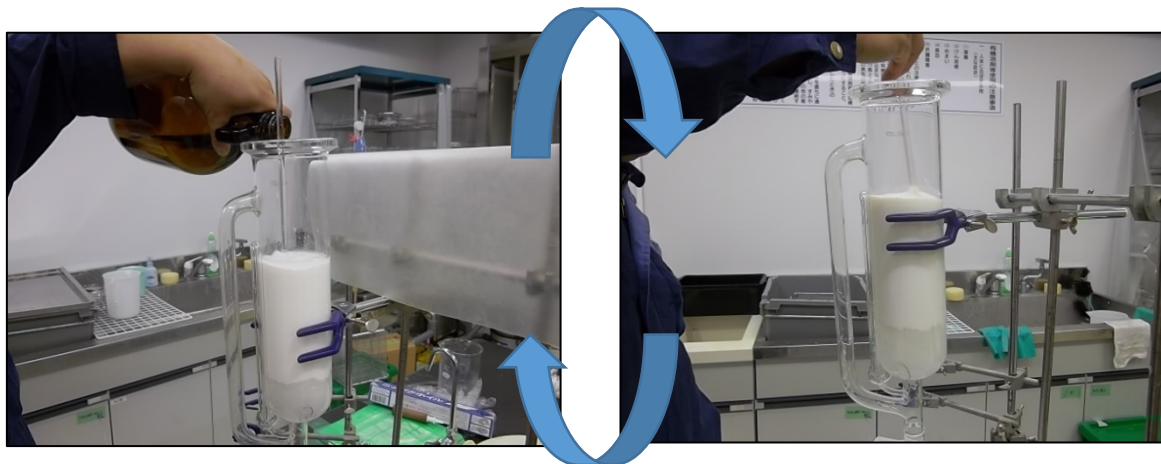


- 5) Set a waste liquid cup beneath the extractor.
- 6) Place a glass funnel on the extractor and thoroughly wash the XAD resin collected in the beaker with industrial acetone.



- 7) While stirring with a glass rod, pour industrial acetone into the extractor up to a level at

which siphoning does not occur, and stir with the glass rod. Tilt the extractor to induce siphoning and let acetone drop. Repeat this step (pre-washing) at least 2 times. (Judge by the color of the acetone wash effluent.)



- 8) After pre-washing is completed, thoroughly wash the glass rod using a wash-bottle filled with acetone to remove the remaining XAD resin.



- 9) Put a few pieces of boiling stones and 2L of industrial acetone in a flat-bottomed flask (2L) of the Soxhlet extractor.
- 10) Place the extractor into which the XAD resin has been transferred in step 6) on top of the flask and wrap seal tape around the joint.



11) Secure with a joint clamp. Connect a condenser to assemble the Soxhlet extractor.



12) Put the condenser into operation, turn on the mantle heater, and set the temperature to that for acetone.

Confirm that the device is siphoning properly, and perform Soxhlet extraction for at least 6 hours.

Note: To prevent drying up due to acetone leakage, check the odor, acetone volume, bending of condenser tube and coolant temperature and volume 1 hour after starting the extraction to ensure that there is no abnormality.

- 13) Turn off the mantle heater and let it cool. At this point, let the acetone remaining in the extractor drop into the flask.
- 14) Prepare another 2L flat-bottomed flask containing a few pieces of boiling stones and 2L of toluene (JIS special grade). When the acetone in step 9) has cooled, replace the flask with the one containing toluene.
- 15) Put the condenser into operation, turn on the mantle heater, and set the temperature to that for toluene. Confirm that the device is siphoning properly, and perform Soxhlet extraction for at least 6 hours.

Note: To prevent drying of toluene due to leakage, check the odor, toluene volume, bending of condenser tube and coolant temperature and volume 1 hour after starting the extraction to ensure that there is no abnormality.

- 16) Turn off the mantle heater and let it cool. At this point, let the toluene remaining in the extractor drop into the flask.
- 17) When sufficiently cooled, remove the extractor and proceed to the next filtration step.
- 18) Set a Buchner funnel on a filtration bottle.



- 19) Using a glass rod, transfer the XAD resin from the extractor onto the Buchner funnel.



- 20) Wash the wall of the extractor using a wash bottle filled with acetone (JIS special grade) to remove the remaining XAD resin.



- 21) Wash the Buchner funnel at least twice with methanol (pesticide analysis grade) to remove the remaining XAD resin. Note that any residual toluene makes it difficult to dry the XAD resin.



*Repeat this at least twice.

22) Using a glass rod, transfer the XAD resin from the Buchner funnel to two 500ml beakers.



23) Place the beakers in a vacuum dryer.

Note: Clean inside the vacuum dryer to make sure that there is no residue of previous use.

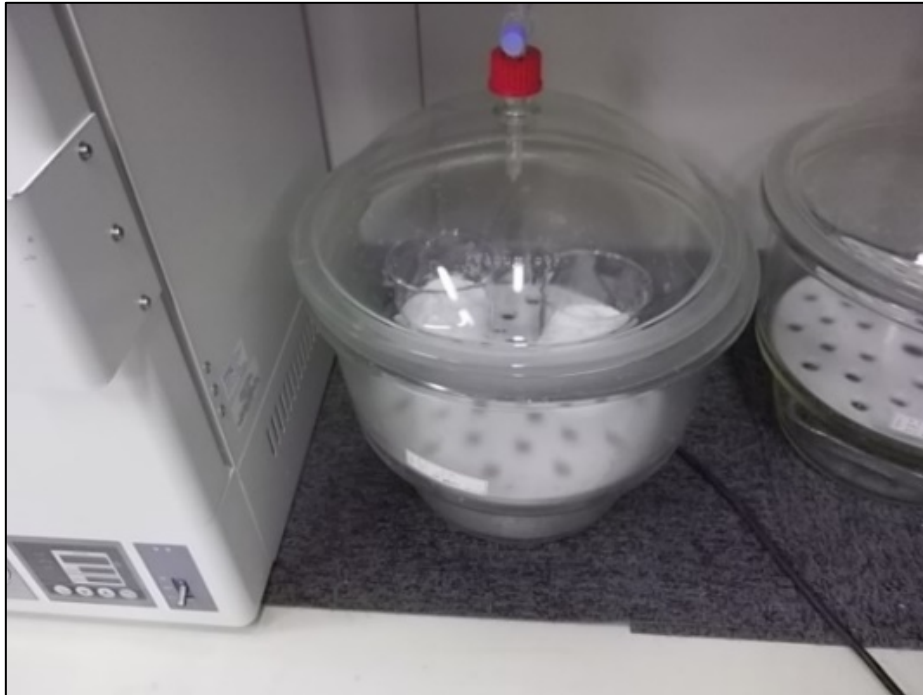


24) Put the vacuum pump and the vacuum dryer into operation and dry the XAD resin at 130 degrees for at least 7 hours.

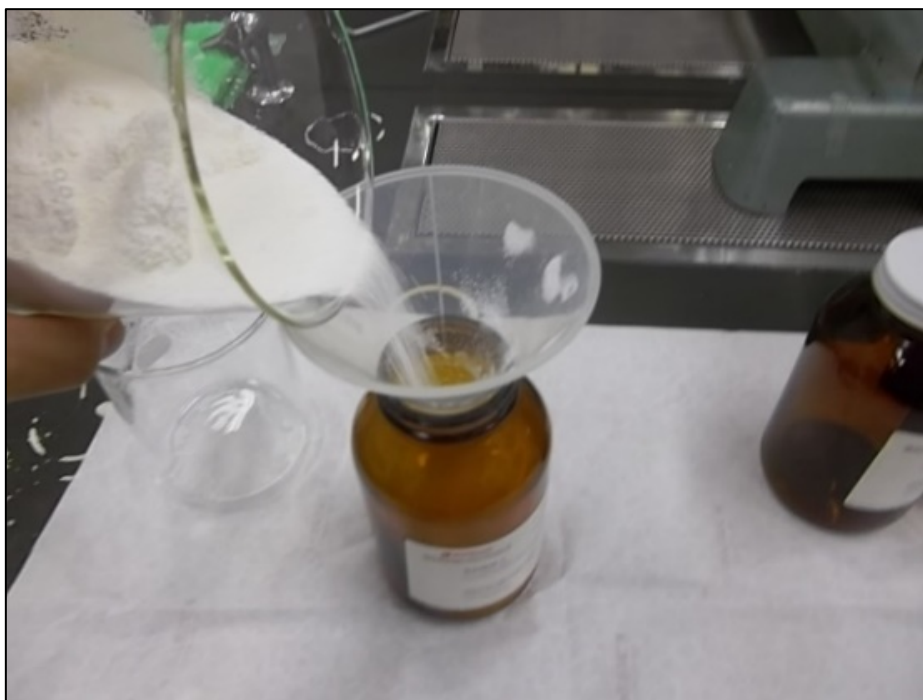
25) Gradually release vacuum, and when ambient pressure is reached, turn power off. Take out

the beakers with tongs and check whether they are dry. If they are not sufficiently dry, continue vacuum drying.

26) If the beakers are completely dry, put them into a desiccator and let them cool.



27) After they have sufficiently cooled, transfer the washed XAD resin through a funnel into a brown bottle dedicated for washed XAD resin.



28) Seal the bottle and store it in a prescribed place.



29) Write the following items in the capturing/adsorbent material preparation record.

- Name of reagent
- Lot No.
- Volume prepared
- Washing start date, washing completion date, storage date
- Storage place
- Person in charge of preparation

3. Preparation of ambient air capturing/adsorbent materials

3-1. Filter paper

- 1) Place filter papers for high volume air sampler in a muffle furnace for burning filter papers.
- 2) Close the door of the muffle furnace and set the temperature to 450°C.
- 3) Confirm that the temperature has reached 450°C and burn for 18 hours.
- 4) Stop heating the muffle furnace and wait until the temperature drops to about 150°C.
- 5) Transfer the filter papers to a dedicated desiccator and wait until they cool to room temperature.
- 6) Wrap each filter paper with aluminum foil and store it in a dedicated cage.

3-2. Polyurethane foam (PUF)

- 1) Use dedicated instruments. The instruments must be washed with acetone and dried immediately before use.

- 2) Instruments used are as follows.

Stainless tray, Soxhlet extractor (upper metal fitting, lower metal fitting)

1L graduated cylinder, beaker (500ml, two for drying)

- 3) Put the necessary number of PUFs on a stainless tray. Up to 5 PUFs can be treated per Soxhlet extractor.



- 4) Wear Saniment gloves and wash the PUFs by rubbing them while soaking with tap water. Rub them 40 times on one side, then turn over and rub another 40 times. After washing, squeeze the PUFs thoroughly.



- 5) Pour purified water onto the PUFs to replace the tap water with purified water. Then, squeeze them thoroughly.



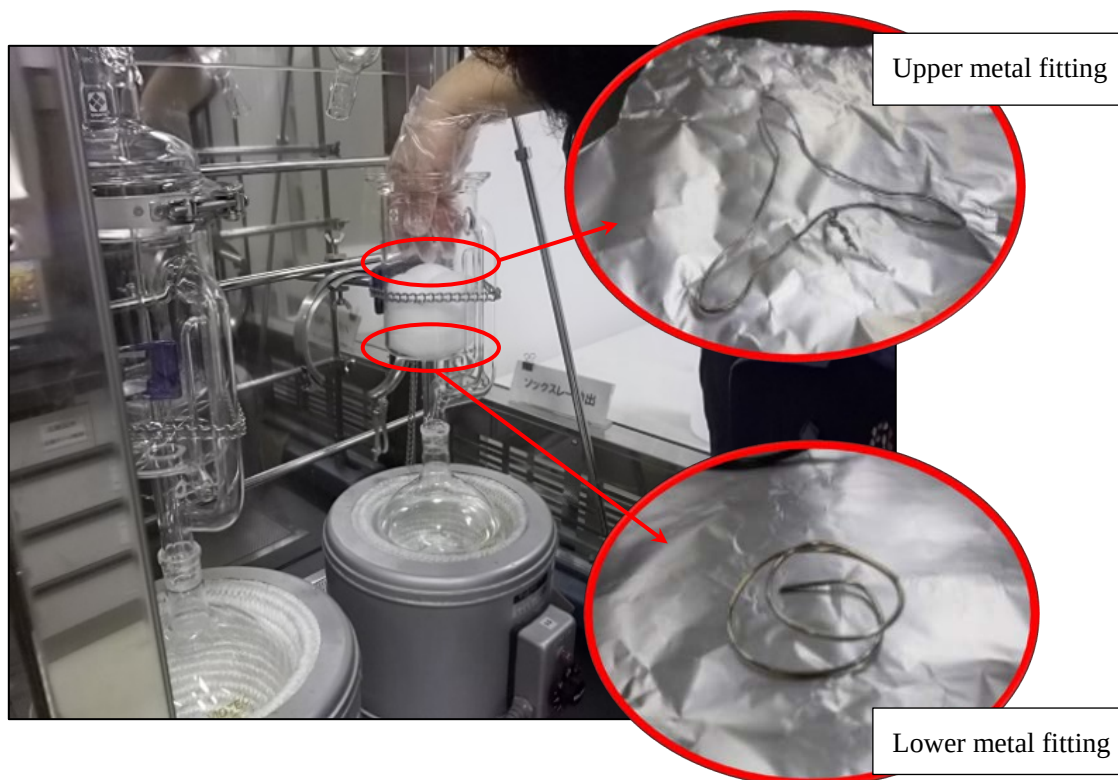


- 6) Finally, pour acetone (JIS special grade) to soak the PUFs and squeeze them thoroughly.





- 7) Disassemble the Soxhlet extractor and place the lower metal fitting at the bottom of the extractor to prevent inlet of siphon tube from being blocked by the PUFs. Then, push and stuff the pre-washed PUFs into the extractor.
- 8) When all the PUFs is stuffed, secure the urethane foam using the upper metal fitting to prevent the PUFs from exceeding to the top of siphon tube as they absorb acetone and swell during extraction.



- 9) Using a 1L graduated cylinder, put 1.6L of acetone (JIS special grade) into each flask. Make sure that boiling stones are placed in the flasks beforehand.
- 10) Place a silicone O-ring, place the upper lid, and secure it with a metal ring. Connect a condenser and seal the joint with seal tape.



- 11) Put the condenser into operation, turn on the mantle heater, and set the temperature to that for acetone. Confirm that the device is siphoning properly, and perform Soxhlet extraction for at least 6 hours.

Note: To prevent drying of acetone due to leakage, check the odor, acetone volume, bending of condenser tube and coolant temperature and volume 1 hour after starting the extraction to ensure that there is no abnormality.

- 12) Turn off the mantle heater and let it cool. At this point, let the acetone remaining in the extractor drop into the flask.
- 13) Clean the vacuum dryer in advance and make sure that it is clean. Wear Saniment gloves and line the vacuum dryer with new aluminum foil as shown in the picture for step 15).

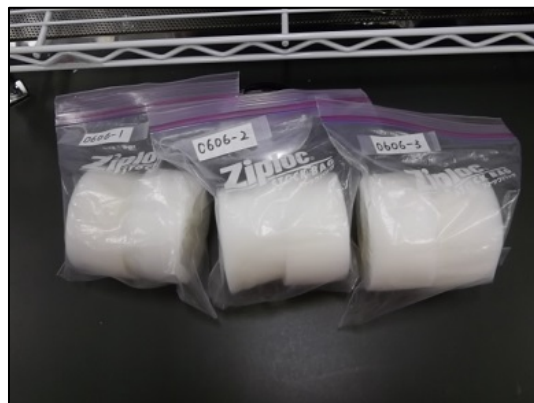
Note: For the operations hereafter, wear Saniment gloves and avoid touching the PUF directly with bare hands.

- 14) When the Soxhlet extractor cools to room temperature, remove the condenser and the lid, wear Saniment gloves and take out the PUFs.
- 15) Squeeze the PUFs and put them in the dryer. Squeeze the PUFs carefully so that they do not lose their shape.



- 16) Put the vacuum pump and the vacuum dryer into operation and dry the PUF at 40 °C for at least 6 hours.
- 17) Gradually release vacuum, and when ambient pressure is reached, turn power off. Confirm that the PUFs are sufficiently dry.
- 18) Prepare the necessary number of polyethylene zipper bags with date labels. Wear Saniment

gloves, put 2 PUFs in each bag and seal.



19) Store them in a dedicated place of the Capturing/adsorbent materials preparation room in the order of preparation date. During storage of PUFs, increase in PCB blank value cannot be avoided, so their use-by date should be about 2 weeks from washing.

20) Write the following items in the capturing/adsorbent material preparation record.

- Name of reagent
- Lot No.
- Volume prepared
- Washing start date, washing completion date, storage date
- Storage place
- Person in charge of preparation

4. Washing of other materials

Glass wool and skimmed cotton used for washing XAD resin and conducting the analysis must be washed with solvents before use. The procedures are as follows.

- * Glass wool damages the skin if handled with bare hands. Glass wool fibers readily float in the air, so also wear protective equipment upon handling to avoid inhalation risks.



- 1) Use dedicated instruments. The instruments must be washed with acetone and dried immediately before use.
- 2) Instruments used are as follows.
Beaker (500ml), tweezers, aluminum drying plate
- 3) Wear a new pair of Saniment gloves. Tear the materials to be washed and put them in beakers.



- 4) Put 500ml of acetone (JIS special grade) in each beaker. Push the materials with tweezers to remove bubbles.



- 5) Place the beakers in a small ultrasonic bath and perform ultrasonic washing for 15 minutes.
*Use a cover to prevent dust contamination.



- 6) When ultrasonic washing is completed, take out the beakers. Be sure to wipe off moisture on the outside of the beakers with paper towels.
- 7) Hold the materials with tweezers and pour out acetone into a waste liquid vessel.



- 8) Put 500ml of toluene (JIS special grade) in each beaker. Remove bubbles with tweezers.
- 9) As in step 5), place the beakers in an ultrasonic bath and perform ultrasonic washing for 15 minutes.
- 10) When ultrasonic washing is completed, take out the beakers. Be sure to wipe off moisture on the outside of the beakers with paper towels.

- 11) Hold the materials with tweezers and pour out toluene into a waste liquid vessel.
- 12) Any residual toluene makes it difficult to dry the materials, so wear Saniment gloves and squeeze the materials thoroughly. The material fibers will pulverize if squeezed too tightly, so it is recommended to squeeze them flat between both hands.
- 13) Put 500ml of acetone (JIS special grade) in each beaker. Remove bubbles with tweezers.
- 14) As in step 5), place the beakers in an ultrasonic bath and perform ultrasonic washing for 15 minutes.
- 15) When ultrasonic washing is completed, take out the beakers. Be sure to wipe off moisture on the outside of the beakers with paper towels.
- 16) Hold the materials with tweezers and pour out acetone into a waste liquid vessel.
- 17) Wear Saniment gloves and squeeze out acetone thoroughly. The material fibers will pulverize if squeezed too tightly, so it is recommended to squeeze them flat between both hands.
- 18) Spread the materials on aluminum drying plates to make them easier to dry.





19) Place them in a vacuum dryer.

Note: Clean inside the vacuum dryer to make sure that there is no residue of previous use.



- 20) Put the vacuum pump and the vacuum dryer into operation and dry the XAD resin at 130 degrees for at least 7 hours.
- 21) Gradually release vacuum, and when ambient pressure is reached, turn power off.
- 22) When ambient pressure is reached, wear Saniment gloves and transfer the materials into dedicated containers.

- 23) Attach labels indicating preparation dates, etc. on the containers and store them in dedicated cages.



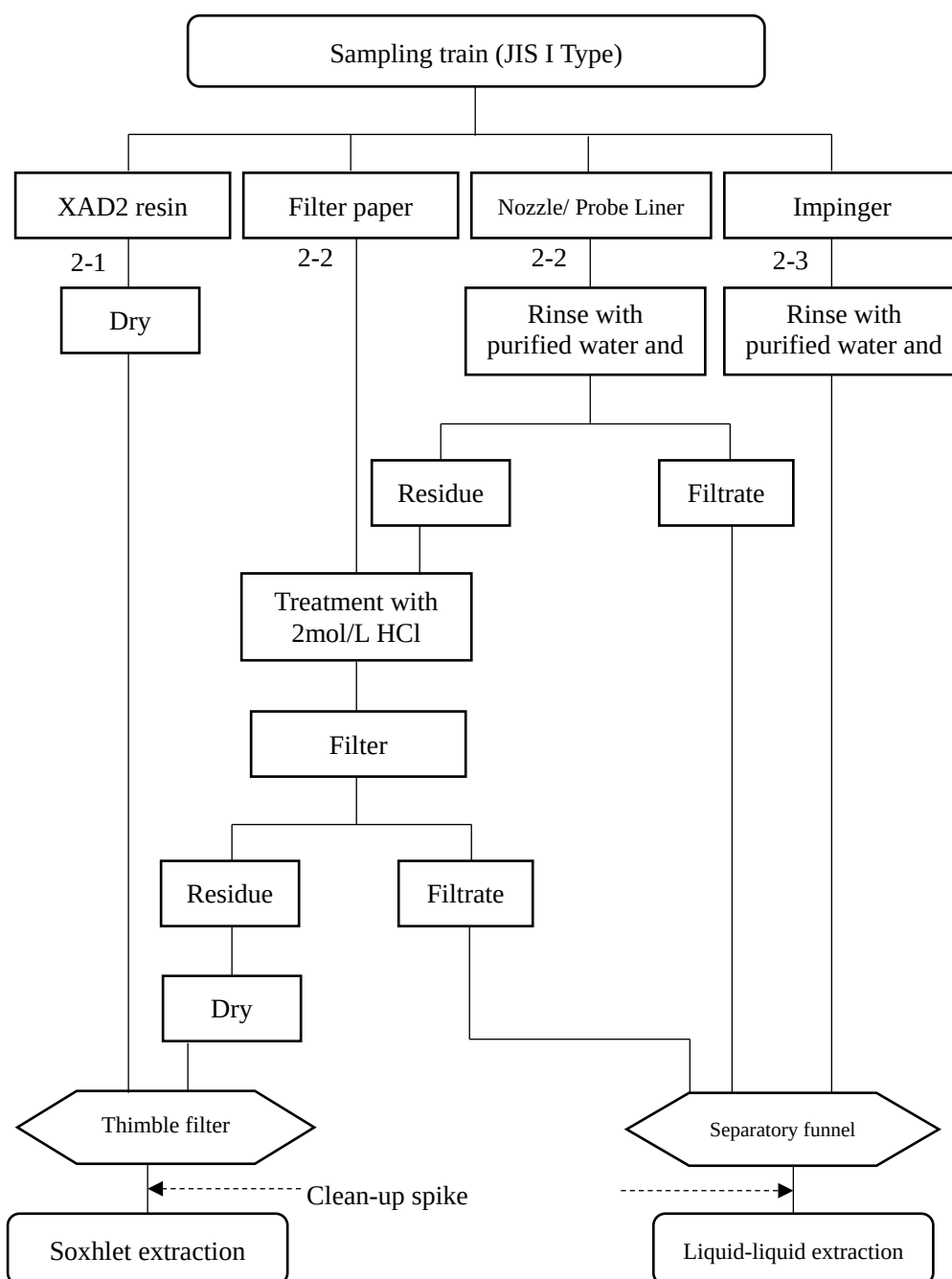
November 16-18, 2021

The Project for Capacity Development on Improving Solid Waste Management through
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Sample recovery from sampling train

1. Outline of sample recovery procedures in Japan

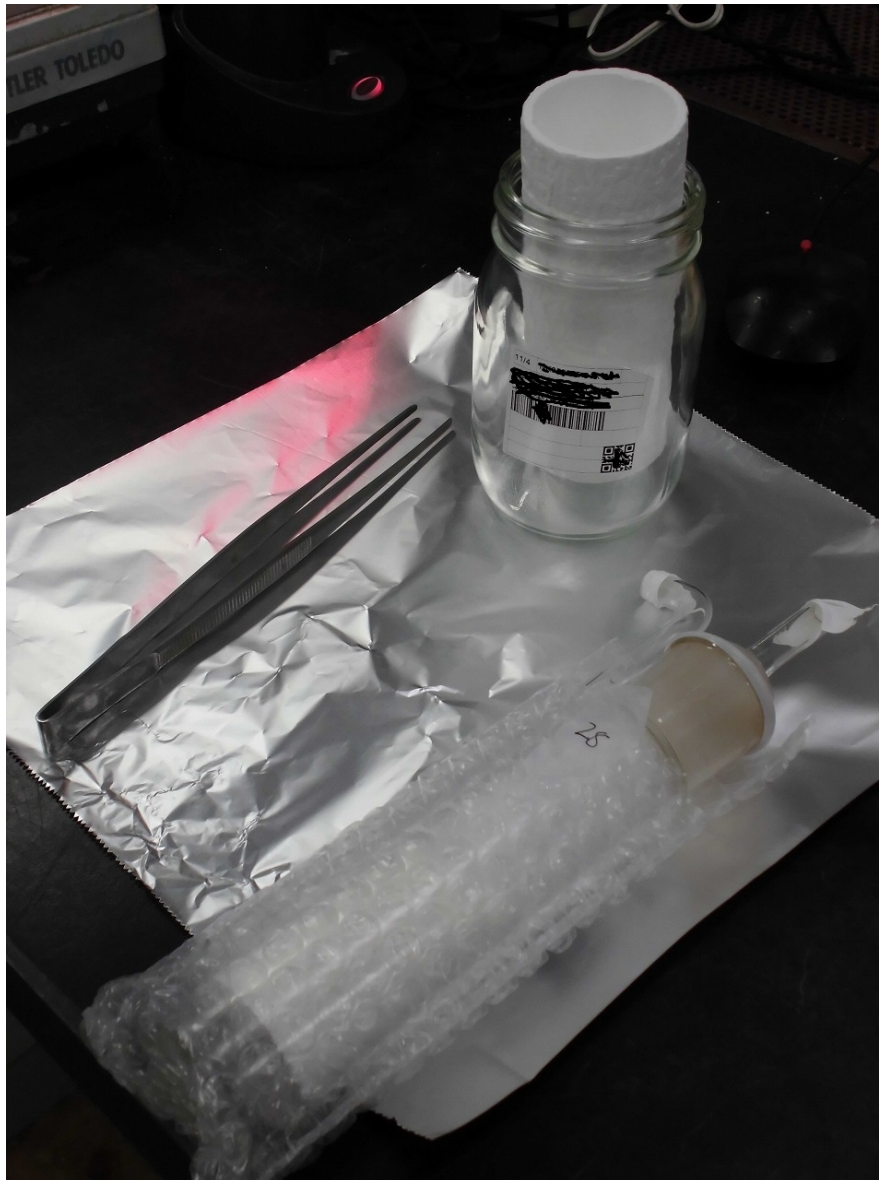
The outline of sample recovery procedures is provided below. Solids containing dust are separated and subjected to Soxhlet extraction. Liquids such as liquid in the impinger and rinse effluents produced during the treatment are combined and subjected to liquid-liquid extraction.



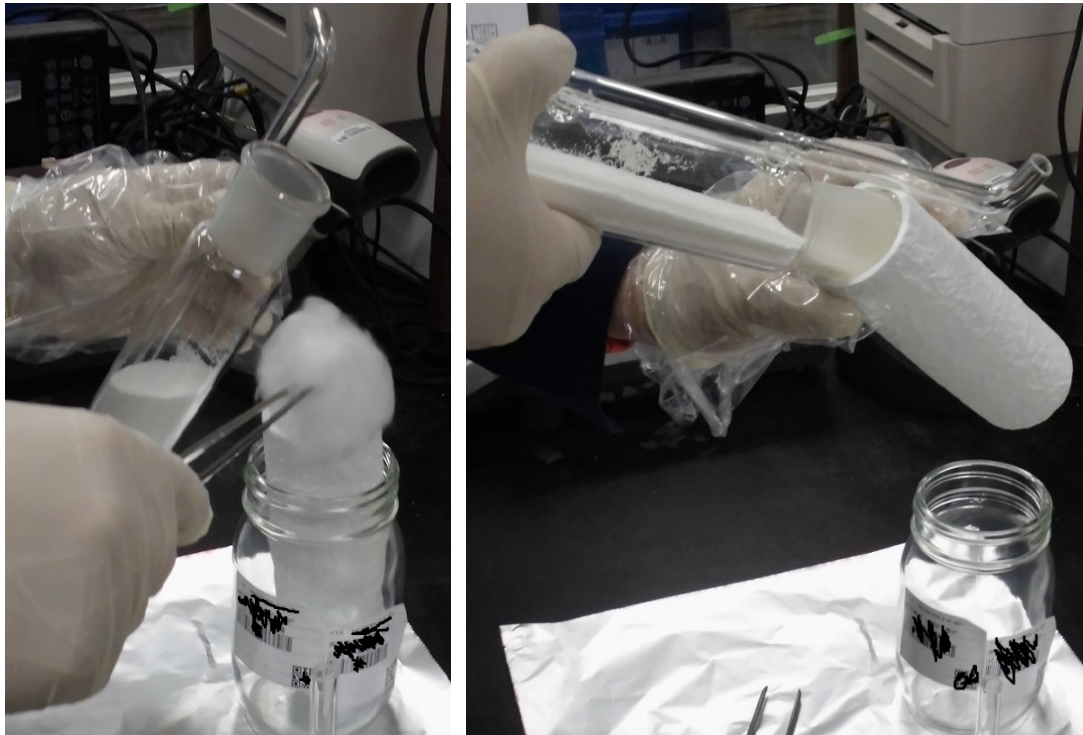
2. Sample recovery procedures

2-1. Recovery of XAD resin

- 1) Subject a thimble filter for Soxhlet extraction to heat-treatment at 450°C and place it upright in a beaker. Cut aluminum foil into about 30cm and spread it under the beaker so that scattered XAD resin can be recovered.



- 2) Remove glass wool from the XAD tube with tweezers and put the glass wool into the thimble filter, and then pour the XAD resin into the thimble filter with care so as not to spill it.



- 3) Rinse the XAD tube with a small amount of methanol and recover the remaining resin completely in the thimble filter. Recover any XAD resin spilled on the aluminum foil.



- 4) Rinse the XAD tube with hexane-washed water, methanol, dichloromethane and methanol in that order. Recover the rinse effluents, combine them with rinse effluents from other instruments and put them in a separatory funnel.



2-2. Recovery and hydrochloric acid treatment of dust

2-2-1. Recovery

Dust is deposited on parts of a sampling train between the nozzle and the filter paper. It is known that dioxins are mostly present in dust. Dioxins in dust cannot be completely extracted unless using highly efficient extraction methods such as Soxhlet extraction. It is thus important to securely separate and recover the dust portion. The procedures are as follows.

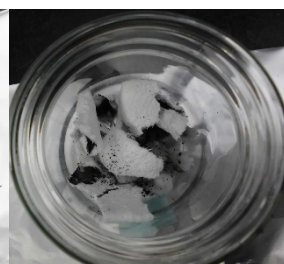
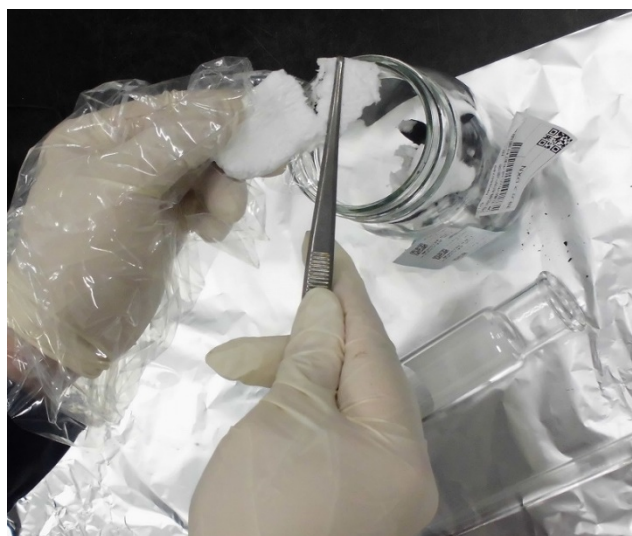


* An example of a nozzle with dust. As can be seen, a large amount of dust may be deposited in some cases. It is difficult to visually detect dust when the amount is small, or its color is white, etc. Nevertheless, always handle these parts assuming that dust is deposited on them.

- 1) Using tweezers, take out a shimble filter paper for stack gas sampling from the filter paper holder, cut it into small pieces and put them in an acid treatment bottle. When dust is also deposited on the filter paper holder, wipe off the dust with skimmed cotton soaked with hexane-washed water, and put the skimmed cotton with dust in the same acid treatment bottle. Then, wash inside the holder with hexane-washed water, and put the wash effluent in the same acid treatment bottle.

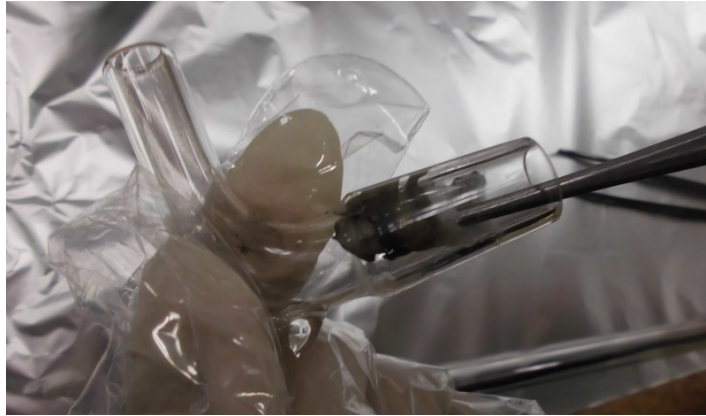
* If acid treatment is not performed, put the filter paper and dust recovered in this step into the thimble filter in which the XAD resin has been recovered in step 2-1. (See 2-2-2 for acid treatment.)

*If acid treatment is not performed, methanol should be used instead of hexane-washed water.



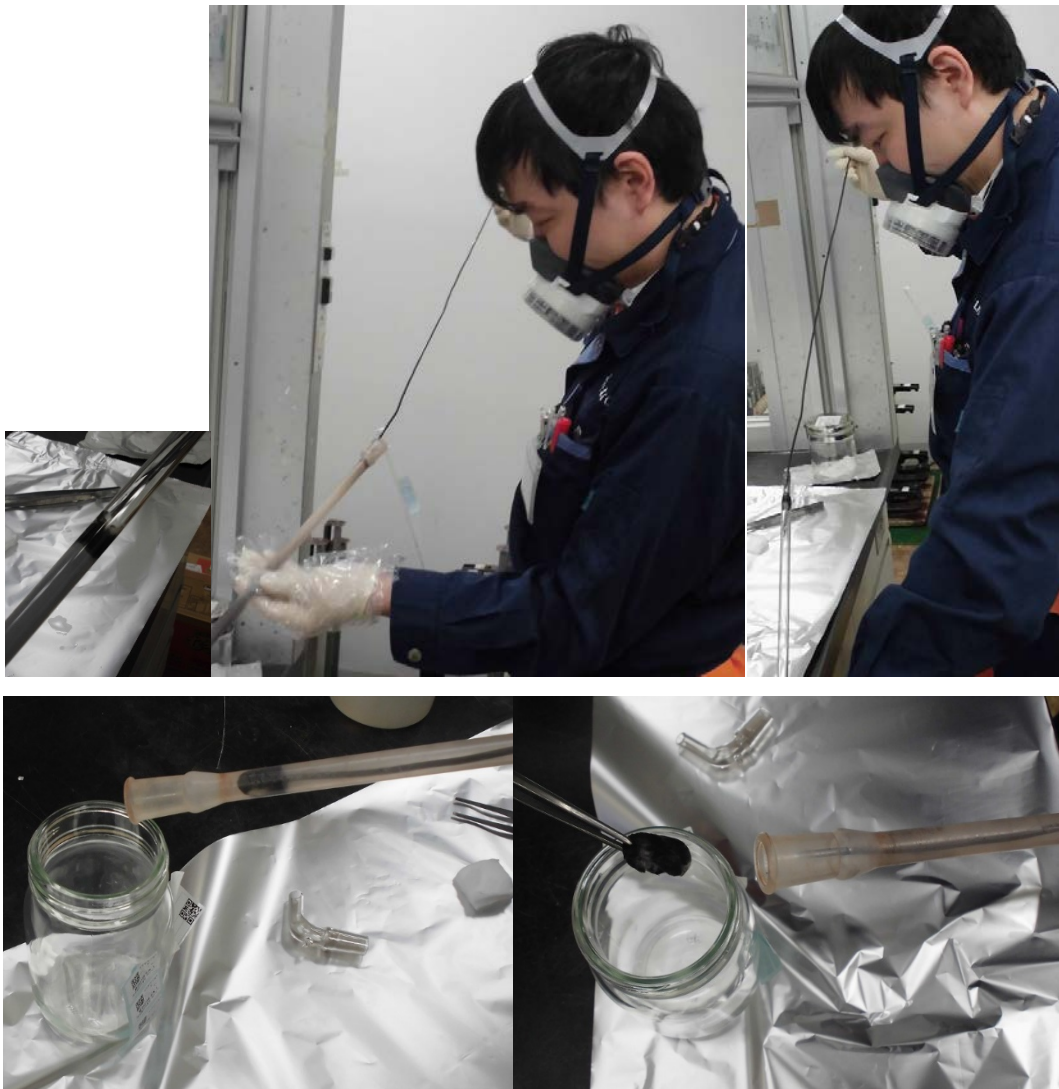


- 2) Wipe off dust deposited on the nozzle with skimmed cotton soaked with hexane-washed water, and put the cotton in the acid treatment bottle. Then, wash inside the holder with hexane-washed water, and put the wash effluent in the same acid treatment bottle.



- 3) Stuff skimmed cotton soaked with hexane-washed water into the probe liner. Then, push the cotton out with a brass rod so that dust deposited on the inner surface of the tube is recovered in the acid treatment bottle. Repeat this step until dust deposited on the inner surface of the tube is completely removed. Then, wash inside the holder with hexane-washed water, and put the wash effluent in the same acid treatment bottle.





4) Nozzle, filter paper holder, and collection tube after dust recovery



- 5) If the water inside the impinger is contaminated with dust, filter the water beforehand. Combine the recovered dust with the wash effluent, and put them in the acid treatment bottle in step 1).

2-2-2. Acid treatment

Acid treatment of recovered dust sample is not provided in the EPA method but is provided in the Japanese official method (JIS). This may be due to the fact that, in Japan, application of calcium carbonate and use of bag filters are the major treatments adopted for reducing dioxins in stack gas of incinerators. Past studies reported that treating dust with calcium carbonate causes dioxins to be trapped in capsules of calcium carbonate, resulting in a poor extraction rate in Soxhlet extraction. Procedures up to Soxhlet extraction including acid treatment are provided below.

- 1) To the acid treatment bottle in step 2-2-1, add 2 mol/L hydrochloric acid until the recovered sample is completely immersed. Stir well. Cover the bottle opening with aluminum foil and let it stand for 1 hour to react.
- 2) If the amount of dust is large, add a small amount of hydrochloric acid after 1 hour to confirm that no further reaction occurs. (If further reaction occurred, repeat addition of hydrochloric acid and letting it stand until no further reaction occurs.)
- 3) Set a Buchner funnel and perform suction filtration of the acid-treated sample. After filtration, wash the residue on the Buchner funnel with hexane-washed water until the pH becomes close to neutral.
- 4) When filtration is completed, continue suction for 5 minutes to dry the filter paper.
- 5) Combine the filtrate recovered in the suction bottle with the rinse effluent obtained in step 2-3 and perform liquid-liquid extraction.
- 6) Remove the filter paper from the Buchner funnel with tweezers and put it into the thimble filter into which the XAD resin was put in step 2.1. After removing the filter paper, recover dust remaining on the Buchner funnel and the perforated plate by wiping them thoroughly with skimmed cotton soaked with acetone. Put the cotton in the thimble filter.
- 7) Dry the thimble filter in a dedicated desiccator. Add granular sodium hydroxide to the desiccator to remove any residual hydrochloric acid. If reaction occurs, replace the granules as needed. (Any residual hydrochloric acid makes it difficult to dry the sample.)
- 8) After confirming that the sample in the thimble filter has sufficiently dried, add clean-up spike to the sample, plug the top with skimmed cotton, and set the thimble filter in a Soxhlet extractor equipped with a Dean-Stark adapter. (It is difficult to dry the sample completely in the thimble filter. Even if some moisture remained in the sample, reduction of extraction

efficiency can be prevented by using a Soxhlet extractor equipped with a Dean-Stark adapter to perform extraction while dehydrating the sample.)

2-3. Thorough washing of impinger

In JIS, the liquid inside the impinger is also regarded as a target of analysis. Meanwhile, the sampling train illustrated in the EPA method adopts a design in which an XAD resin holder is installed immediately below the condenser. This is based on the assumption that gaseous dioxins passing through the filter are cooled here so that all dioxins, including those in the condensed water, can be recovered in the XAD resin. The impinger part is only used for weighing water content and correcting the calculated volume of sampled gas, so it is not regarded as a target of dioxins analysis.

For reference, the method specified in JIS for recovering dioxins from impinger liquids by liquid-liquid extraction is described below.

- 1) Set a large glass funnel on a recovery container (gallon glass bottle is used in our laboratory) and transfer the drain water from the impinger to the bottle. Rinse the impinger with hexane-washed water and put the rinse effluent in the separatory funnel. As described in 2-2.2, if the drain water contains a large amount of dust, filter the drain water and treat the filter paper with hydrochloric acid together with other dust.
*The liquids may be recovered directly in the separatory funnel, but to avoid the risk of damaging the separatory funnel, they are first recovered in a large glass bottle and then combined in the separatory funnel.
- 2) Rinse the impinger with methanol, dichloromethane and methanol in this order and recover all rinse effluents in the recovery container.
- 3) Combine the liquids recovered in this step and the rinse effluents obtained in other steps, and put them in a 2L separatory funnel. Add clean-up spike to the sample and perform liquid-liquid extraction with dichloromethane.
- 4) Concentrate the extracted dichloromethane layer in a rotary evaporator, combine it with the extract from Soxhlet extraction and proceed to clean-up.

End

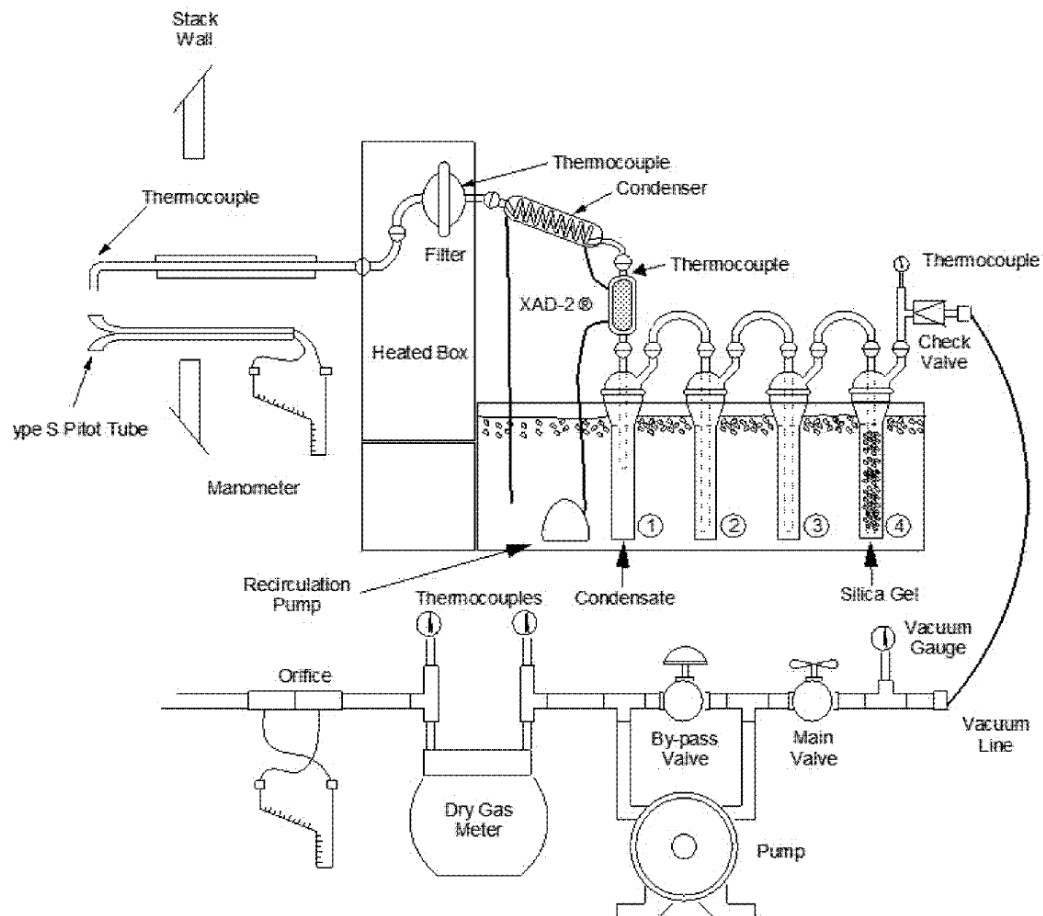


Figure 23-1. Method 23 Sampling Train

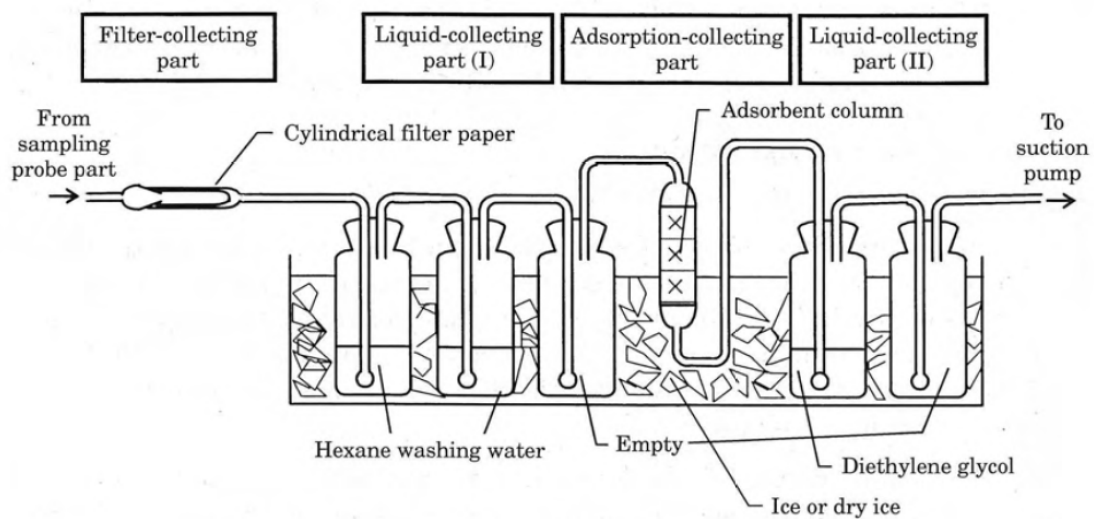


Figure A.1 Example of JIS Type I apparatus

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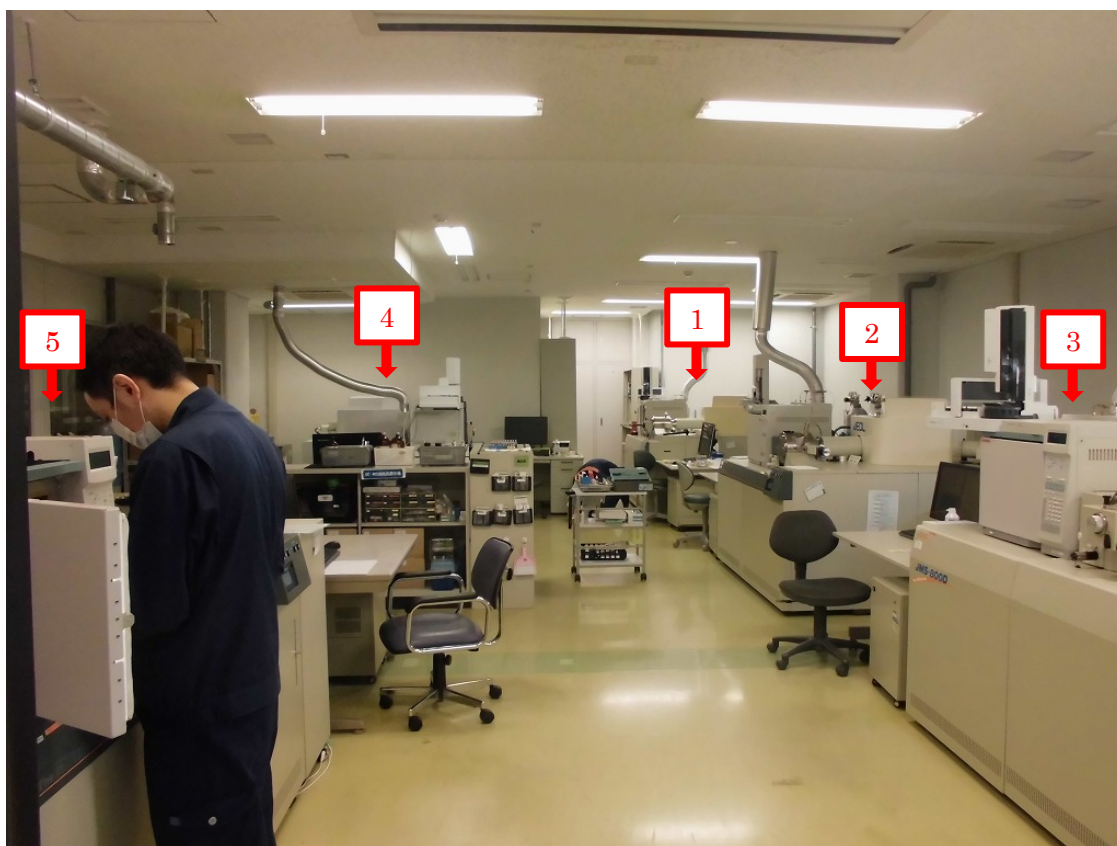
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GC/HRMS measurement and data processing by Diok

1. Examples of facility and equipment

1-1. GC/HRMS room

Our company has five JEOL GC/HRMS units. They are all installed in the same temperature-controlled room (1 to 5 in the photo below). In this room, measurement of pre-treated samples is conducted.

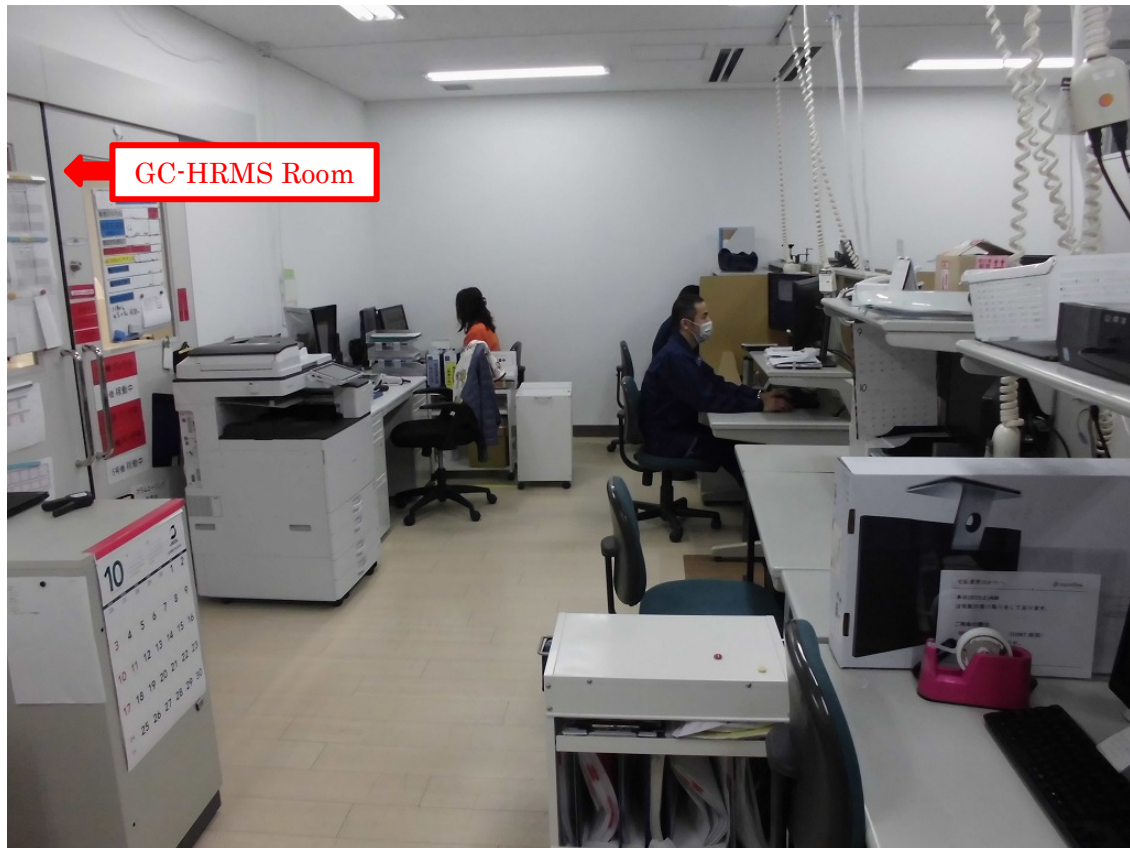


1-2. Data processing room

In the analysis room adjacent to the GC/HRMS room, there are PCs connected to the GC/HRMS room via LAN, and loading of measurement data to Diok, peak integration, calculation, confirm validity of result and preparation of reports are performed.

Persons assigned to work in the data processing room have practical experience in performing all operations of Dioxins pre-treatment. They have been trained to detect abnormalities in measurement

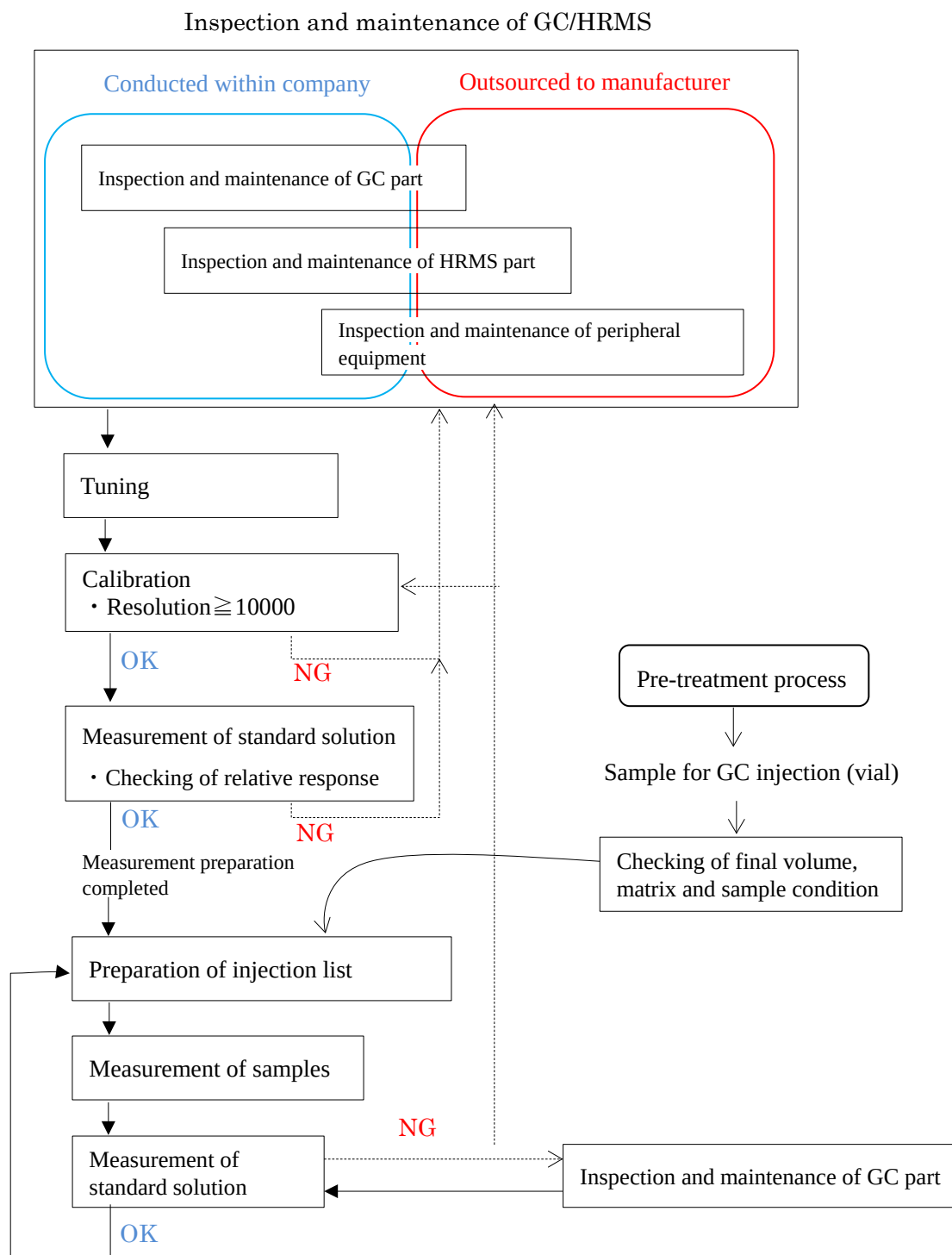
data, select appropriate re-analysis methods and give instructions to persons responsible for the tasks required for re-analysis.



2. Dioxins measurement using GC/HRMS

2-1. Outline of measurement work

The general flow of the measurement work is provided below.



2-2. Maintenance of GC/HRMS

Besides periodical maintenance, maintenance is also conducted whenever needed, e.g., when any problem is found in the measurement or when daily inspection do not meet the criteria. Based on the conditions under which the problem occurred (e.g., measurement results of standard solution for fluctuation of relative response check, chromatogram peak shapes, status of lock channel) and usage conditions of the device (e.g., last replacement dates of consumables, conditions of samples measured in the past, number of injections performed), the person in charge identifies the parts suspected of having problems and performs the necessary maintenance.

Typical examples are given below, but actual cases could be much more complicated.

Symptom	Typical cause	Countermeasures
Severe peak tailing	✓ Contamination around GC injection port	✓ Replace guard column, liner, gold coating seal
Poor peak resolution	✓ Contamination on ion source block	✓ Clean or replace ion source block
Electric discharge during measurement	✓ Introduction of air by leakage ✓ Improper positioning of guard column on outlet side ✓ Contamination on ion source block (particularly insulator parts)	✓ Re-install guard column on outlet side ✓ Clean or replace ion source block
Poor peak shape or separation	✓ Deterioration of column	✓ Cut front side of column or replace column

The table below summarizes maintenance work that can be conducted within the company.

For problems occurring at detection parts or in peripheral equipment (e.g., cooling and circulation device, exhaust system) and problems that cannot be solved by in-house maintenance, it is necessary to contact the manufacturer and request maintenance.

Maintenance that can be conducted within the company	
GC part	• Replacement of liner • Replacement of gold coating Sealing • Replacement or cutting of front-side guard column • Replacement of rear-side guard column • Replacement or cutting of capillary column

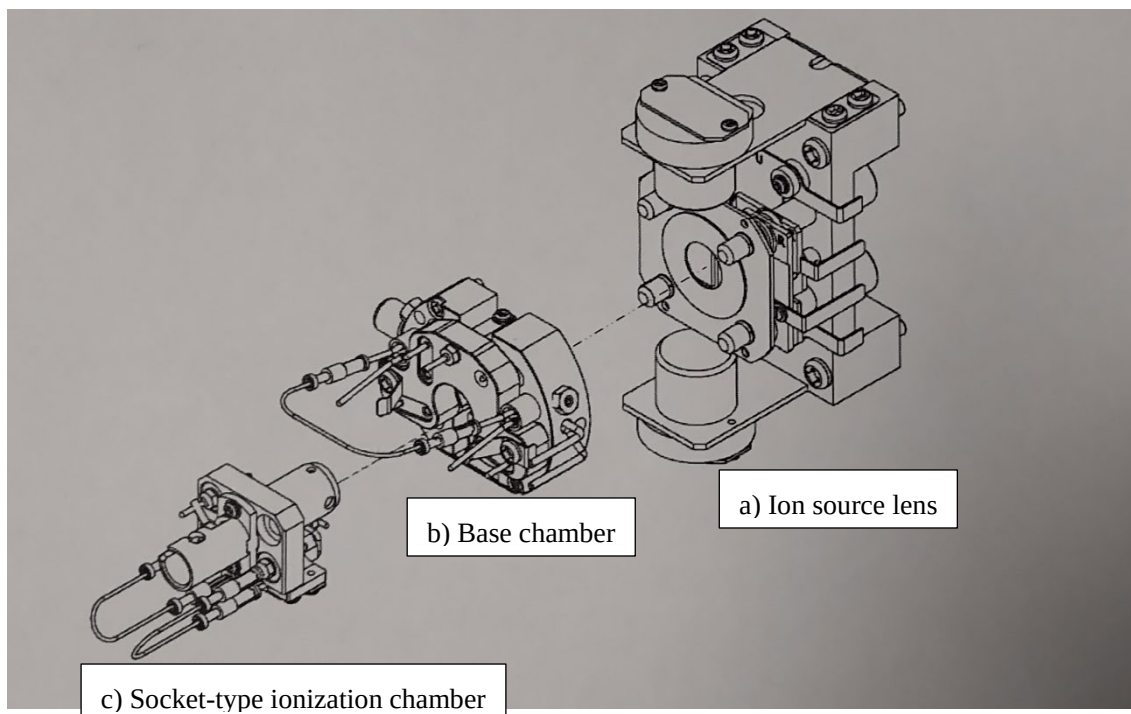
	• Cleaning or replacement of microsyringe • Replacement of septum • Replacement of ferrule
HRMS part	• Maintenance of ion source block Clean or replace ion source block Replacement of filament Cleaning of repeller Replacement of lead wire Replacement of heater Bake-out of insulator part Replenishment of PFK Calibration of magnetic and electric fields

2-3. Maintenance of GC/HRMS (how to clean an ion source block)

Procedures for cleaning an ion source block is described. There is no need to clean every part every time. Clean efficiently by focusing on heavily contaminated parts.

As shown below, an ion source block consists of three major parts.

[a) ion source lens, b) base chamber, c) socket-type ionization chamber]



By using an introduction rod, the “c) socket-type ionization chamber” can be removed without releasing vacuum in the ion source part. Thus, it is efficient to perform cleaning when removing the

“c) socket-type ionization chamber”, such as when replacing the filament.

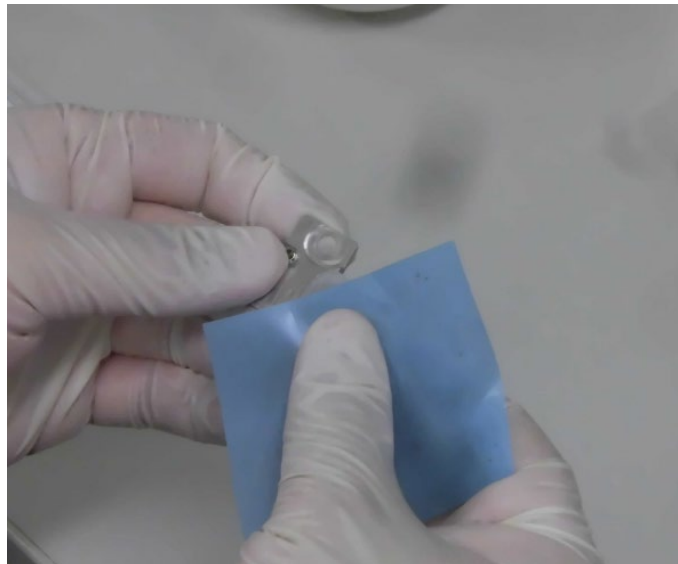
If the ion source block is removed with the ionization chamber vacuum released, it will require more than one day until measurement can be resumed, so such maintenance should be done with proper planning. Collectively clean each of the above parts a), b) and c), focusing on heavily contaminated parts.

For detailed procedures for removing, disassembling and reassembling the ion source block, see manufacturer’s instructions.

When cleaning the ion source, wear powder-free latex gloves to avoid issues with the sebum of your hands.

Divide the disassembled ion source block into three categories, i.e., non-washing parts (e.g., heater, lead wire), metal parts and insulator parts, before starting cleaning of the metal parts and the insulator parts.

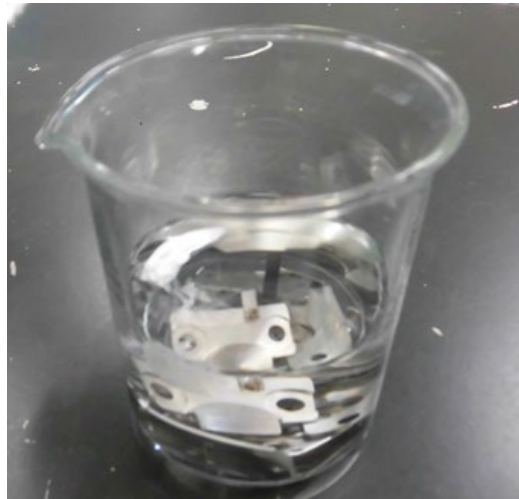
Polish the metal parts with #3000-10000 sandpaper.



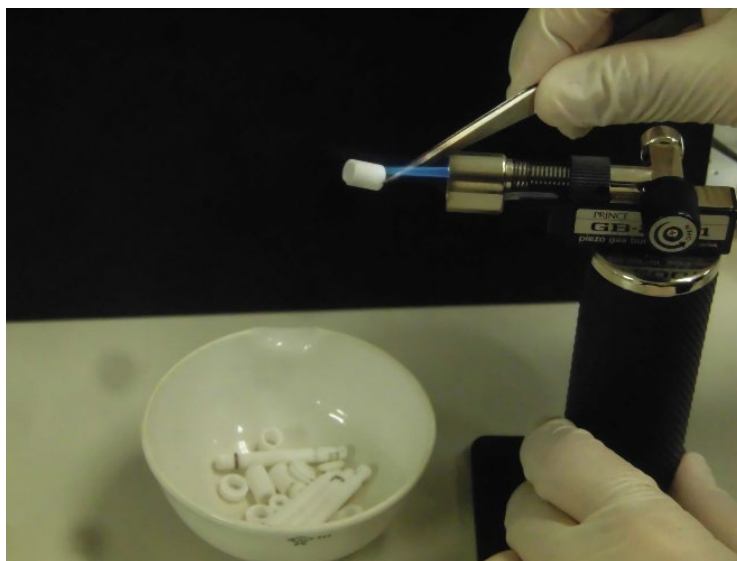
Alternatively, polish them with a paste of alumina powder (particle size of #3000 or larger) suspended in water using a felt buff (mini hand grinder).



Soak and clean the polished parts in a solvent in an ultrasonic bath.



For insulator parts, it is recommended to bake out with a gas burner.



2-4. Daily inspection

Daily inspection is carried out to retain the performance of GC/HRMS and ensure stable measurement. Perform daily inspection at the start of work or at predetermined intervals, and record the results in a prescribed format. Standard inspection items and problems expected to occur when defects are found in these items are summarized in the table below.

Inspection items	Frequency	Problems expected to occur when defects are found
a) Coolant temperature	Work start time	Shutdown of GC/HRMS Drift from center of calibrated mass
b) Temperature of room in which GC/HRMS is installed	Work start time	Drift from center of calibrated mass Board failure caused by dew condensation
c) Gas pressure in carrier gas cylinder	Work start time	Damage of column Unstable separation by GC
d) Pressure of air compressor	Work start time	Shutdown of turbo pump/rotary pump
e) Vacuum degree of ion source	Work start time	Reduced sensitivity of GC/HRMS
f) Noise (operation noise) from turbo pump/rotary pump	Work start time	Malfunction or deterioration in exhaust efficiency causing a critical problem and shutdown
g) Rotary pump oil level and oil leakage	Once a month	Leads to pump failure (replace oil once a year during regular maintenance)
h) GC injection temperature	Work start time	Reduced sensitivity Peak tailing
i) EI ion source status • Emission efficiency • Chamber temperature	At MS tuning (see 2-5, 2-7)	Reduced sensitivity Reduced filament life Peak tailing
j) Lens conditions Move the lens and confirm that beam intensity changes	At MS tuning (see 2-5, 2-7)	Reduced sensitivity, unstable measurement results
k) Accelerating voltage, Q1, Q2, Q3 lens voltage, Q lens 1, 2 correction values, magnetic field intensity,	At MS tuning (see 2-5, 2-7)	Failure to detect specified ion Reduced resolution, poor peak shape, poor S/N ratio

resolution		
l) Vacuum degree in analyzer part	At restart after vacuum release	Reduced sensitivity, reduced resolution
m) Operations of entrance slit, alpha slit, beta slit, exit slit	At restart after vacuum release	Reduced sensitivity, reduced resolution
n) Detector voltage, preamplifier setting, baseline	At restart after vacuum release	Reduced sensitivity, reduced quantitativity Monitor detector voltage→Recognize appropriate timing of detector maintenance

2-5. Tuning

When GC/HRMS has been shutdown, be sure to perform tuning after restarting the device to adjust the resolution of the mass spectrometer to 10000 or higher.

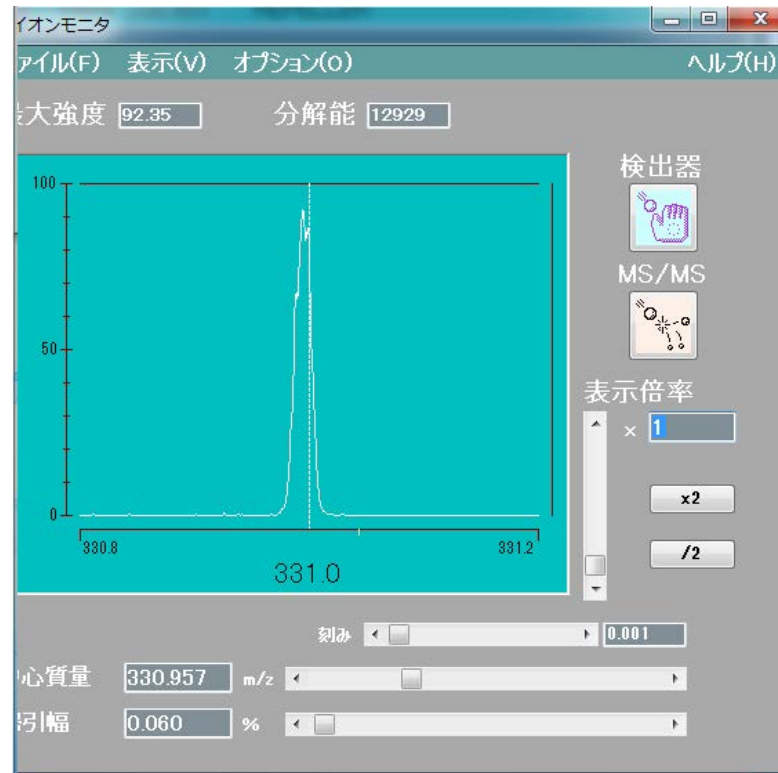
The tuning window can be accessed from the MS Controller menu preset in the PC connected to the CG/HRMS.



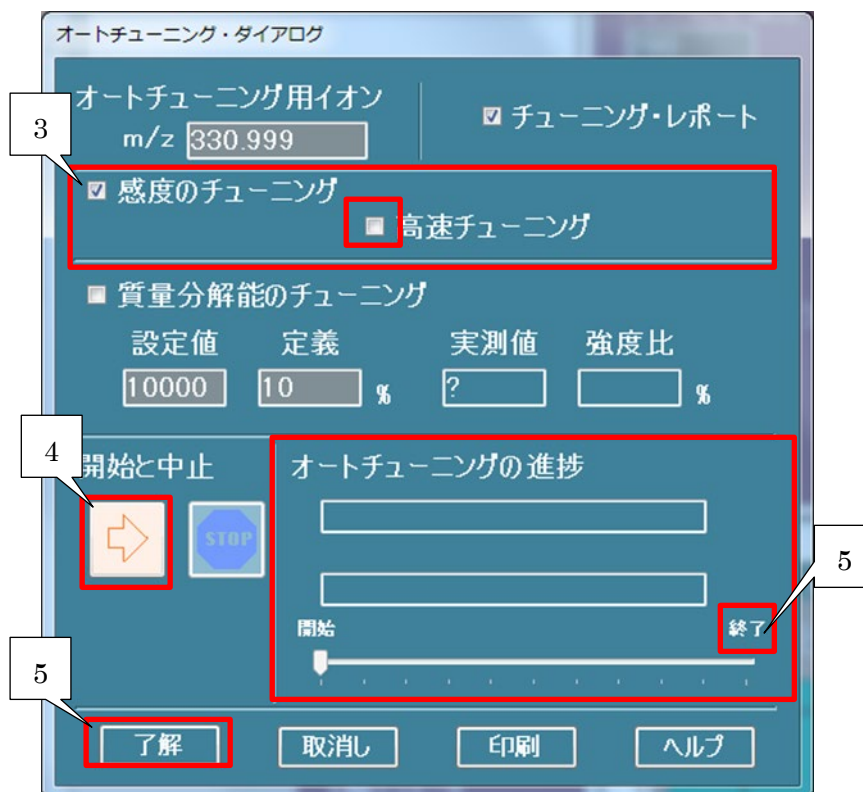
- a) Auto Tuning Dialog
- b) Mode Controller
- c) Ion Source Controller
- d) Lens Controller
- e) Analyzer Controller
- f) Detector Controller
- g) Ion Monitor

2-5-1. Auto Tuning

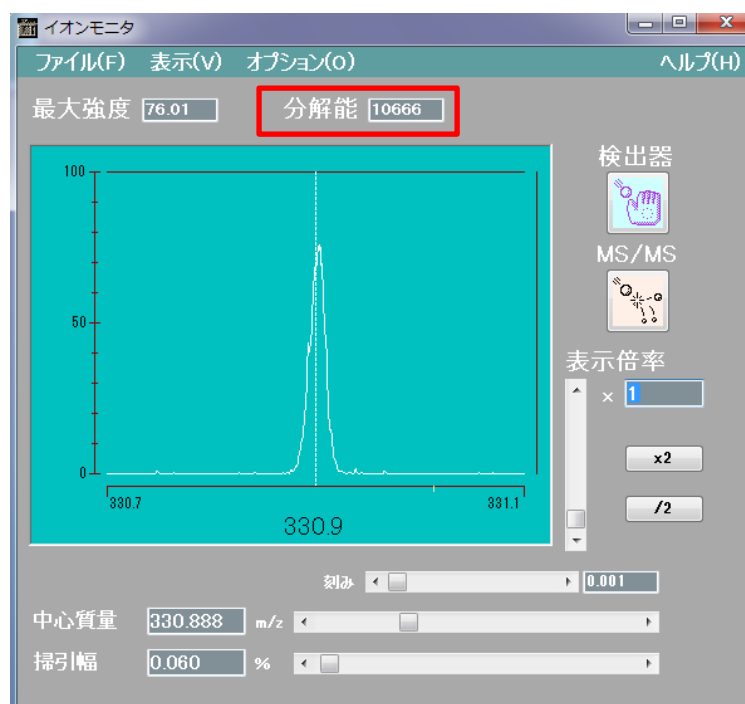
- 1) Open g) Ion Monitor, and adjust the PFK valve so that adequate response is achieved, i.e., the PFK peak does not go off the scale.



2) Open a) Auto Tuning Dialog



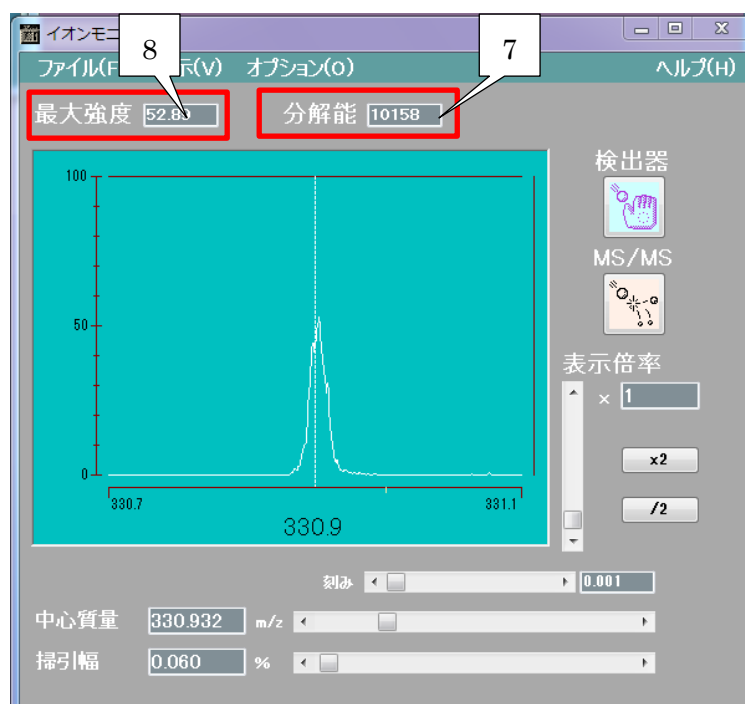
- 3) Put a check mark in Sensitivity Tuning and remove a check mark from High-speed Tuning.
- 4) Click  and Start Tuning
- 5) When the Progress of Auto Tuning reaches Complete, click OK.
- 6) After Auto Tuning, confirm that the resolution indicated on Ion Monitor is 10000 or higher.



*If the resolution is below 10000, perform Tuning again or manually change the parameters of lens, etc.

- 7) Change the accelerating voltage on Mode Controller to 7.5kV, and confirm that the resolution is 10000 or higher.

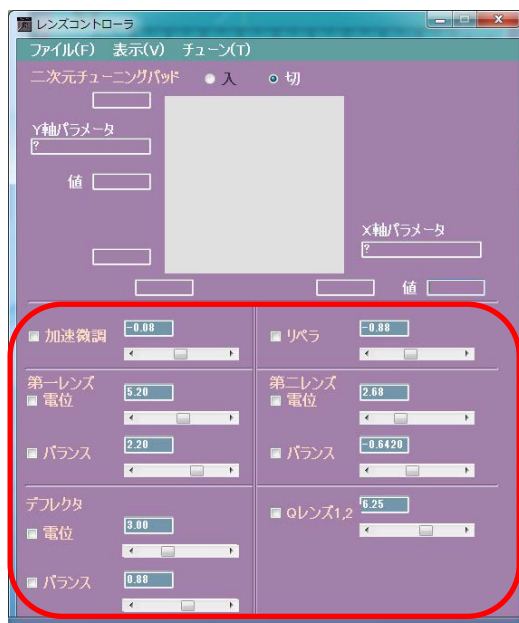




- 8) Perform adjustment so that the ratio of ion intensity at this voltage to that at 10kV becomes about 7.5:10.

*Manual adjustment of lens

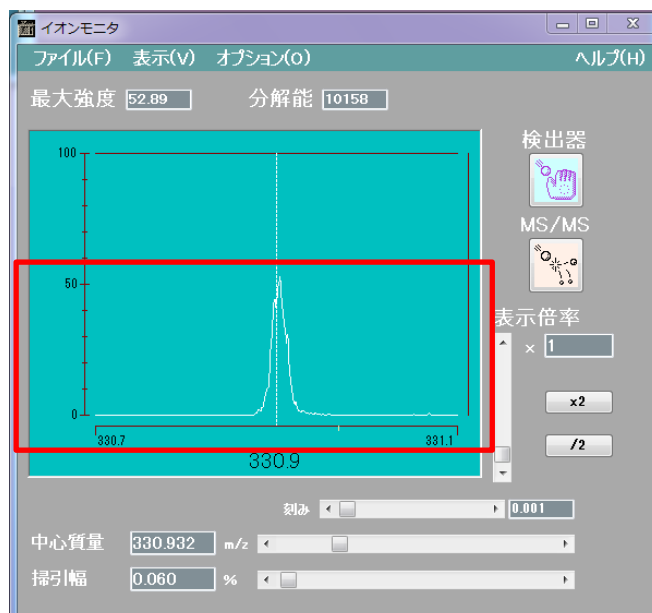
When the resolution does not reach 10000 by Auto Tune, open d) Lens Controller and adjust the lens values while watching the Ion Monitor. Take a screen shot to keep a record of the settings.



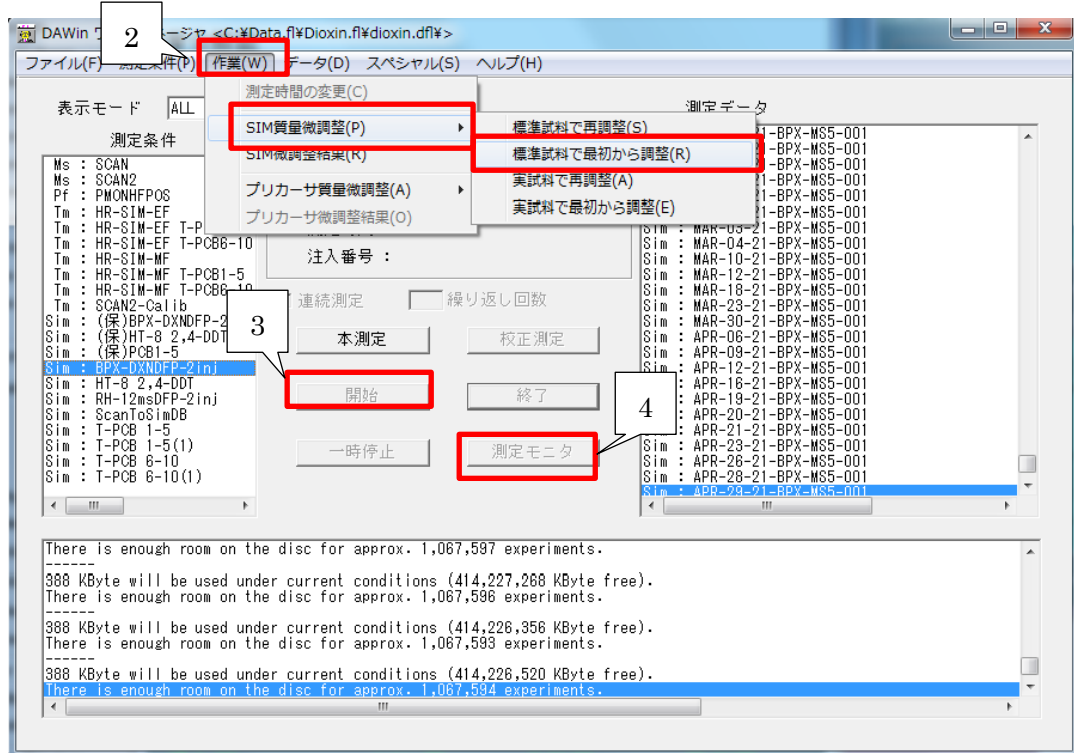
2-6. Peak adjustment

In SIM measurement, perform peak adjustment within the mass range used for the measurement to calibrate the difference between the measured and theoretical mass numbers of the individual PFK peaks.

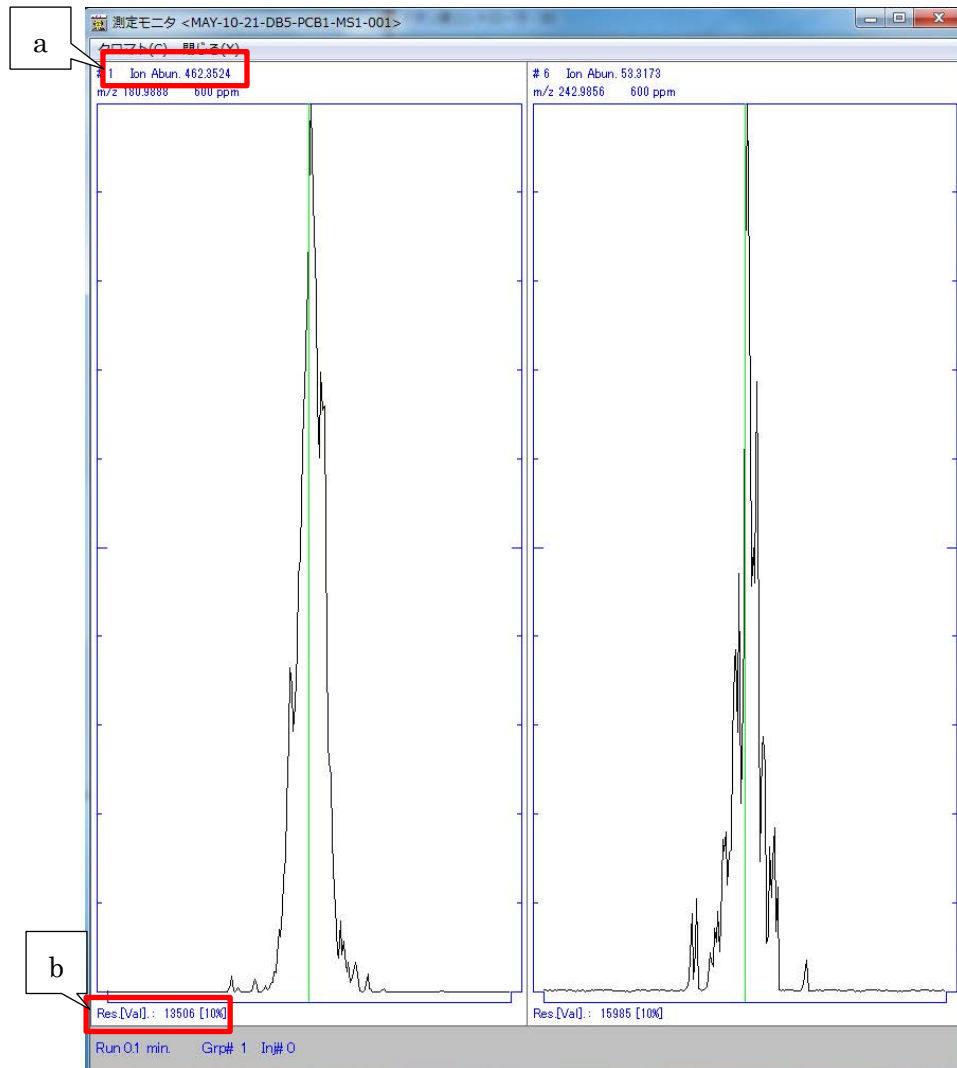
- 1) Open Ion Monitor and adjust the PFK valve so that the PFK ion intensity on Ion Monitor becomes about 50%.



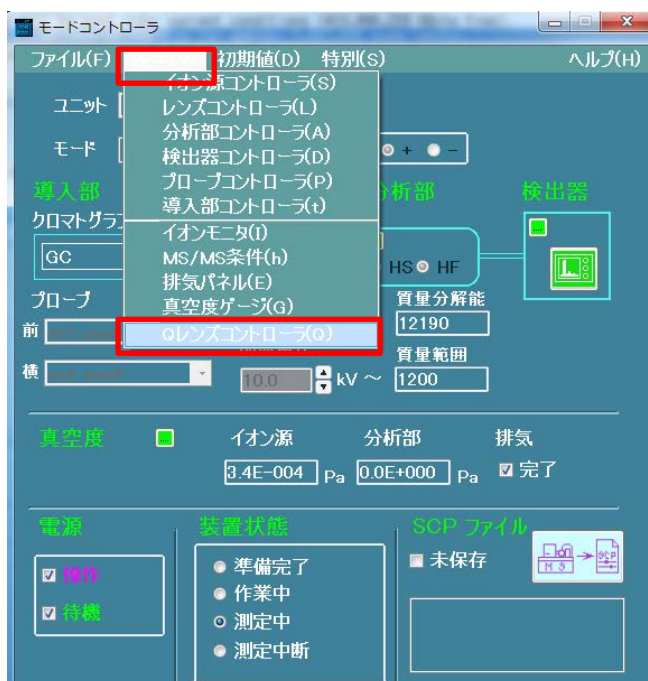
- 2) Start DAWin Work Manager ⇒ click Work (W) ⇒ SIM Mass Fine Adjustment (P) ⇒ Adjust From Start With Standard Sample (R)



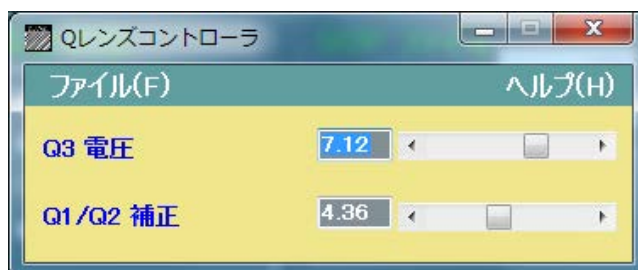
- 3) Click Start
- 4) Click Measurement Monitor
- 5) Peak Adjustment starts and Measurement Monitor is displayed, so check a) and b) and perform fine adjustments as needed.
 - a) Make sure that Ion Abun has not gone off the scale (upper limit 1600). If Ion Abun has gone off the scale, throttle the PFK valve.
 - b) Check the dynamic resolution. If it is lower than 10000, open Lens Controller and perform the following adjustments.
 - Fine-tune 1, 2 on Lens Controller
 - Fine-tune Q1/Q2 correction on Q Lens Controller



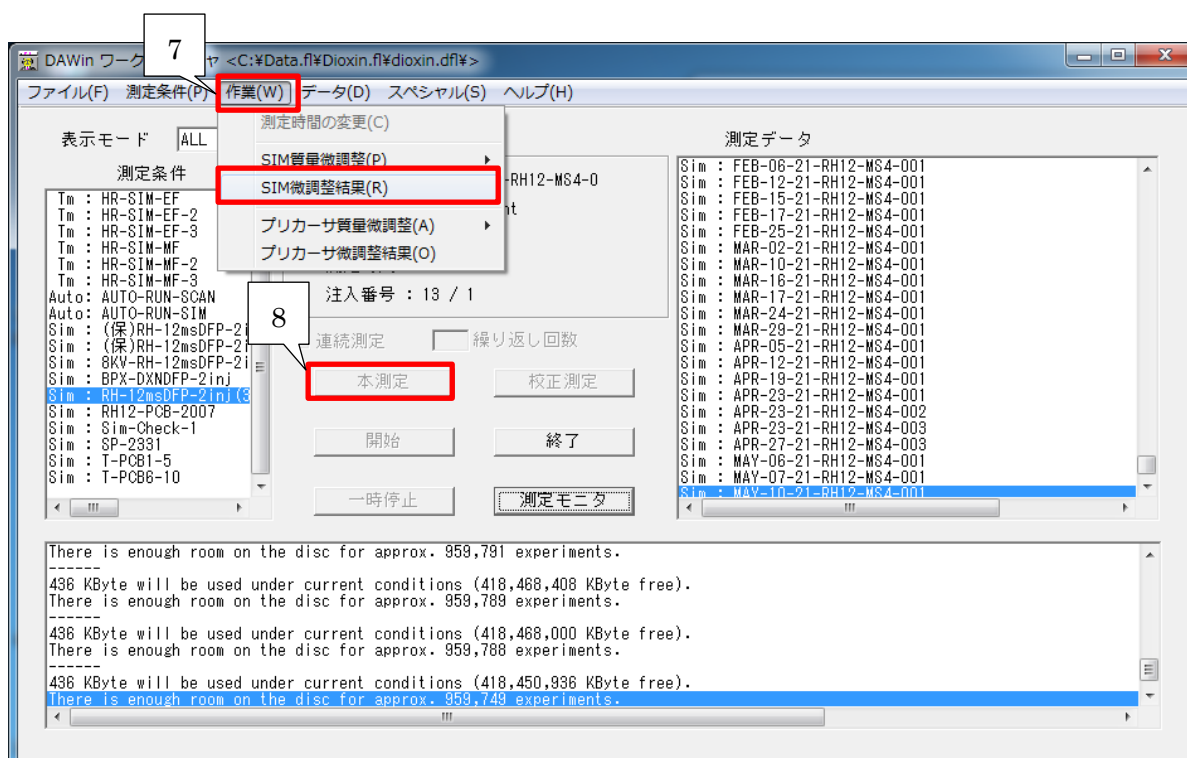
*To open Q Lens Controller, open Mode Controller and select Display (V) ⇒ Q Lens Controller (Q).



Q Lens Controller

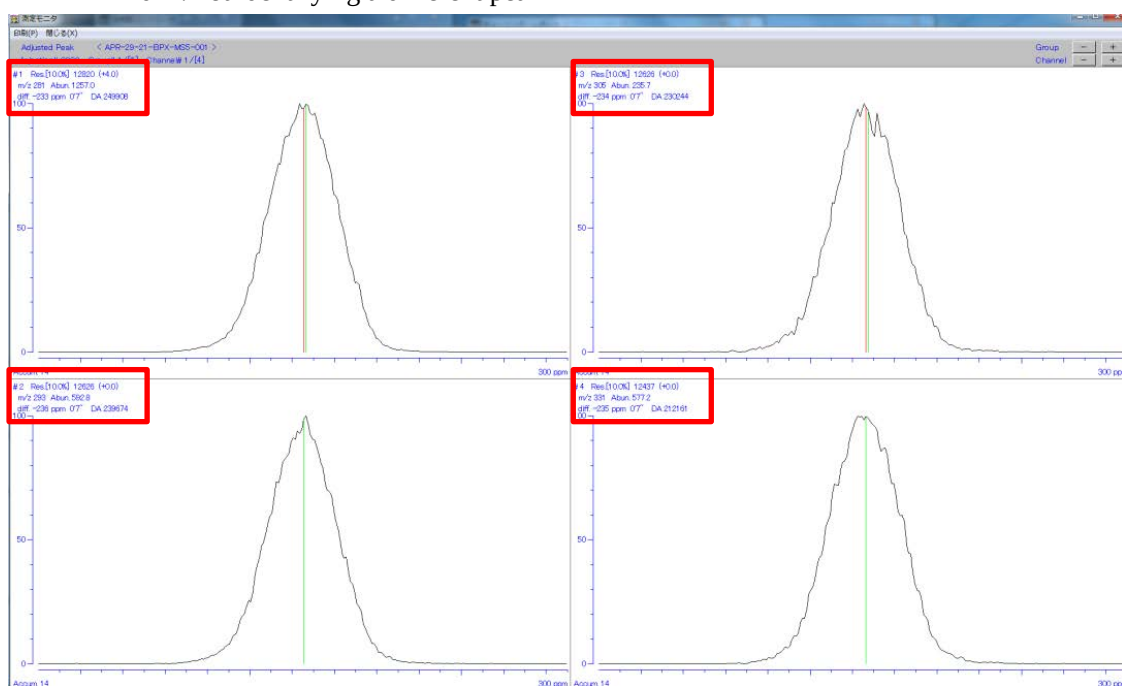


- 6) When peak adjustment is completed, check the result. On DAWin Work Manager, ⇒ click Work (W) ⇒ SIM Mass Fine Adjustment Results (R) to display the results.



7) Check the following statuses for all group channels. If not satisfied, perform adjustment again.

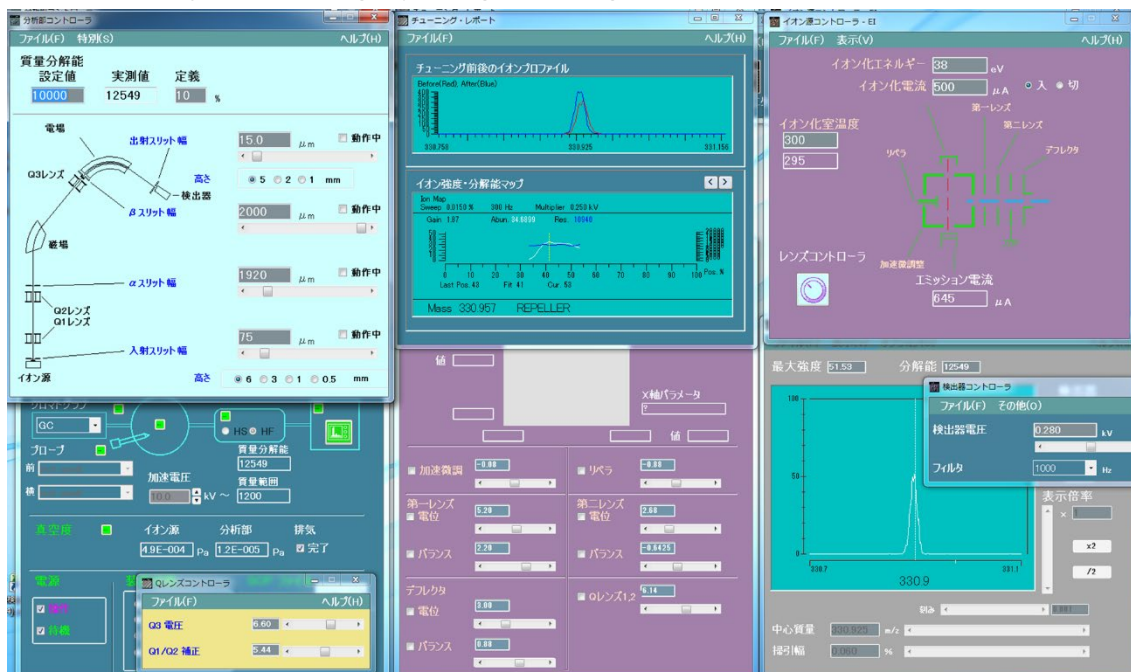
- Res[10.0%] : 10000 or higher
- Abun: within scale
- diff: not identifying a different peak



8) Click Final Measurement to complete preparation for measurement

2-7. Record of adjustment

Record the adjustment settings by taking and saving screen shots as below.



2-8. Preparation of injection list

When preparation for GC/HRMS measurement is completed, prepare an injection list. An injection list serves as an important management record for ensuring traceability of samples, checking carry-over of samples from the last measurement and preventing misplacement of samples when setting vials to the autosampler.

General rules for preparing injection lists are provided below.

- Choose lots with close delivery dates.
- Measure samples in the order of their expected concentrations from the lowest.
Categorize the samples by matrix and determine the order, for example, environmental water→ ambient air→ work environment→ soil→ sediment→ bottom ash→fly ash→ stack gas. However, the order should be changed depending on prior information on samples, condition of samples during pre-treatment and condition of sample for GC injection.
- Measure decane (solvent) when the concentration level is expected to change, e.g., when matrix is changed.
- At the end of the measurement lot, measure a standard solution whose concentration is in the middle range to check fluctuation of relative response.

- Measure decane (solvent) before and after the standard solution.

An example of an injection list is provided below.

インジェクションリスト

別紙5-1

測定日: 21年 09月 16日

ファイル名:

Sep-16-21-BPX-MS5-001

使用測定ファイル: ☒ BPX-2ini ☐ RH12-2ini ☐ SP-2331 ☐ RH12ms-HpO ☐ RH12ms-PCB ☐ RH12ms-DXN

使用機器: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☒ 5

担当者

GC-MS:

NO.	Sample name		備考	妨害成分の有無	DiaK 読込	ピーク 解析者名	ピーク解析 (完了日)
1	ST0816-1	感度変動	-0	無	☒		9/16
2	d		-0	有・無	☐		
3	NK049093-09K-1	水質・排水・露出	-0	無	☐		
4	NK049101-01K-2	排水・気・腐食物	-0	無	☐		
5	d		-0	有・無	☐		
6	NK052423-03K-5	水質・排水・露出	-0	2ul	無	☐	
7	NK052423-03K-6	水質・排水・露出	-0	2ul	無	☐	
8	NK052423-03K-1	水質・排水・露出	-0	2ul	無	☐	
9	NK052423-03K-2	水質・排水・露出	-0	2ul	無	☐	
10	NK052423-03K-3	水質・排水・露出	-0	2ul	無	☐	
11	NK049576-03K-1	大気・作環	-0	無	☐		
12	NK049839-02K-1	大気・作環	-0	無	☐		
13	NK049839-02K-2	大気・作環	-0	無	☐		
14	NK052932-01K-1	大気・作環	-0	無	☐		
15	NK052932-01K-2	大気・作環	-0	無	☐		
16	NK051405-01K-1	排水・気・腐食物	-0	無	☐		
17	NK053928-01K-1	排水・気・腐食物	-0	無	☐		
18	NK053928-01K-4	排水・気・腐食物	-0	無	☐		
19	d		-0	有・無	☐		
20	ST0100-2	感度変動	-0	有・無	☐		

2.9. Measurement

The procedures of measurement are provided below.

- 1) Place vials on the autosampler one-by-one while checking the printed injection list.
- 2) Check the remaining volume of microsyringe cleaning solvent. If there is not enough, add to it or replace it.
- 3) Set the GC method and start measurement.
Make sure the setting is correct, as the injection volume differs depending on the medium.
- 4) After the measurement is completed, recover the vials from the autosampler while checking the injection list. Also check if there are any holes in the septa of the vials to confirm that injection has been properly performed.

- 5) Replace the vial cap with a new one and store the samples temporarily.
- 6) After loading data in the next step (dataprocessing) and confirming that the measurement results have no problems, organize and move the samples to the long-term storage area.

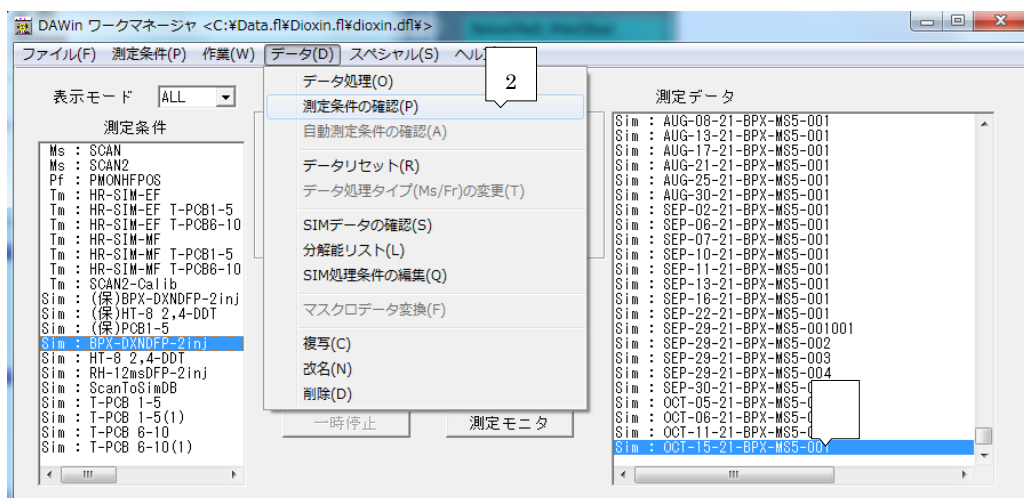
3. Data processing using Diok

3-1. Loading measurement data into Diok

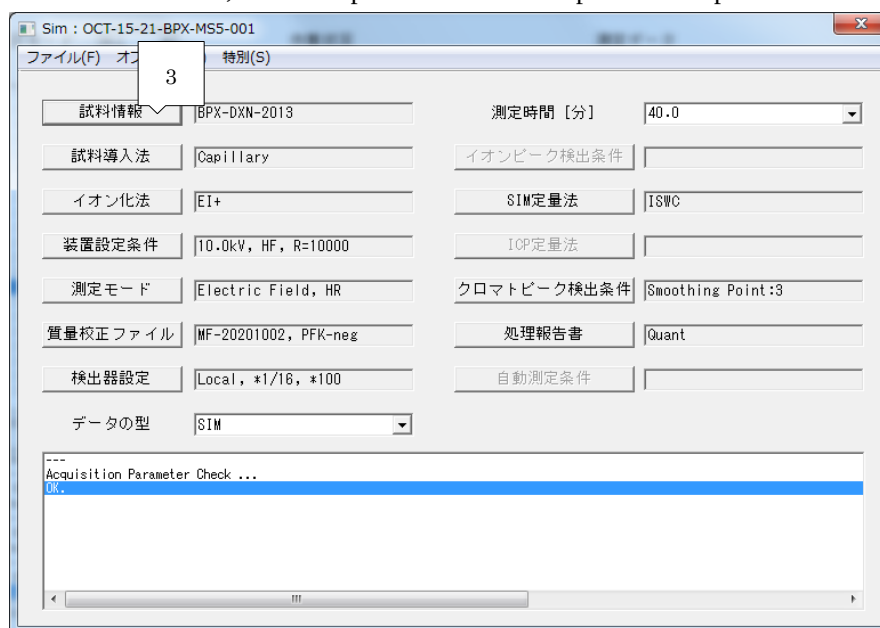
As a means for detecting any mistakes at loading of measurement data, check whether the sample information entered from DAWin Work Manager, the main program on the GC/HRMS, matches with that loaded on Diok.

3-1-1. Entry of sample information into GC/HRMS side

- 1) On DAWin Work Manager, click and select the measurement data to be loaded.
- 2) Click Data tab→Check Measurement Parameters (P) to open the Sim window.



- 3) On the Sim window, click Sample Information to open the Sample Information window.



- 4) On the Sample Information window, click Edit to open the Sample Information Edit window
- 5) Put a check mark in “Current Position” of Insert Position
- 6) Check the injection list and click and select the data to be entered
- 7) Enter sample information into Sample Name
- 8) Click Change
- 9) Repeat steps 6) to 8)
- 10) After entering all data, click OK on the Sample Information window

試料情報

試料名 BPX-DXN-2013

注釈 R=10000

測定メモ

Operator name

Date

Instrument MS8000

Comment

試料情報

Sample No.	Date	Time	Sample	Sample ID
29	16-Oct-2021	16:18:32	Sample	50489-06K-2
30	16-Oct-2021	17:01:46	Sample	50489-06K-3
31	16-Oct-2021	17:44:51	Sample	50789-06K-5
32				50789-06K-6
33				55104-02K-1

編集

OK キャンセル

試料情報編集

測定日時

試料の種類

濃度/希釈倍率

試料名 50789-06K-6

注釈

試料係数

挿入位置

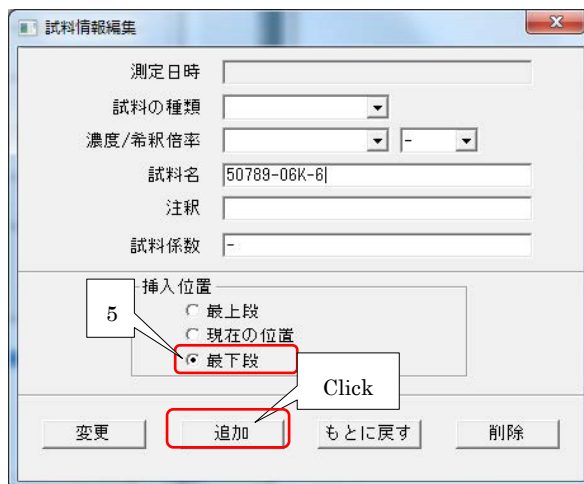
☐ 最上段

☒ 現在の位置

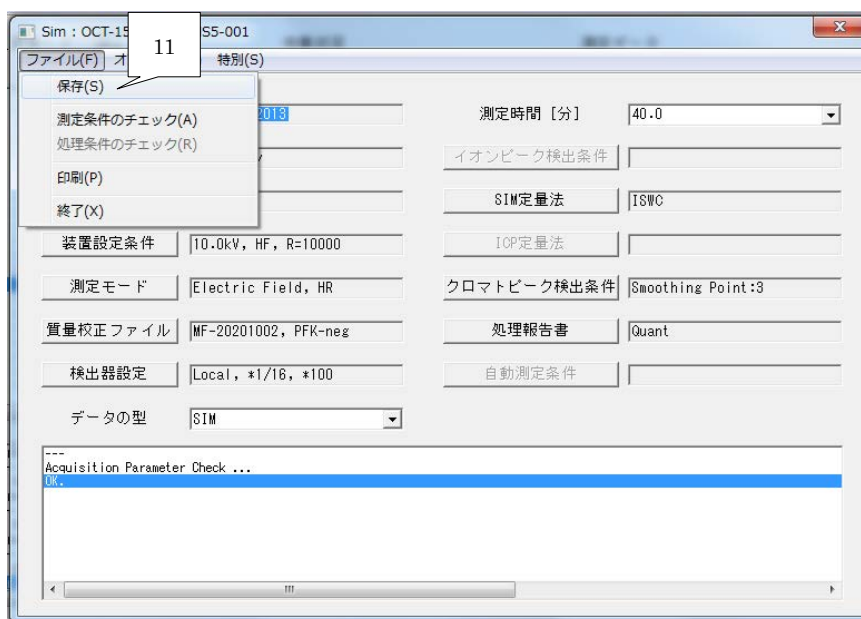
☐ 最下段

変更 追加 もとに戻す 削除

*The above editing steps are applicable to samples for which measurement has already been performed. When you wish to enter sample information before performing the measurement, put a check mark in “Bottom” of Insert Position and then click “Add” in step 5).



11) Finally, on the Sim window in step 3), click File (F)→Save (S) to save the data.



3-1-2. Loading of measurement data into Diok

After measurement is completed, load the measurement data by DqAuto menu into Diok.

If more than one person works on Diok, it is recommended that you establish rules on folder usage so that the data will not be mixed up or lost. For reference, the rules adopted in our company are provided below.

Examples of Diok folder usage rules

- Data for samples of different matrix are loaded into different folders.

Folders are separated by matrix, as more than one person cannot open the same folder at the same time. In addition, data processing work of samples of different matrix are assigned to different persons. In this way, analysis, the most time-consuming work, can be performed concurrently by persons assigned to individual types of matrix.

Separating folders by matrix type also makes it easier for each person in charge to notice the abnormal peak patterns in chromatograms or errors in the addition of cleanup standard during analysis work.

- Measurement results of standard solution for checking fluctuation of relative response are loaded into all folders.

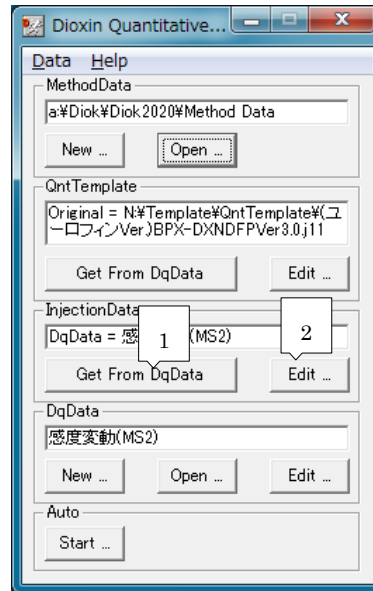
JIS stipulates that standard solutions for calibration curve preparation with intermediate concentrations should be measured regularly to check fluctuation of relative response. At Eurofins, it is performed daily, but sometimes, measurements of more than one matrix type are performed on the same day. Therefore, when folders are separated by matrix type, the same measurement results of the standard solution for checking fluctuation of relative response will be redundantly loaded into more than one folder. This enables all persons assigned to different matrix types to simultaneously check fluctuation of relative response and recovery rate of GC/HRMS.

- Folders are switched to new folders every six months to one year.

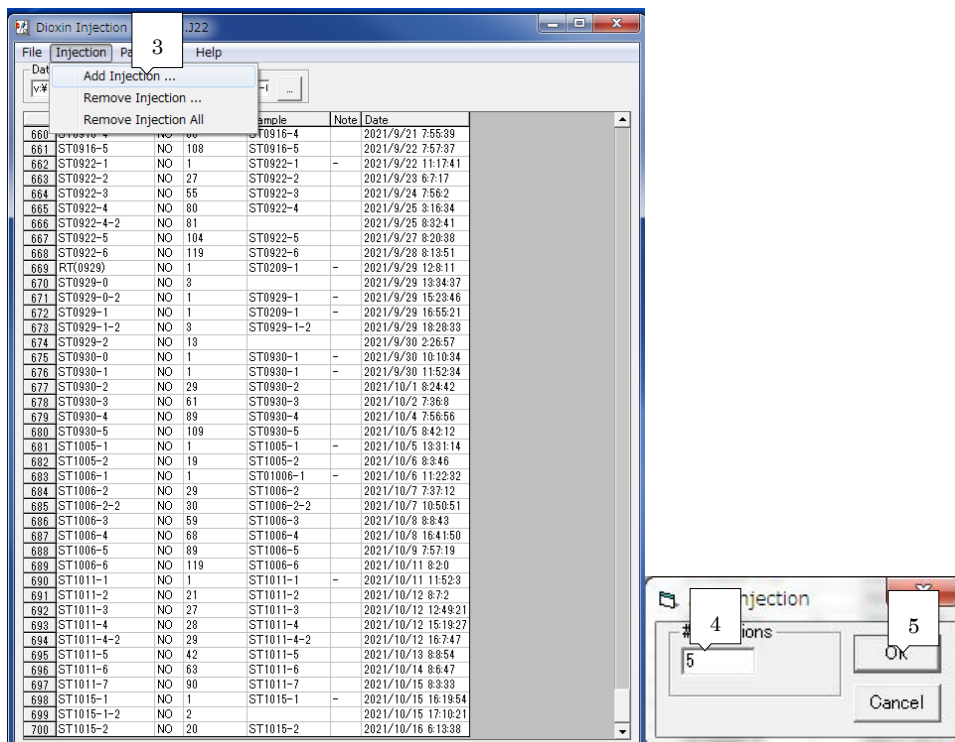
The operating speed of Diok becomes slower as the number of injection increases, so it is efficient to prepare new folders regularly.

The actual operation procedures are provided below.

- 1) On the Dioxin Quantitative Auto window, click Get From DqData in InjectionData to update information.
- 2) Click Edit in InjectionData to open the Dioxin Injection Data window.



- 3) Click Add Injection on the Injection tab to open the Add Injection window.
- 4) Edit the number of samples to be loaded. (* Five samples in this example)
- 5) Click OK to add Injection.



- 6) To the added injection, copy and paste the data on the injection list sorted by matrix.
- 7) Click Concentration on the Parameter tab to open the Concentration window.

The screenshot displays the 'Dioxin Injection Data - Id.J22' window. The 'Injection' tab is active, showing a list of injections with columns for 'Injection', 'STD', and 'InjectionNo'. The 'Parameter' tab is also visible, showing a list of parameters with columns for 'Parameter', 'Check', and 'Date'. A red arrow points from the 'Injection' tab to the 'Parameter' tab, indicating the next step in the process.

The 'Injection' list includes the following data:

Injection	STD	InjectionNo
665 ST0922-4	NO 80	
666 ST0922-4-2	NO 81	
667 ST0922-5	NO 104	
668 ST0922-6	NO 119	
669 RT(0929)	NO 1	
670 ST0929-0	NO 3	
671 ST0929-0-2	NO 1	
672 ST0929-1	NO 1	
673 ST0929-1-2	NO 3	
674 ST0929-2	NO 13	
675 ST0930-0	NO 1	
676 ST0930-1	NO 1	
677 ST0930-2	NO 29	
678 ST0930-3	NO 61	
679 ST0930-4	NO 89	
680 ST0930-5	NO 109	
681 ST1005-1	NO 1	
682 ST1005-2	NO 19	
683 ST1006-1	NO 1	
684 ST1006-2	NO 29	
685 ST1006-2-2	NO 30	
686 ST1006-3	NO 59	
687 ST1006-4	NO 68	
688 ST1006-5	NO 89	
689 ST1006-6	NO 119	
690 ST1011-1	NO 1	
691 ST1011-2	NO 21	
692 ST1011-3	NO 27	
693 ST1011-4	NO 28	
694 ST1011-4-2	NO 29	
695 ST1011-5	NO 42	
696 ST1011-6	NO 63	
697 ST1011-7	NO 90	
698 ST1015-1	NO 1	
699 ST1015-1-2	NO 2	
700 ST1015-2	NO 20	
701	NO	
702	NO	
703	NO	
704	NO	
705	NO	

The 'Parameter' list includes the following data:

Parameter	Check	Date
665 ST0922-4	NO 81	2021/9/25 3:16:34
666 ST0922-4-2	NO 104	2021/9/25 8:32:41
667 ST0922-5	NO 119	2021/9/27 8:20:38
668 ST0922-6	NO 1	2021/9/28 8:13:51
669 RT(0929)	NO 3	2021/9/29 12:8:11
670 ST0929-0	NO 1	2021/9/29 13:34:37
671 ST0929-0-2	NO 1	2021/9/29 15:23:46
672 ST0929-1	NO 1	2021/9/29 16:55:21
673 ST0929-1-2	NO 3	2021/9/29 18:28:33
674 ST0929-2	NO 13	2021/9/30 2:26:57
675 ST0930-0	NO 1	2021/9/30 10:10:34
676 ST0930-1	NO 1	2021/9/30 11:52:34
677 ST0930-2	NO 29	2021/10/1 8:24:42
678 ST0930-3	NO 61	2021/10/2 7:36:8
679 ST0930-4	NO 89	2021/10/4 7:56:56
680 ST0930-5	NO 109	2021/10/5 8:42:12
681 ST1005-1	NO 1	2021/10/5 13:31:14
682 ST1005-2	NO 19	2021/10/6 8:3:46
683 ST1006-1	NO 1	2021/10/6 11:22:32
684 ST1006-2	NO 29	2021/10/7 7:37:12
685 ST1006-2-2	NO 30	2021/10/7 10:50:51
686 ST1006-3	NO 59	2021/10/8 8:8:43
687 ST1006-4	NO 68	2021/10/8 16:41:50
688 ST1006-5	NO 89	2021/10/9 7:57:19
689 ST1006-6	NO 119	2021/10/11 8:2:0
690 ST1011-1	NO 1	2021/10/11 11:52:3
691 ST1011-2	NO 21	2021/10/12 8:7:2
692 ST1011-3	NO 27	2021/10/12 12:49:21
693 ST1011-4	NO 28	2021/10/12 15:19:27
694 ST1011-4-2	NO 29	2021/10/12 16:7:47
695 ST1011-5	NO 42	2021/10/13 8:8:54
696 ST1011-6	NO 63	2021/10/14 8:6:47
697 ST1011-7	NO 90	2021/10/15 8:3:33
698 ST1015-1	NO 1	2021/10/15 16:19:54
699 ST1015-1-2	NO 2	2021/10/15 17:10:21
700 ST1015-2	NO 20	2021/10/16 6:13:38
701 NK050789-06K-2	NO 029	
702 NK050789-06K-3	NO 030	
703 NK050789-06K-5	NO 031	
704 NK050789-06K-6	NO 032	
705 NK055104-02K-1	NO 033	

The 'Concentration' window is open, showing a table with columns for 'Sample name', 'Concentration', and 'Date'. The 'Concentration' column is highlighted, and a red arrow points to it, indicating the next step in the process.

- 8) On the Concentration window, enter the concentration of the standard material used for the

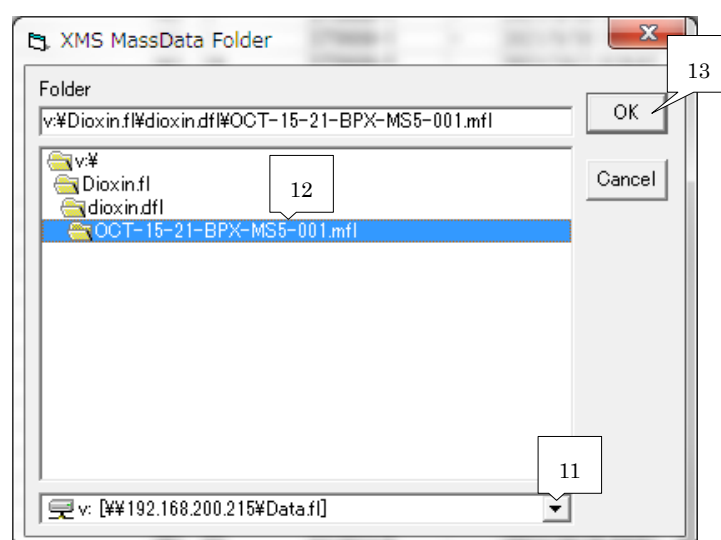
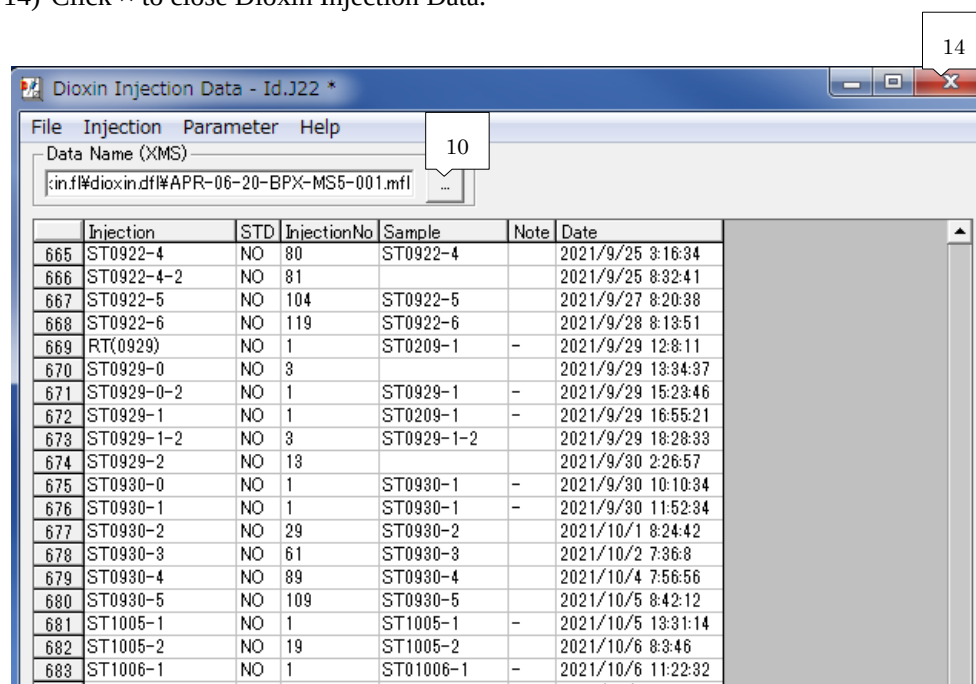
added injection.

9) Click OK.

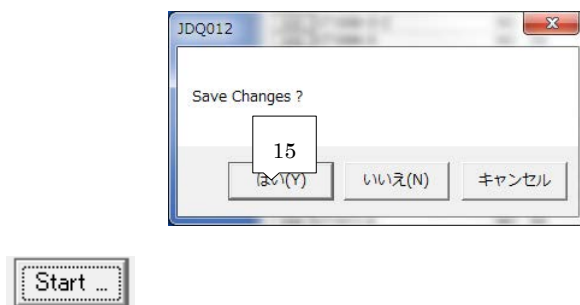
Function	TC0	PS0	HC0	HP0	TC1	PS1	HC1	HP1	TC2	PS2	HC2	HP2	TC3	PS3	HC3	HP3	TC4	PS4	HC4	HP4	TC5	PS5	HC5	HP5	TC6	PS6	HC6	HP6	TC7	PS7	HC7	HP7	TC8	PS8	HC8	HP8	TC9	PS9	HC9	HP9	TC10	PS10	HC10	HP10	TC11	PS11	HC11	HP11	TC12	PS12	HC12	HP12	TC13	PS13	HC13	HP13	TC14	PS14	HC14	HP14	TC15	PS15	HC15	HP15	TC16	PS16	HC16	HP16	TC17	PS17	HC17	HP17	TC18	PS18	HC18	HP18	TC19	PS19	HC19	HP19	TC20	PS20	HC20	HP20	TC21	PS21	HC21	HP21	TC22	PS22	HC22	HP22	TC23	PS23	HC23	HP23	TC24	PS24	HC24	HP24	TC25	PS25	HC25	HP25	TC26	PS26	HC26	HP26	TC27	PS27	HC27	HP27	TC28	PS28	HC28	HP28	TC29	PS29	HC29	HP29	TC30	PS30	HC30	HP30	TC31	PS31	HC31	HP31	TC32	PS32	HC32	HP32	TC33	PS33	HC33	HP33	TC34	PS34	HC34	HP34	TC35	PS35	HC35	HP35	TC36	PS36	HC36	HP36	TC37	PS37	HC37	HP37	TC38	PS38	HC38	HP38	TC39	PS39	HC39	HP39	TC40	PS40	HC40	HP40	TC41	PS41	HC41	HP41	TC42	PS42	HC42	HP42	TC43	PS43	HC43	HP43	TC44	PS44	HC44	HP44	TC45	PS45	HC45	HP45	TC46	PS46	HC46	HP46	TC47	PS47	HC47	HP47	TC48	PS48	HC48	HP48	TC49	PS49	HC49	HP49	TC50	PS50	HC50	HP50	TC51	PS51	HC51	HP51	TC52	PS52	HC52	HP52	TC53	PS53	HC53	HP53	TC54	PS54	HC54	HP54	TC55	PS55	HC55	HP55	TC56	PS56	HC56	HP56	TC57	PS57	HC57	HP57	TC58	PS58	HC58	HP58	TC59	PS59	HC59	HP59	TC60	PS60	HC60	HP60	TC61	PS61	HC61	HP61	TC62	PS62	HC62	HP62	TC63	PS63	HC63	HP63	TC64	PS64	HC64	HP64	TC65	PS65	HC65	HP65	TC66	PS66	HC66	HP66	TC67	PS67	HC67	HP67	TC68	PS68	HC68	HP68	TC69	PS69	HC69	HP69	TC70	PS70	HC70	HP70	TC71	PS71	HC71	HP71	TC72	PS72	HC72	HP72	TC73	PS73	HC73	HP73	TC74	PS74	HC74	HP74	TC75	PS75	HC75	HP75	TC76	PS76	HC76	HP76	TC77	PS77	HC77	HP77	TC78	PS78	HC78	HP78	TC79	PS79	HC79	HP79	TC80	PS80	HC80	HP80	TC81	PS81	HC81	HP81	TC82	PS82	HC82	HP82	TC83	PS83	HC83	HP83	TC84	PS84	HC84	HP84	TC85	PS85	HC85	HP85	TC86	PS86	HC86	HP86	TC87	PS87	HC87	HP87	TC88	PS88	HC88	HP88	TC89	PS89	HC89	HP89	TC90	PS90	HC90	HP90	TC91	PS91	HC91	HP91	TC92	PS92	HC92	HP92	TC93	PS93	HC93	HP93	TC94	PS94	HC94	HP94	TC95	PS95	HC95	HP95	TC96	PS96	HC96	HP96	TC97	PS97	HC97	HP97	TC98	PS98	HC98	HP98	TC99	PS99	HC99	HP99	TC100	PS100	HC100	HP100	TC101	PS101	HC101	HP101	TC102	PS102	HC102	HP102	TC103	PS103	HC103	HP103	TC104	PS104	HC104	HP104	TC105	PS105	HC105	HP105	TC106	PS106	HC106	HP106	TC107	PS107	HC107	HP107	TC108	PS108	HC108	HP108	TC109	PS109	HC109	HP109	TC110	PS110	HC110	HP110	TC111	PS111	HC111	HP111	TC112	PS112	HC112	HP112	TC113	PS113	HC113	HP113	TC114	PS114	HC114	HP114	TC115	PS115	HC115	HP115	TC116	PS116	HC116	HP116	TC117	PS117	HC117	HP117	TC118	PS118	HC118	HP118	TC119	PS119	HC119	HP119	TC120	PS120	HC120	HP120	TC121	PS121	HC121	HP121	TC122	PS122	HC122	HP122	TC123	PS123	HC123	HP123	TC124	PS124	HC124	HP124	TC125	PS125	HC125	HP125	TC126	PS126	HC126	HP126	TC127	PS127	HC127	HP127	TC128	PS128	HC128	HP128	TC129	PS129	HC129	HP129	TC130	PS130	HC130	HP130	TC131	PS131	HC131	HP131	TC132	PS132	HC132	HP132	TC133	PS133	HC133	HP133	TC134	PS134	HC134	HP134	TC135	PS135	HC135	HP135	TC136	PS136	HC136	HP136	TC137	PS137	HC137	HP137	TC138	PS138	HC138	HP138	TC139	PS139	HC139	HP139	TC140	PS140	HC140	HP140	TC141	PS141	HC141	HP141	TC142	PS142	HC142	HP142	TC143	PS143	HC143	HP143	TC144	PS144	HC144	HP144	TC145	PS145	HC145	HP145	TC146	PS146	HC146	HP146	TC147	PS147	HC147	HP147	TC148	PS148	HC148	HP148	TC149	PS149	HC149	HP149	TC150	PS150	HC150	HP150	TC151	PS151	HC151	HP151	TC152	PS152	HC152	HP152	TC153	PS153	HC153	HP153	TC154	PS154	HC154	HP154	TC155	PS155	HC155	HP155	TC156	PS156	HC156	HP156	TC157	PS157	HC157	HP157	TC158	PS158	HC158	HP158	TC159	PS159	HC159	HP159	TC160	PS160	HC160	HP160	TC161	PS161	HC161	HP161	TC162	PS162	HC162	HP162	TC163	PS163	HC163	HP163	TC164	PS164	HC164	HP164	TC165	PS165	HC165	HP165	TC166	PS166	HC166	HP166	TC167	PS167	HC167	HP167	TC168	PS168	HC168	HP168	TC169	PS169	HC169	HP169	TC170	PS170	HC170	HP170	TC171	PS171	HC171	HP171	TC172	PS172	HC172	HP172	TC173	PS173	HC173	HP173	TC174	PS174	HC174	HP174	TC175	PS175	HC175	HP175	TC176	PS176	HC176	HP176	TC177	PS177	HC177	HP177	TC178	PS178	HC178	HP178	TC179	PS179	HC179	HP179	TC180	PS180	HC180	HP180	TC181	PS181	HC181	HP181	TC182	PS182	HC182	HP182	TC183	PS183	HC183	HP183	TC184	PS184	HC184	HP184	TC185	PS185	HC185	HP185	TC186	PS186	HC186	HP186	TC187	PS187	HC187	HP187	TC188	PS188	HC188	HP188	TC189	PS189	HC189	HP189	TC190	PS190	HC190	HP190	TC191	PS191	HC191	HP191	TC192	PS192	HC192	HP192	TC193	PS193	HC193	HP193	TC194	PS194	HC194	HP194	TC195	PS195	HC195	HP195	TC196	PS196	HC196	HP196	TC197	PS197	HC197	HP197	TC198	PS198	HC198	HP198	TC199	PS199	HC199	HP199	TC200	PS200	HC200	HP200	TC201	PS201	HC201	HP201	TC202	PS202	HC202	HP202	TC203	PS203	HC203	HP203	TC204	PS204	HC204	HP204	TC205	PS205	HC205	HP205	TC206	PS206	HC206	HP206	TC207	PS207	HC207	HP207	TC208	PS208	HC208	HP208	TC209	PS209	HC209	HP209	TC210	PS210	HC210	HP210	TC211	PS211	HC211	HP211	TC212	PS212	HC212	HP212	TC213	PS213	HC213	HP213	TC214	PS214	HC214	HP214	TC215	PS215	HC215	HP215	TC216	PS216	HC216	HP216	TC217	PS217	HC217	HP217	TC218	PS218	HC218	HP218	TC219	PS219	HC219	HP219	TC220	PS220	HC220	HP220	TC221	PS221	HC221	HP221	TC222	PS222	HC222	HP222	TC223	PS223	HC223	HP223	TC224	PS224	HC224	HP224	TC225	PS225	HC225	HP225	TC226	P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- 11) Select the device containing the measurement data to be loaded.
- 12) Select the measurement data to be loaded from the folder.
- 13) Click OK.
- 14) Click × to close Dioxin Injection Data.



15) The window shown below pops up, so click Yes to save the settings.



17) Put a check mark in Partial.



19) Select the injection for which loading is to be started.

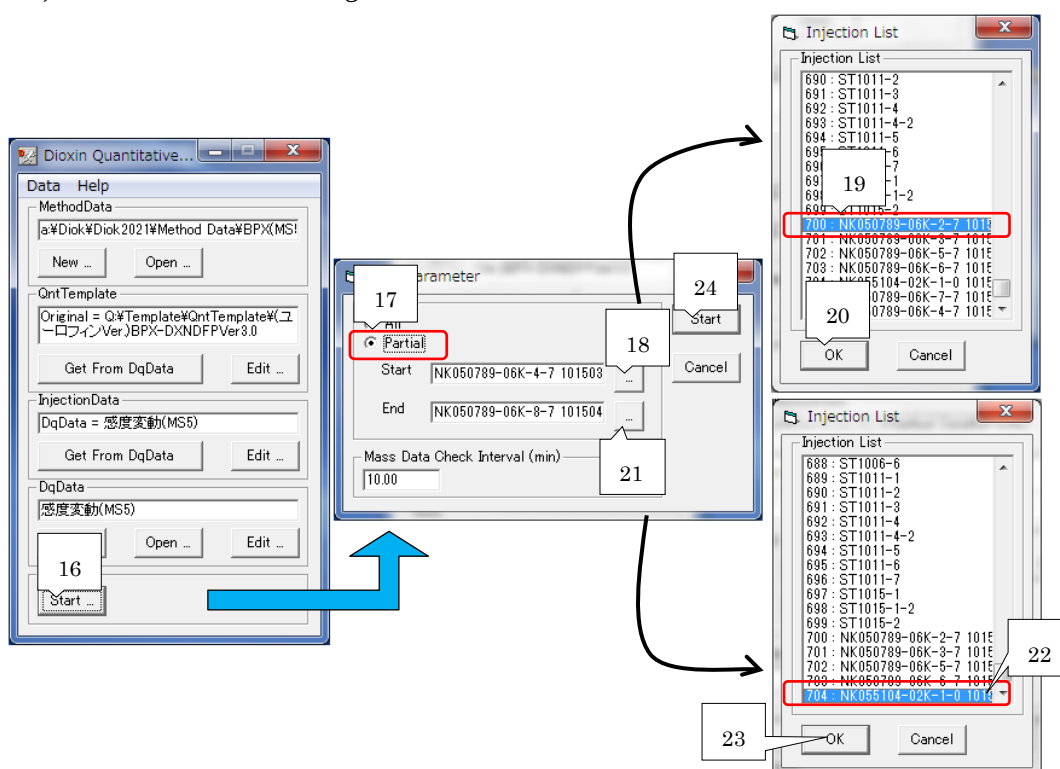
20) Click OK.



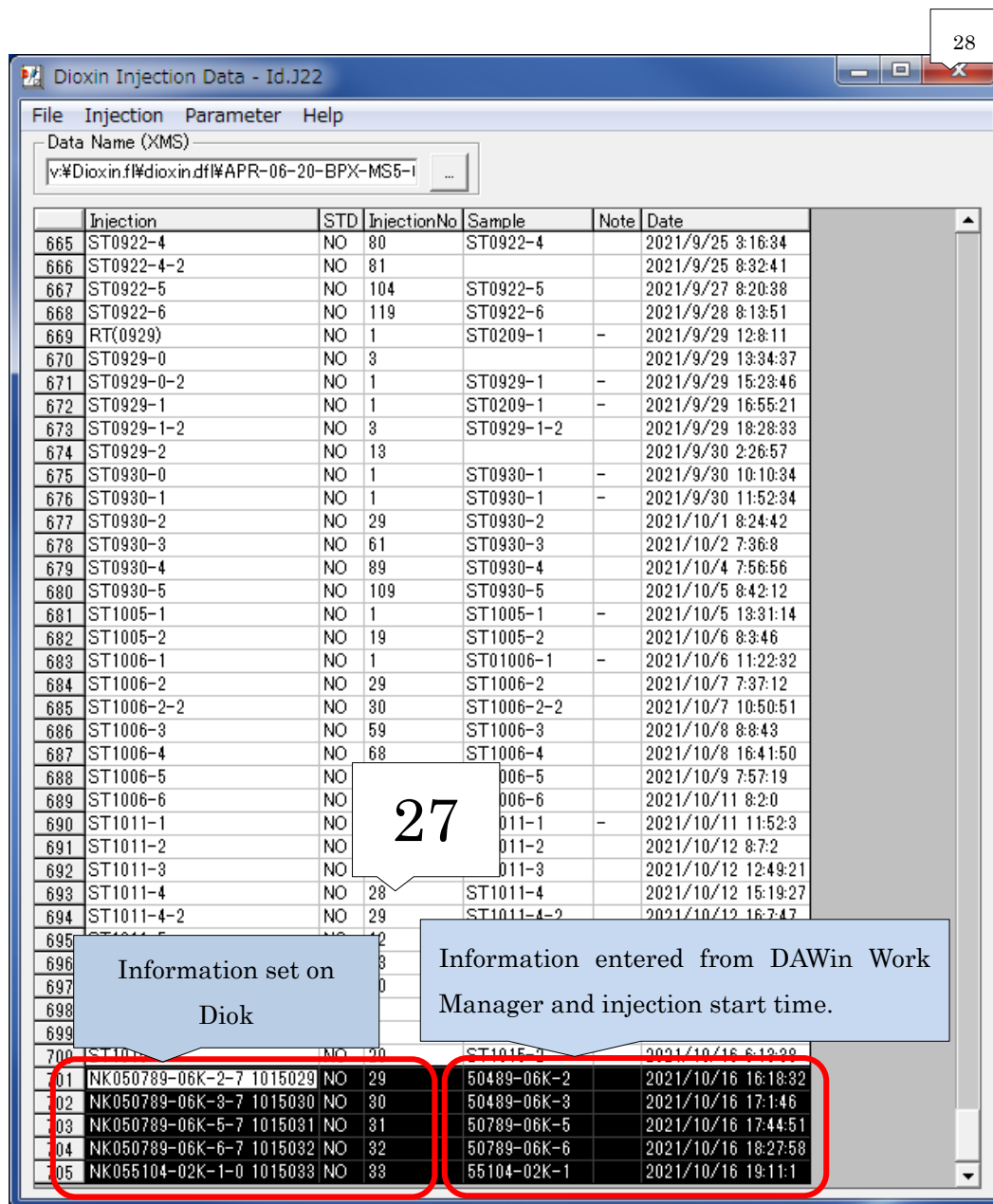
22) Select the injection for which loading is to be ended.

23) Click OK.

24) Click Start to start loading.



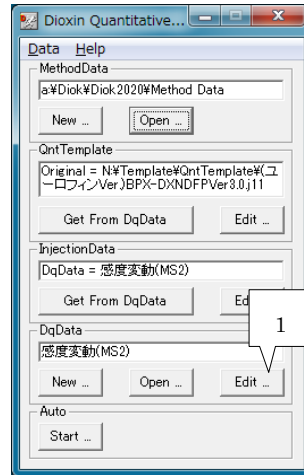
- 25) When loading is completed and a pop-up window appears, click OK.
- 26) Repeat the operations in steps 1) and 2) to open the updated Dioxin Injection Data.
- 27) On the Dioxin Injection Data window, check whether the information set on Diok matches with the information entered from GC/HRMS side (i.e., data entered in 3-1-1).
- 28) If matching is confirmed, click × to close Dioxin Injection Data and end loading operation.



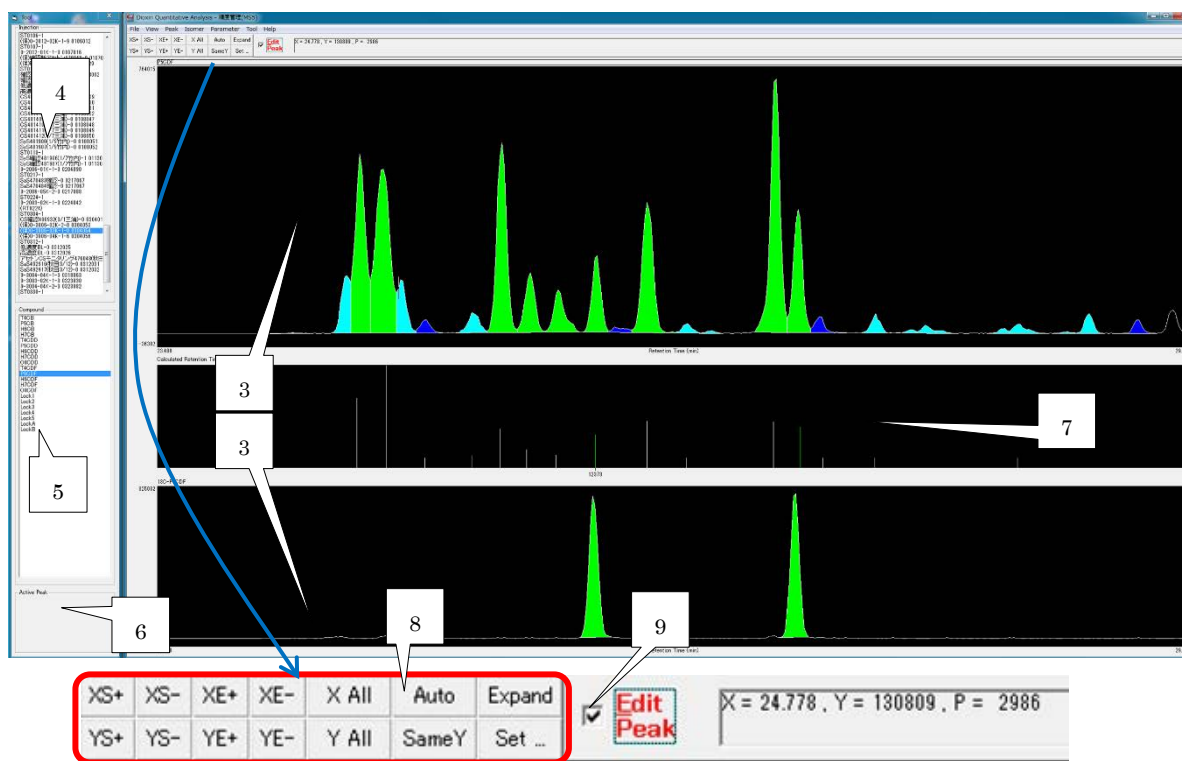
3-2 Confirmation of loaded data and peak integration

3-2-1 How to view and operate the Dioxin Quantitative Analysis window

- 1) Click Edit in DqData to open the Dioxin Quantitative Analysis window.



- 2) Methods for viewing and operating the Dioxin Quantitative Analysis window are provided below in steps 3) to 12).



- 3) The upper chromatogram is peaks averaged across individual channels for Native form. The lower chromatogram is peaks averaged across individual channels for ¹³C-labeled form.

The colors of the peaks represent the following status.

: assign OK, ion intensity ratio OK

: assign OK, ion intensity ratio NG

: assign NG, ion intensity ratio OK

: assign NG, ion intensity ratio NG

Assign: indicate the condition of information such as isomer name, retention time and area has been assigned to the peak.

- 4) Displays the loaded sample information. Displays chromatogram of the selected sample on the right.
- 5) Homologs of the measured substance. Displays chromatogram of the selected homolog on the right.
- 6) Displays Active Peak information for a peak selected on the right.
Information such as isomer name, RT, Area, Height and S/N are displayed here
- 7) Assignment bar. Displays retention time of each isomer
Assignment can be done by selecting the lower part of the assignment bar and dragging and

dropping onto the corresponding peak in the upper diagram.

*Note that the position of the assignment bar is not always correct by default.

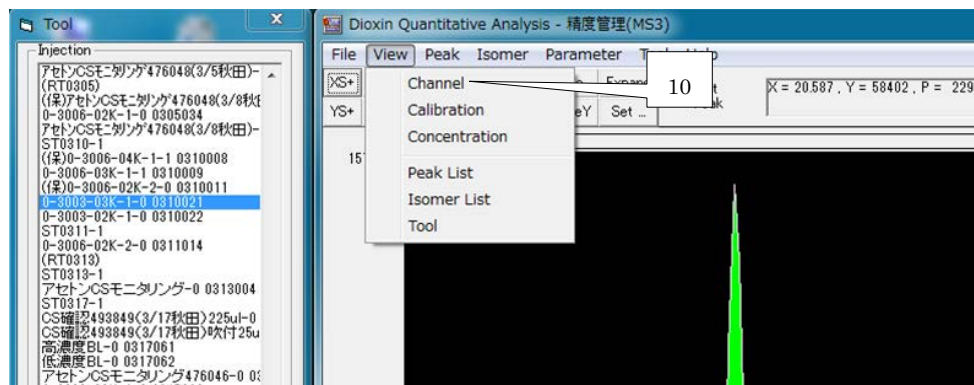
- 8) The display range of chromatograph can be changed.

Frequently used operations are introduced below.

- Click **Expand**, and drag and draw a square around the range you wish to enlarge
→enlarges the range enclosed by the square.
- Click **Auto** →displays the Display Range set
- Click **SameY** →Applies and displays the Y-axis range of the selected chromatogram to all chromatograms

- 9) The peak can be edited when the checkbox is ☒

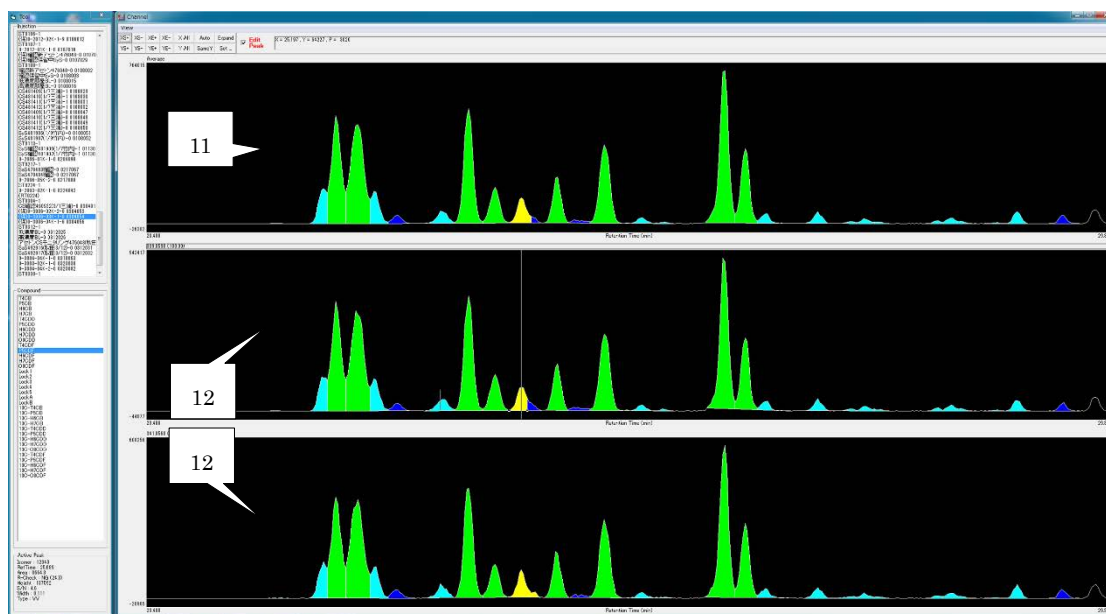
- 10) Click Channel on the View tab to switch to channel display mode.



11) The window below is the window displaying individual channels.

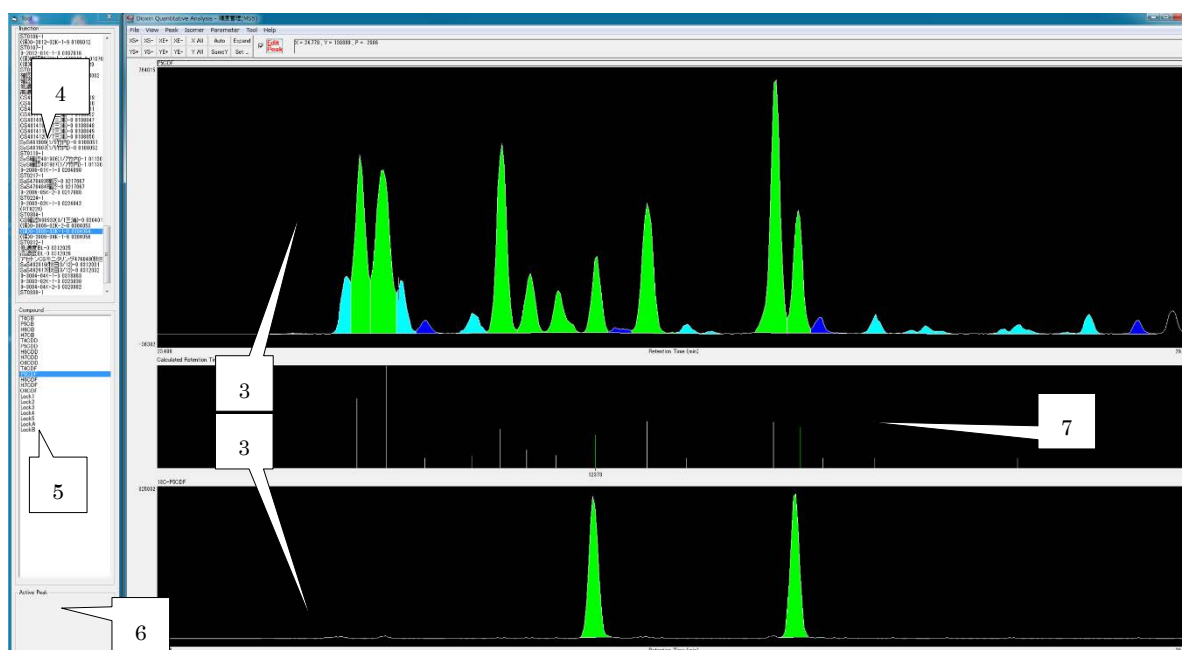
The upper chromatogram shows the peaks for Native form averaged across individual channels.

12) The middle and lower chromatogram show the peaks for Native form of individual channels.



3-2-2 Confirmation of loaded data (Identify samples that need to be re-measured & re-analyzed)

The window below is the same as the Dioxin Quantitative Analysis window shown in 3-2-1 step 2).

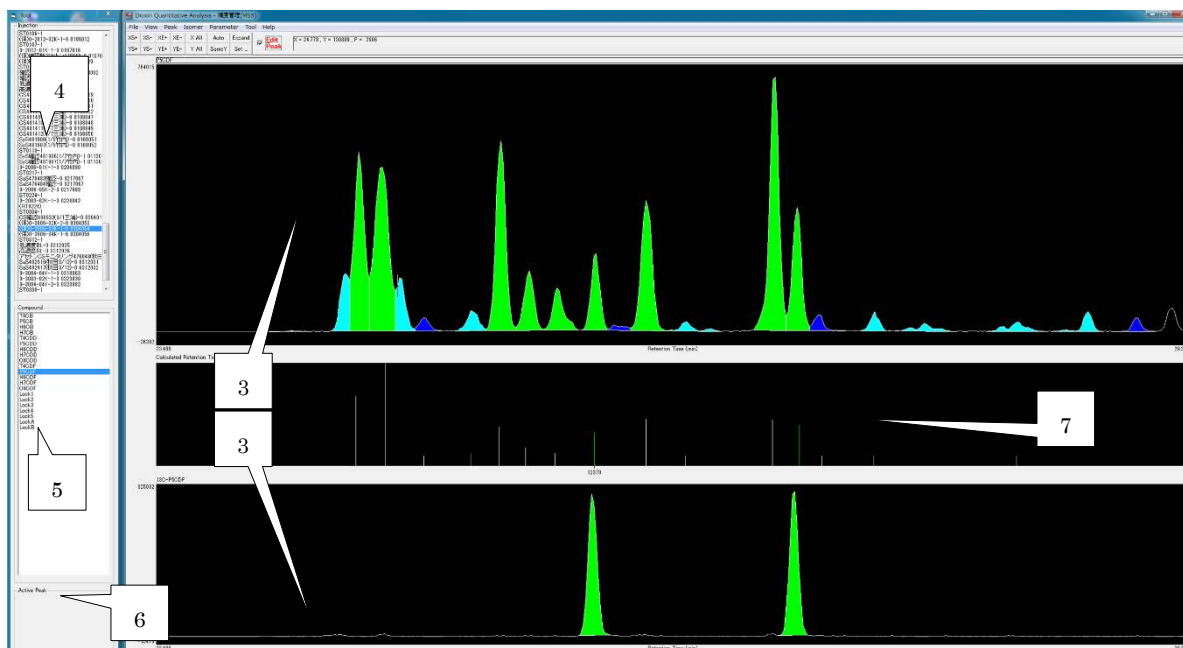


Switch the displays of 3-2-1 step 4) and 5) and check the peaks in the loaded chromatograms. If there are any samples that need to be re-measured, enter the details in the injection list and separate them from other samples before storing GC/HRMS vials. Similarly, if there are any samples that need to be re-analyzed, enter the details in the injection list and give instructions for re-analysis. Examples of status requiring re-measurement or re-analysis are provided below.

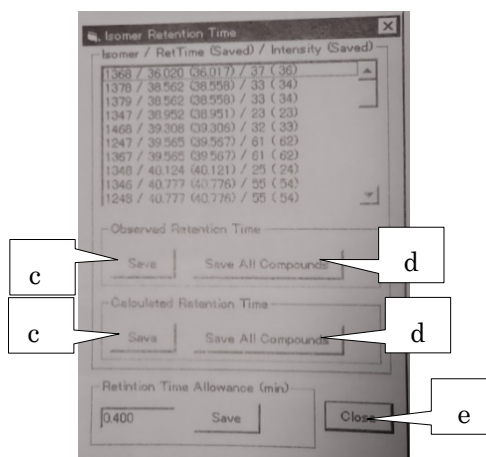
Status of measurement results	Operation to be performed
Peak tip splitting	Perform GC/HRMS measurement again
Low sensitivity (peak response)	Perform GC/HRMS measurement again
Ghost peaks (Interference from the previous measurement)	Perform GC/HRMS measurement again
Unstable baseline (Interference from the previous measurement)	Perform GC/HRMS measurement again
Measurement lot for which measurement results of standard solution for checking fluctuation of relative response described in 3-1-2 did not meet the criteria	Subject all samples in the lot to GC/HRMS measurement again (JIS requirement)
Peak saturation	Perform re-analysis (reduce sampling volume or dilute)
Interference overlapping analyte peak	Perform re-analysis (add purification treatment, etc.)
Severe interference from sample	Perform re-analysis (add purification treatment, etc.)
Recovery rate not meeting criteria	Perform re-analysis
Decline or large variation in lock mass	Perform re-analysis (add purification treatment, etc.)

3-2-3 Peak integration and assignment

The window below is the same as the Dioxin Quantitative Analysis window shown in 3-2-1 step 2).

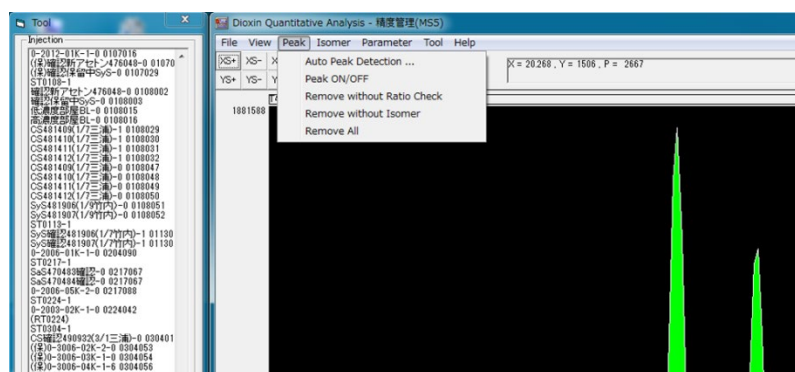


- 1) Assignment can be done by selecting the lower part of the assignment bar in 7) and dragging and dropping onto the peak.
- 2) If the position of the assignment bar is not correct, perform re-setting according to the following procedures.
 - a) Assign all isomers by using a sample from which all isomers have been detected (e.g., fly ash).

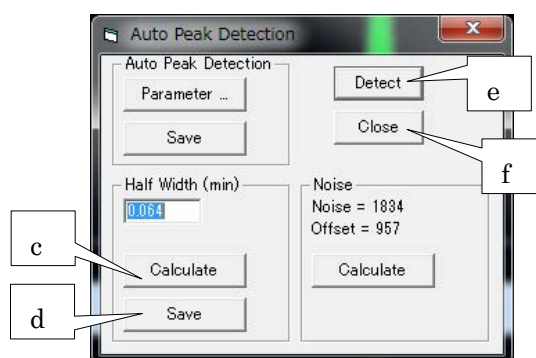


- b) Click Retention Time on the Isomer menu to open the Retention Time window.
 - c) For saving retention time of the selected homolog, click the two Save buttons.
 - d) For saving retention time of all isomers, click the two Save All Compounds buttons.
 - e) Press the Close button to close the window.
- 3) If display range deviates from the chromatogram that should be displayed, perform re-setting according to the following procedures.

- a) Click Data Range on the parameter menu to open the Quantitative parameter Data Range window.
- b) Select the homolog to be changed and edit Display Range.
- * Setting needs to be individually performed for native and ^{13}C -labeled forms. Make sure that Display Range of ^{13}C -label form is the same as that of Native form. Otherwise, it will be difficult to check.
- 4) Delete any unnecessary peaks or peaks with S/N ratio of 3 or smaller.
 - * For deleting a peak, select the peak and press the Delete key
 - * For re-setting noise, perform the following steps.
 - a) Ctrl+drag to select a range corresponding to about 10-fold of the half value width of the peak.
 - b) Click Auto Peak Detection in the Peak menu.



- c) Click Calculate to update the half value width.



- d) Click Save.
- e) Click Detect.
- f) Click Close to close the window.
- 5) Switch to the window displaying individual channels and perform analysis on individual peaks.

Yellow-colored peaks having intensity ratios not meeting the set value tend to be improperly

peak integration, so check their results and make corrections as needed. After the peak integration is completed, delete peaks with ion intensity ratios that do not meet the criteria, as they are not considered to be DXNs. (The deleted peaks cannot be adopted as measurement results of Dioxins. It is necessary to perform the GC/HRMS measurement again or start all over from sample extraction/clean-up.)

- 6) Repeat the above operations to integrate and assign all peaks.

End

10-4: WTEに関する日本の 経験・知見

EJEC REPORT

PPP for WTE project

~ The process of forming a MSW treatment project in Japan ~

株式会社
EJEC エイト日本技術開発

November 26, 2021
Kaitaro SHIMAMUNE
Solid Waste Management Dept.,
Tokyo Branch,
Eight-Japan Engineering Consultants Inc. (EJEC)

価値ある環境を未来に

2021/11/26

1

Handling of Waste Generated by Households

Category of Waste

In Japan, waste is mainly classified into “general waste (MSW)” generated by households and “industrial waste” generated by Industries, factories, etc.

Outline

General waste

Industrial waste

Waste

Other than industrial waste
e.g. waste generated by households

Generated as a result of business activities
e.g. resin waste that is not needed
in the manufacturing process

Handling responsibility

Local government

Business operator

Handling Responsibility of General Waste (MSW)

Local governments are responsible for collecting, transporting, treating, and disposing of general waste, either individually or in cooperation with other local governments.

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3

Flow from Facility Development to Operation

Overall Schedule

Incineration facilities are generally planned to be upgraded based on the service life of the existing facilities. The service life is generally 30–40 years.

Since it will take approx. 10 years to complete the facility construction, the overall schedule is planned backwards.

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Remarks		
Existing Facility	Operation	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	Renewed in 30-40 yrs (e.g. 35 yrs)	
New Facility	MSW Treatment Master Plan (MP)	26	27	28	29	30	31	32	33	34	35	10	1	Decision on renewal & site
	Facility Development Conceptual Plan													Decision on processing method
	Facility Basic Plan													Decision on business scheme
	PFI/PPP Feasibility Study													Reflected in facility basic plan
	Topographic Survey													Reflected in facility basic plan
	Geological Survey													1.5-4 yrs
New Facility	Environmental Impact Assessment													standard 2 yrs
	Selection of Winning Bidder													standard 3-4 yrs
	Construction Work													
Operation														Start

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4

Flow from Facility Development to Operation

MSW Treatment Master Plan (M/P)

It is a long-term plan for 10 to 15 years, and is defined by law as “the basic plan for municipalities responsible for the overall treatment of general waste (MSW) to manage and ensure the proper treatment of it in their area”, and is required to be revised approximately every five years.

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Remarks		
Existing Facility	Operation	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	Renewed in 30-40 yrs (e.g. 35 yrs)	
New Facility	MSW Treatment Master Plan (MP)	26	27	28	29	30	31	32	33	34	35	10	1	Decision on renewal & site
	Facility Development Conceptual Plan													Decision on processing method
	Facility Basic Plan													Decision on business scheme
	PFI/PPP Feasibility Study													Reflected in facility basic plan
	Topographic Survey													Reflected in facility basic plan
	Geological Survey													1.5-4 yrs
New Facility	Environmental Impact Assessment													standard 2 yrs
	Selection of Winning Bidder													standard 3-4 yrs
	Construction Work													
Operation														Start

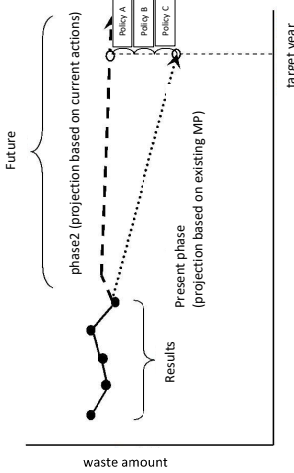
2021/11/26

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Main Contents of MSW Treatment Master Plan (M/P)

It clarifies the basic policy for general waste management in the region from a long-term perspective.

- ◆ **Current Status of Waste**
Summarize the current status and issues based on the population and the amount of waste generated (and collected).
Grasp the amount of waste processed and the amount of final disposal, which are the actual results of waste treatment.
- ◆ **Projection of Future Waste Amount**
Project the amount of waste to be generated in the future based on future projections of population and waste output.
Consider measures to promote recycling and reduce waste.
- ◆ **Basic Policy of Waste Management**
Set numerical targets for future waste volumes and measures how to achieve them.
Examine the direction of collection and transportation, Intermediate treatment (recycling, incineration, etc.), and final disposal of general waste.



Facility Development Conceptual Plan

Based on the MSW Treatment Master Plan (M/P), the principles for the development of facilities will be determined, e.g. applied technology, processing capacity and construction site.

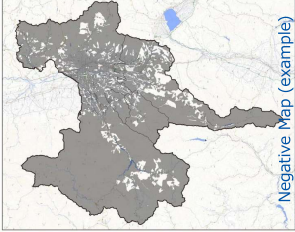
It should be noted that it may take many years to decide on a potential construction site due to local opposition.

Existing Facility	2021 (1)	2022 (2)	2023 (3)	2024 (4)	2025 (5)	2026 (6)	2027 (7)	2028 (8)	2029 (9)	2030 (10)	2031 (11)	Remarks
Operation	26	27	28	29	30	31	32	33	34	35		Renewed in 30-40 yrs (e.g. 35 yrs)
MSW Treatment Master Plan (MP)												Decision on renewal & site Decision on processing method Decision on business scheme
Facility Development Conceptual Plan												Reflected in facility basic plan Reflected in facility basic plan 1.5-4 yrs
Facility Basic Plan												standard 2 yrs
PFI/PPP Feasibility Study												standard 3-4 yrs
Topographic Survey												
Geological Survey												
Environmental Impact Assessment												
Selection of Winning Bidder												
Construction Work												
Operation												Start

Main Contents of Facility Development Conceptual Plan

It is a basic concept for the development of new facilities.

- ◆ **Decision on Facility Renewal**
Decide on the future treatment system and renewal of facilities (new construction) based on the basic waste management plan.
Determine the size of the facility (processing capacity) required for the service area (region).
- ◆ **Decision on Planned Construction Site**
Set the conditions for the planned construction site, and narrow down the candidate sites from the negative map (areas to be avoided due to laws and regulations).
Evaluate multiple candidate sites from various perspectives (environment, land use, economic efficiency) and decide on a site for construction.
- ◆ **Resident Briefings and Public Comments**
Hold resident briefings and public comments on the basic concept (draft) in order to build consensus among residents.



Facility Basic Plan

Determine the specific details of the facility to be upgraded, such as its processing capacity, incinerator type, plant equipment, and basic specifications for civil engineering and construction, as well as the estimated project cost.

In order to determine the conditions for PFI feasibility study and environmental impact assessment, coordination with these related tasks is necessary.

Existing Facility	2021 (1)	2022 (2)	2023 (3)	2024 (4)	2025 (5)	2026 (6)	2027 (7)	2028 (8)	2029 (9)	2030 (10)	2031 (11)	Remarks
Operation	26	27	28	29	30	31	32	33	34	35		Renewed in 30-40 yrs (e.g. 35 yrs)
MSW Treatment Master Plan (MP)												Decision on renewal & site Decision on processing method Decision on business scheme
Facility Development Conceptual Plan												Reflected in facility basic plan Reflected in facility basic plan 1.5-4 yrs
Facility Basic Plan												standard 2 yrs
PFI/PPP Feasibility Study												standard 3-4 yrs
Topographic Survey												
Geological Survey												
Environmental Impact Assessment												
Selection of Winning Bidder												
Construction Work												
Operation												Start

Main Contents of Facility Basic Plan

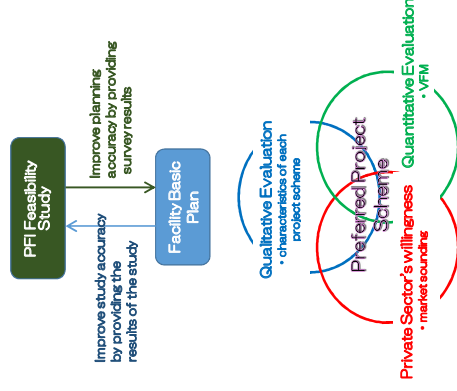
It is a basic plan that summarizes the development details and basic conditions of the facilities to be developed.

- ◆ **Decision on Treatment Method**
Select the type of furnace to be installed (stoker type or gasification and melting type).
- ◆ **Set Pollution Prevention Standards and Basic Specifications for Plants and Civil Engineering Buildings**
Set pollution prevention standards (facility performance) for exhaust gas, noise, vibration, odor, etc. in consideration of laws and regulations.
Examine the processing flow, the number and general specifications of major equipment, the grade of the building, and the need for disaster countermeasures, etc.
- ◆ **Calculation of Estimated Project Cost**
Calculate estimated project cost by surveying plant manufacturers.
- ◆ **Holding of the Construction Review Committee Including External Experts**
Hold committee meetings including external experts since the facility basic plan includes specialized content.

Main Contents of PFI/PPP Feasibility Study

Evaluate the possibility of introducing PFI schemes (BOO, BOT, BTO, DBO, etc.) and determine the project scheme. The survey will be conducted in conjunction with the basic facility plan.

- ◆ **Examination of Project Scheme**
Examine the scope of the project, project period, and risk sharing.
- ◆ **Evaluation of Project Scheme**
The project will be evaluated comprehensively through quantitative evaluation (economic evaluation) based on the private sector's willingness to participate and VFM, and qualitative evaluation (merits and demerits of each project scheme) based on the characteristics of the project scheme at the business entity selection and implementation stages.



PFI/PPP Feasibility Study

After considering the scope and duration of the project as preconditions, quantitative (Value for Money) and qualitative evaluations are conducted to determine the most appropriate project scheme from PFI, DBO, and public management.

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Remarks
Existing Facility												
Operation	26	27	28	29	30	31	32	33	34	35		Renewed in 30-40 yrs (e.g. 35 yrs)
MSW Treatment Master Plan (MP)												
Facility Development Conceptual Plan												Decision on renewal & site
Facility Basic Plan												Decision on processing method
PFI/PPP Feasibility Study												Decision on business scheme
Topographic Survey												Reflected in facility basic plan
Geological Survey												Reflected in facility basic plan
Environmental Impact Assessment												1.5-4 yrs
Selection of Winning Bidder												Standard 2 yrs
Construction Work						Construction						Standard 3-4 yrs
Operation											Start	

PFI/PPP Feasibility Study (1)

Major Project Schemes used in WTE in Japan

Item	Role			Owner of Facility		Outline
	Construction Design	Construction	Finance	Operation	After operation period	
PFI	Private	Private	Private	Private	Private	Schemes in which the private sector raises funds, and designs, constructs, and operates the facility. BOO : Ownership will not be transferred to the public even after the operation period. BOT : Ownership will be transferred to the public at the end of operation period.
	Private	Private	Private	Private	Public	BTO : Ownership will be transferred to the public after completion of the facility.
	Private	Private	Private	Private	Public	The public sector raises funds through bonds and grants, and comprehensively outsources the design, construction, operation of the facility to the private.
Others	Public	Public	Public	Public	Public	The public sector raises funds through bonds and grants, and comprehensively outsources the design, construction, maintenance of the facility to the private.
	Public	Public	Public	Public	Public	The public sector raises funds through bonds and grants, and comprehensively outsources the design, construction, maintenance of the facility to the private.
	Public	Public	Public	Public	Public	The public sector designs and constructs the facility, and the private is entrusted with the operation for multiple years.

Points of Emphasis in the Selection of WTE's Project Scheme in Japan

In the selection of the project scheme for incineration plants (WTE) in Japan, economic efficiency is taken into consideration, but not pursued excessively, only to the extent of confirming that VFM is achieved. Rather, the following points are emphasized in the selection of the project scheme.

- ◆ **Handling Responsibility of General Waste (MSW)**
As stated in Law, municipalities are responsible for the handling of general waste, and the project scheme should be such that municipalities can fulfill their responsibilities in any case.
- ◆ **Gaining Understanding from Residents**
In the development and operation of a waste treatment facility, it is important to have a relationship of trust with the local residents, so the project scheme should be in harmony with the local community and surrounding environment.
- ◆ **Long Term Use**
The project scheme must be able to use the facility safely and stably over the long term.
- ◆ **Efficiency**
Efficient project scheme should be used for the development and operation of waste treatment facilities.
- ◆ **High Reliability**
Highly reliable project scheme should be used for the construction and operation of waste treatment facilities.

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Flow from Facility Development to Operation

Topographic & Geological Survey

Conduct topographic survey and geological investigations of the proposed construction site to determine the conditions that will affect the construction cost. The results of these surveys are used as prerequisites for surveys of construction costs, etc. to plant manufacturers for the Basic Facility Plan.

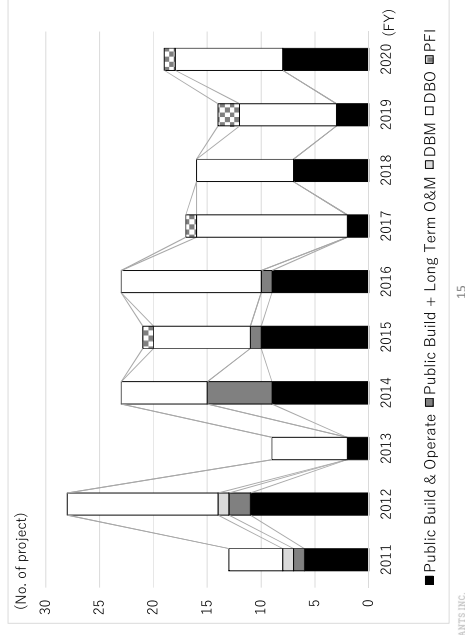
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Remarks
Existing Facility												
Operation												
MSW Treatment Master Plan (MP)												Renewed in 30-40 yrs (e.g. 35 yrs)
Facility Development Conceptual Plan												Decision on renewal & site
Facility Basic Plan												Decision on processing method
PFI/PPP Feasibility Study												Decision on business scheme
Topographic Survey												Reflected in facility basic plan
Geological Survey												Reflected in facility basic plan
Environmental Impact Assessment												1.5-4 yrs
Selection of Winning Bidder												standard 2 yrs
Construction Work												standard 3-4 yrs
Operation												Start

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Changes in Project Scheme of WTE over the past 10 years in JP



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Flow from Facility Development to Operation

Environmental Impact Assessment

Conduct environmental surveys (air quality, noise, vibration, odor, water quality) in the vicinity of the proposed construction site to predict and evaluate the impact of the facility on exhaust gas, noise, vibration, and odor. Since the procedures vary depending on the capacity of the facility, the survey period takes 1.5 to maximum 4 years in Japan.

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Remarks
Existing Facility												
Operation												
MSW Treatment Master Plan (MP)												Renewed in 30-40 yrs (e.g. 35 yrs)
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Geological Survey												Reflected in facility basic plan
Environmental Impact Assessment												1.5-4 yrs
Selection of Winning Bidder												standard 2 yrs
Construction Work												standard 3-4 yrs
Operation												Start

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Selection of Winning bidder

Select construction and/or operation companies for PFI and DBO etc. "Comprehensive Evaluation Method" is generally applied to select the business entity, which involves a comprehensive evaluation of technology and price.

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Remarks
Existing Facility		(1) 26	(2) 27	(3) 28	(4) 29	(5) 30	(6) 31	(7) 32	(8) 33	(9) 34	(10) 35	Renewed in 30-40 yrs (e.g. 35 yrs)
MSW Treatment Master Plan (MP)		2	3	4	5	6	7	8	9	10	11	Reviewed once every 5 yrs
Facility Development Conceptual Plan												Decision on renewal & site
Facility Basic Plan												Decision on processing method
PFI/PPP Feasibility Study												Decision on business scheme
Topographic Survey												Reflected in facility basic plan
Geological Survey												Reflected in facility basic plan
Environmental Impact Assessment												1.5-4 yrs
Selection of Winning Bidder												standard 2 yrs
Construction Work								Construction				standard 3-4 yrs
Operation											Start	

Main Contents of Selection of Winning Bidder

Bidding documents are prepared, evaluation criteria are set, and private business entity is selected through comprehensive evaluation method (Final selection criteria = technical point + financial point).

In the past, projects were selected by bidding on price alone, although design documents were reviewed in advance. However, with the increase of PPP projects, the comprehensive evaluation method has become the mainstream for selecting contractors, and is now widely used not only for PPP projects but also for public projects. This is due to the fact that the comprehensive evaluation bidding method was recommended from the perspective of ensuring transparency and fairness in the selection of business operators for PFI projects.

The following is an example of a comprehensive evaluation bidding system in the DBO that is becoming mainstream.

◆ Planning Stage

In order to allocate the budget for the project, the budget is determined based on the preliminary requirements.

Quotations will be collected from plant manufacturers, but the budget will be assessed by using the unit price of orders for similar projects.

◆ Bidding Documents Preparation Stage

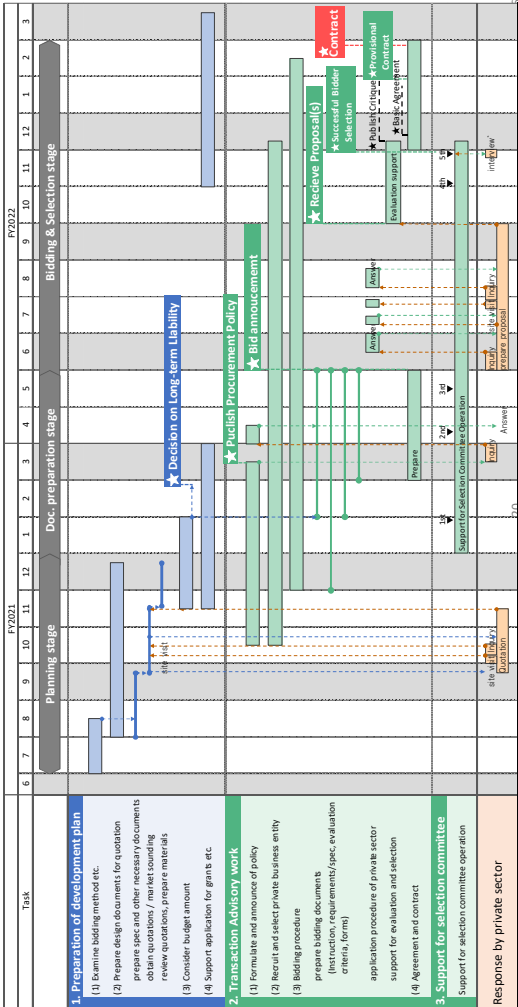
To publicize the project widely, prepare and publish an implementation policy.

Prepare bidding documents (bid explanatory documents, requirements, criteria for determining successful bidders, contract documents, etc.)

◆ Bidding & Selection of Business Entity Stage

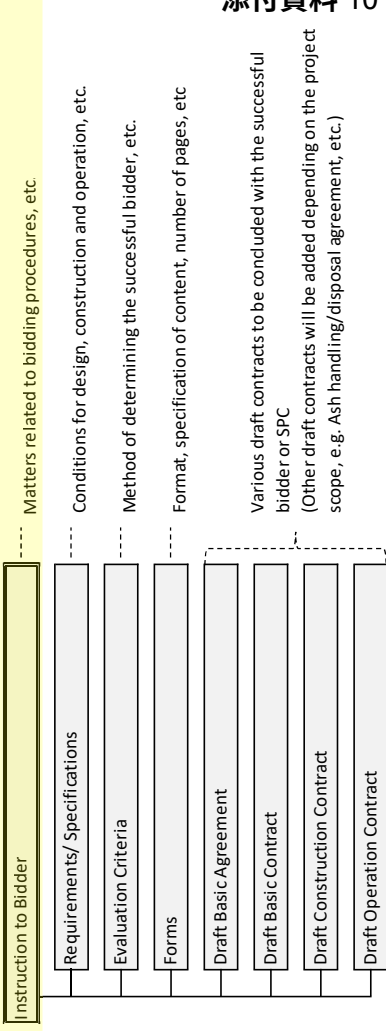
Issue a public notice for bidding, evaluate the proposals, and select the successful bidder

After that, contract negotiations will be held with the successful bidder and a contract will be concluded.



Documents of Bid Announcement (in case of DBO)

Main Contents



Main Contents of Instruction to Bidder

◆ **Project Scope**

Whether ash recycling is mandatory, etc.

◆ **Bidding Schedule**◆ **Qualification Criteria**

Track record of construction company

Track record of operation company, etc.

◆ **Classification and Method of Payment**◆ **Framework of Incentives and Penalties**

Table: Classification of Payment

Classification	Item	Contents
Construction cost	Design cost Construction cost	All costs related to construction
	Fuel Chemicals Utility	Costs that vary depending on the amount of waste
Operation cost	Variable cost	Costs that do not vary depending on the amount of waste
	Fixed cost	Costs that do not vary depending on the amount of waste

※In principle, the revenue from electricity sales becomes the revenue of the local government.

Documents of Bid Announcement (in case of DBO)

Instruction to Bidder	Contents
Requirements/ Specifications	Matters related to bidding procedures, etc.
Evaluation Criteria	Conditions for design, construction and operation, etc.
Forms	Method of determining the successful bidder, etc.
Draft Basic Agreement	Format, specification of content, number of pages, etc.
Draft Basic Contract	Various draft contracts to be concluded with the successful bidder or SPC
Draft Construction Contract	(Other draft contracts will be added depending on the project scope, e.g. Ash handling/disposal agreement, etc.)
Draft Operation Contract	

Positioning of Requirements/Specifications

The requirements/specifications indicate the level of facility specifications and services that the client (local government) requires from bidders.

It does not preclude the proposals that demonstrate originality and ingenuity, or that exceed them.

Part I	Common Items
Chapter 1	Positioning of this requirements/specifications
Chapter 2	Definitions
Chapter 3	Outline of the Project
Part II	Design and Construction
Chapter 1	General
Chapter 2	Overall Plan
Chapter 3	Mechanical equipment
Part III	Operation
Chapter 1	General
Chapter 2	Operational structure
Chapter 3	Operation management
Chapter 4	Operation and Maintenance
Chapter 5	Environmental management
Chapter 4	Electrical instrumentation equipment
Chapter 5	Civil engineering and building
Chapter 6	Civil engineering and building
Chapter 6	Effective utilization
Chapter 7	Information management
Chapter 8	Disaster management
Chapter 9	Related tasks
Chapter 10	Municipality's tasks

Main Contents of Requirements/Specifications

◆ **Matters related to Planned Project Site**

Site boundary, geology, planned ground elevation, land use regulations, greening standards, etc.

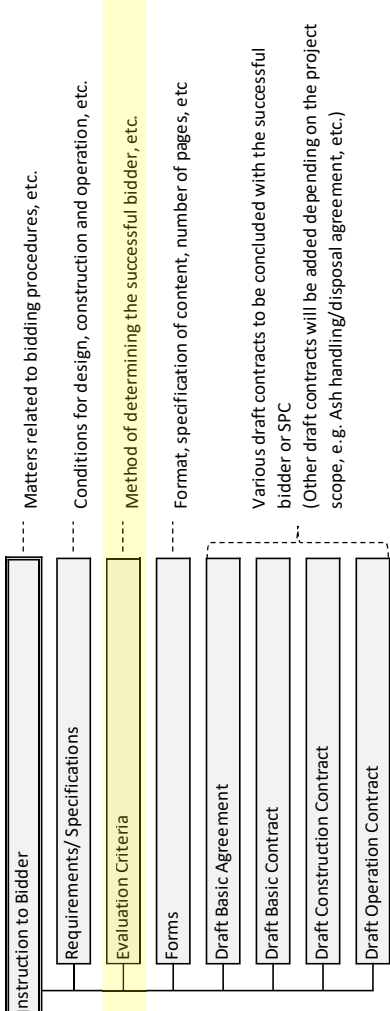
◆ **Facility Size and Object to be Treated**◆ **Pollution Control Standards**◆ **Performance Guarantee Items**

Since WTF development utilizes the plant manufacturer's own patents and know-how, the performance-based ordering system is adopted to let the contractor perform both design and construction. The performance guarantee sections describes the testing items/procedures and pass/fail criteria for the preliminary performance test as well as the performance test to be conducted in final phase of the construction work to confirm the performance guarantee.

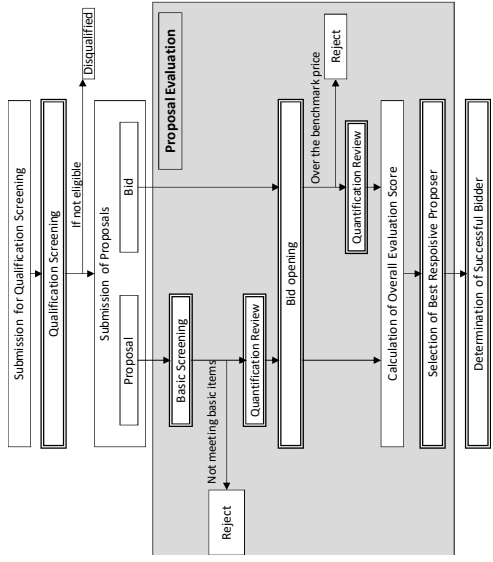
◆ **Specifications for Plant, Civil and Building works,**◆ **Contents of Operation Work,**

Documents of Bid Announcement (in case of DBO)

Main Contents



Successful Bidder Selection Process
in Comprehensive Evaluation Method



Keys to a Fair Evaluation System

1. Complete separation of technical review and price bid opening procedures
2. Ensuring transparency in selection procedures
3. Technical evaluation (scoring) by a neutral committee members
4. Explanation of assessment results

Successful Bidder Selection Criteria
in Comprehensive Evaluation Method

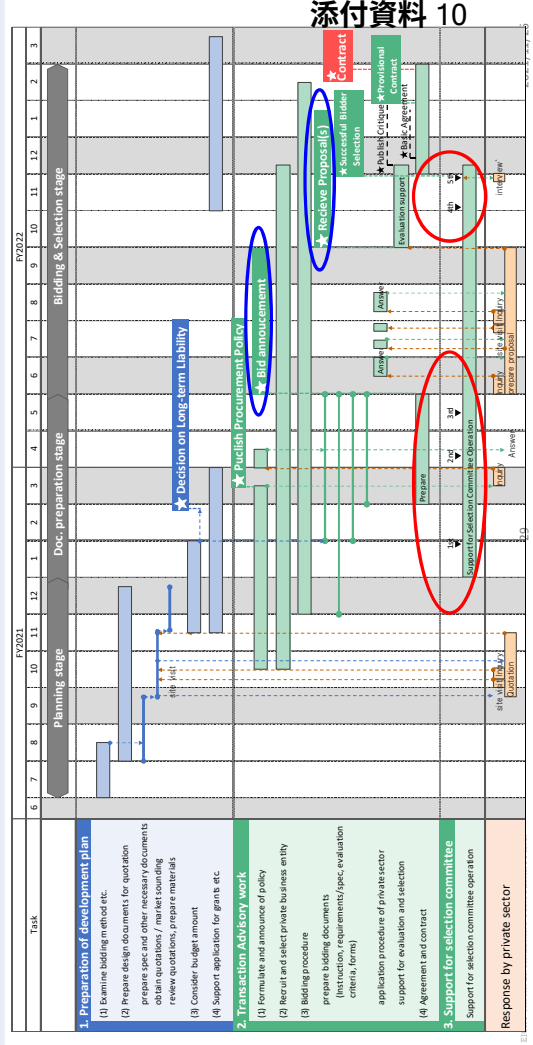
In the quantitative evaluation, the ratio of technology scores and price scores should be set to avoid "cheap but shoddy" facility.

The evaluation items are set with reference to those set as the concept of facility development in the facility basic plan, etc.

Higher points will be given to items that the client emphasizes in the development of facilities.

The evaluation items are designed to make it easy for the private sector to submit proposals and for the evaluation committee members to score them.

Item	Evaluation Items	Score
1	Design, construction, operation and maintenance	40
1-1	Environment friendly facility	11
1-1-1	(1) Efforts to safety pollution prevention standards	4
1-1-2	(2) Global warming measures	1
1-1-3	(3) Visitor support & environmental learning plan	3
1-1-4	(4) Landscaping	3
2	Facility that considers resource recycling	7
2-1	(1) Amount of power generation	4
2-2	(2) Efficient use of energy	3
3	Resource recycling & final disposal	22
3-1	Facility designed to ensure safety and stable operation	3
3-1-1	(1) Amount of residue	3
3-1-2	(2) Indoor layout flow planning	3
3-1-3	(3) Ensuring safety during disasters	2
3-1-4	(4) Fire and explosion prevention	4
3-1-5	(5) Reliability of handling system	2
3-1-6	(6) Reliability of maintenance	2
3-1-7	(7) Prevention of pollution and other problem measures	2
3-1-8	(8) Carry-in and carry-out management	2
2	Business plan	20
2-1	Organization structure	4
2-1-1	(1) Organization structure, staffing plan	4
2-2	Management plan & business balance plan	6
2-2-1	(1) Approach to formulation of plans	3
2-2-2	(2) Security for business continuity	3
3	Risk management	3
3-1	Risk management and handling	3
3-1-1	(1) Risk management & self-monitoring	3
4	Community contribution	7
4-1	Utilization of local companies and local employment	3
4-2	Local economy and community	4
4-2-1	(1) Contribution to community	4
3	Bidding price	40
3-1	Bidding price	40



Construction Work

The contractor selected through the selection process will carry out the construction work in accordance with the construction contract and specifications/requirements in the bidding document.

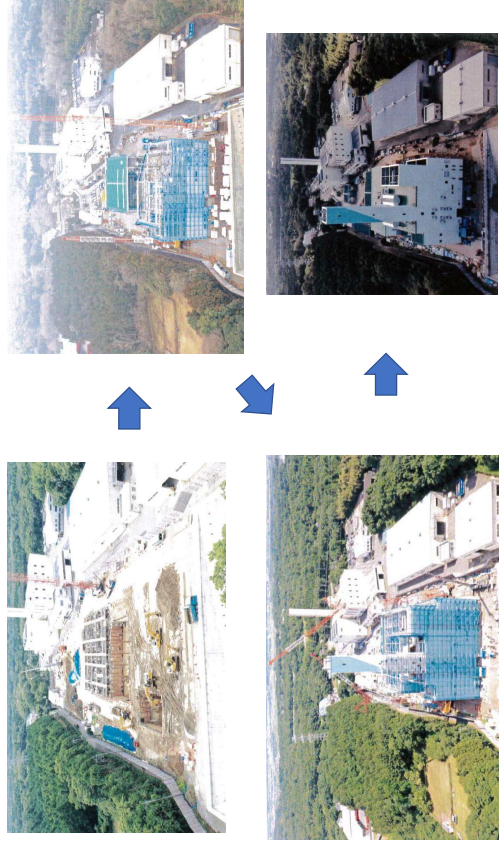
Construction work will generally take 3 to 4 years, depending on the processing capacity and site conditions. At the end of the construction work, a performance test is conducted to confirm that the performance specified in the requirements document has been secured.

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Remarks
Existing Facility												
Operation	26	27	28	29	30	31	32	33	34	35		Renewed in 30-40 yrs (e.g. 35 yrs)
MSW Treatment Master Plan (MP)												Reviewed once every 5 yrs
Facility Development Conceptual Plan												Decision on renewal & site
Facility Basic Plan												Decision on processing method
PFI/PPP Feasibility Study												Decision on business scheme
Topographic Survey												Reflected in facility basic plan
Geological Survey												Reflected in facility basic plan
Environmental Impact Assessment												1.5-4 yrs
Selection of Winning Bidder												Standard 2 yrs
Construction Work							Construction					Standard 3-4 yrs
Operation											Start	

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Operation Work

After construction is completed, the operator selected through the selection process (in case of DBO) is responsible for operation and maintenance of the facility in accordance with the O&M agreement and specifications/requirements in the bidding document.

The local government, as the client, monitors the implementation status of the operation every month during the operation period.

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Remarks
Existing Facility												
Operation	26	27	28	29	30	31	32	33	34	35		Renewed in 30-40 yrs (e.g. 35 yrs)
MSW Treatment Master Plan (MP)												Reviewed once every 5 yrs
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Selection of Winning Bidder												Standard 2 yrs
Construction Work							Construction					Standard 3-4 yrs
Operation											Start	

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Outline of Waste to Energy (WtE)* Technology and Requirements for WtE Project

Note: WtE in this document intends WtE-ACC (Appropriately Controlled Combustion) which is Incineration Technology.

December 10, 2021

Manabu ETO
Solid Waste Management Dept., Tokyo Branch,
Eight-Japan Engineering Consultants Inc. (EJEC)

Agenda

1. Outline of WtE project

- (1) Characteristics of WtE project (WtE Plant) in Japan
- (2) Procedure of WtE Project Development

2. What are the requirements in WtE Project?

- (1) Input Conditions
- (2) Output Conditions
- (3) Plant Conditions

3. How to succeed in WtE project?

- (1) Is the contents described in the Employer's Requirement feasible?
- (2) Can they be executed as requested?

1. Outline of WtE project

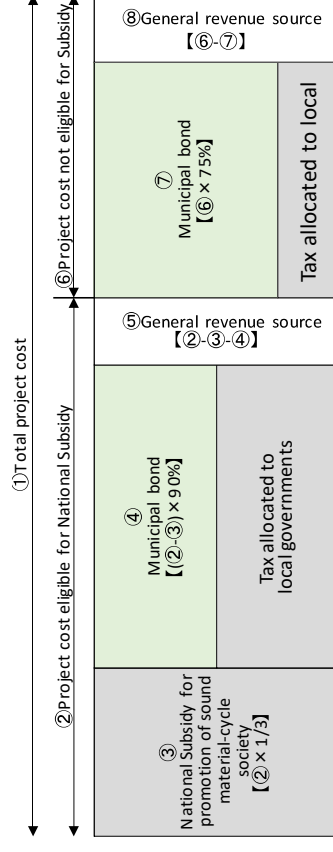
(1) Characteristics of WtE project in Japan

- ① Out of 1,067 incineration plants in Japan, **384 (36%)** are WtE plants (power generation plants).
- ② Scale of WtE plants varies from **less than 100t/d to Max. 1,800t/d**.
- ③ The average efficiency of power generation is 13.74%. The National Government (NG) hopes to raise the efficiency by increasing the scale of facilities.
- ④ **There are generous national subsidy programs**:
 - ✓ The National Government supports **40-50%** of the cost of facility construction, including both subsidies and local allocation of taxes.
 - ✓ Even Local Governments (LGs) with weak financial base can construct WtE plants by this.
- ⑤ Because of ④, Design-Build (DB) or Design-Build-Operate (DBO) schemes are the mainstream in Japan, with a minority of municipalities choosing Build-Operate-Transfer (BOT) or BOT*.
- ⑥ Most of the facilities have been in operation for **more than 30 years (or are about to be)** by conducting appropriate inspections and repairs.
- ⑦ The WtE plant is a facility that is in charge for “(thermal) Recycle” among the 3Rs (Reduce, Reuse, Recycle).

Note: Design-Build (DB) or Design-Build-Operate (DBO) schemes where LG shall raise the fund while Build-Own-Operate (BOO) or Build-Operate-Transfer (BOT) schemes where let private partner finance the capital expenditure.

1. Outline of WtE project

(1) Characteristics of WtE project in Japan/ Generous National Subsidy programs



- The gray area is the portion subsidized by NG, which corresponds to about 40-50% of the total construction cost.
- The municipal bond portion (in green) is also lent by NG at ultra low interest rates, so the interest burden on LGs is low.
=> Municipalities that choose DB and DBO are blessed with financial resources, so BOT and BOO with private funding are less likely to be chosen in Japan.

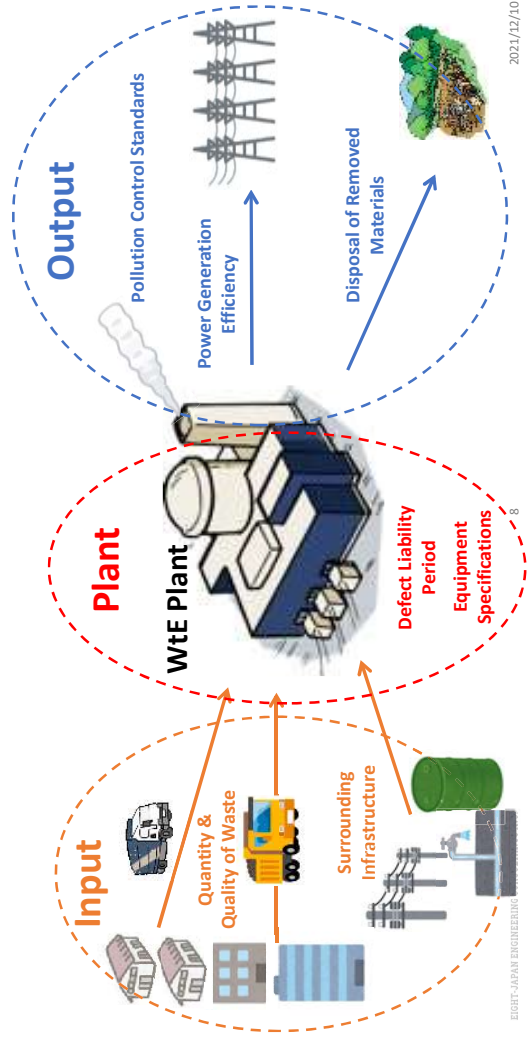
1. Outline of WtE project

(2) Procedure of WtE Project Development

Since the Law clearly stipulates that "local government is responsible for Waste treatment", even if LG contracts some parts to private, LG is still primarily responsible for waste treatment. Thus, WtE Project shall be led by local governments.
=> Throwing the whole part of waste treatment to the private sector is not an option.

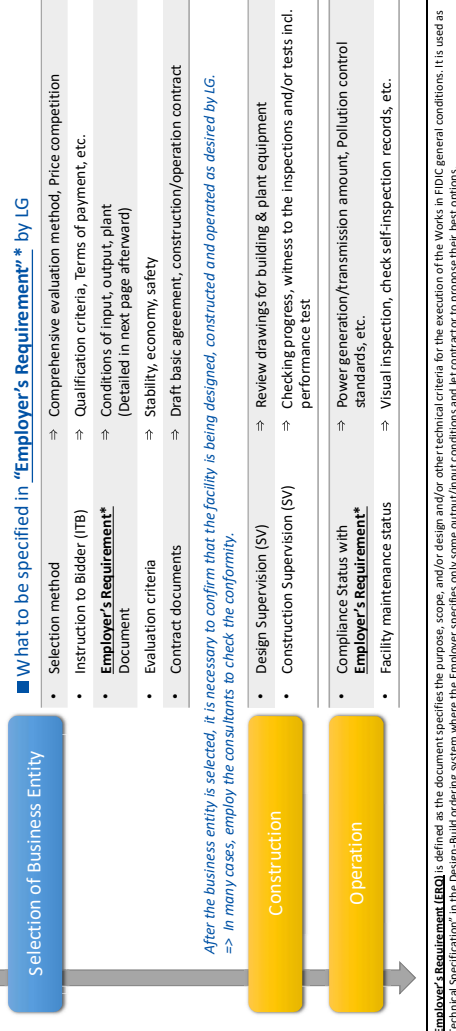


2. What are the requirements in WtE Project?



1. Outline of WtE project

(2) Procedure of WtE Project Development (Cont.)



2. What are the requirements in WtE Project?

(1) Input conditions

Main contents of "Employer's Requirement" in Bidding Document

(A) COMMON	(B) CONSTRUCTION	(C) OPERATION
1. Capacity of the Facility, Project scheme	1. Quantity and quality of waste	1. Project implementation structure
2. Construction Site, Area	2. Performance Guarantee Matters;	2. Development of manuals and plans
3. Project period, time schedule	(1) Power generation efficiency	3. Operation and maintenance contents;
4. Topography and geology conditions	(2) Pollution control standards, etc.	(1) Operation management
5. Surrounding infrastructure, city planning related matters	3. Performance guarantee method	(2) Inspection, testing, repair and renewal
	4. Defect Liability Period	(3) Disposal of removed materials
	5. Equipment specifications	(4) Information management
	(1) Mechanical equipment specifications	4. Handling after the Project Period
	(2) Electrical instrumentation equipment specifications	
	(3) Civil engineering and building works specifications	

添付資料 10

2. What are the requirements in WTE Project?

(1) Input conditions; **Quantity & Quality of Waste**

Quantity & quality of waste are the quantity and quality of "fuel" for WTE plant.

=> WTE plant runs trouble-free when the quality of fuel is good.

=> WTE plant generates more power if the fuel quantity is high.

■ Quantity of waste;

Setting Service Area	=> Within LG's jurisdiction, or with other LGs (how extensive can be?)
Setting Target Waste	=> Domestic/business, combustible, sludge, medical waste, etc. (Possibility to collect waste which less unsuitable matter with higher calorific value?)

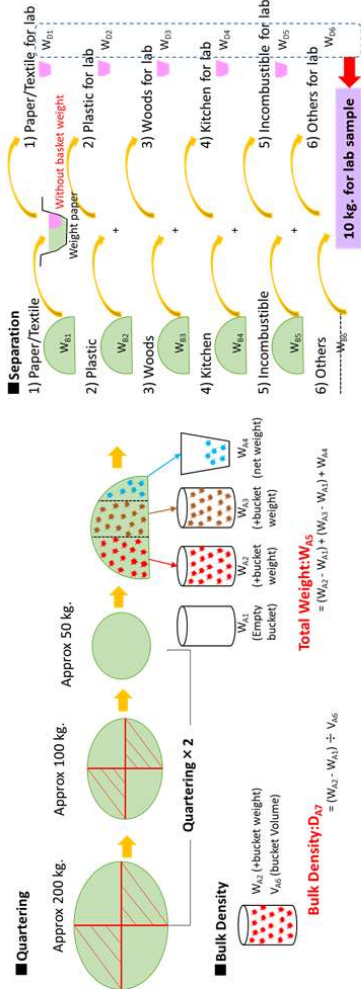
■ Quality of waste;

Physical Composition	=> Papers, Plastics, Woods, Kitchen waste, Incombustibles, Others
3 components (Proximate Analysis)	=> Moisture, Combustible, Ash
Ultimate Composition	=> Carbon(C), Hydrogen(H), Oxygen(O), Sulphur(S), Nitrogen(N), Chloride(Cl)
Unit volume weight	=> Bulk density
Calorific value	=> Net Calorific Value (NCV) or Low Calorific Value (LCV)

2. What are the requirements in WTE Project?

(1) Input conditions; **Quantity of Waste**

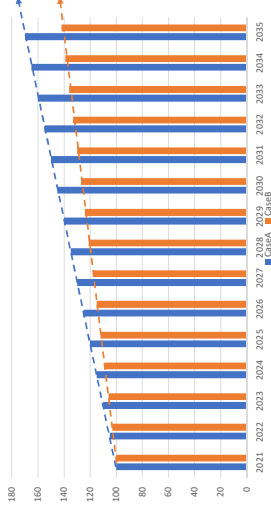
- Waste quality surveys are conducted at least 4 times/year at all facilities.
- Reduction of the sample by Quartering and measure Bulk Density and Physical Composition.



2. What are the requirements in WTE Project?

(1) Input conditions; **Quantity of Waste**

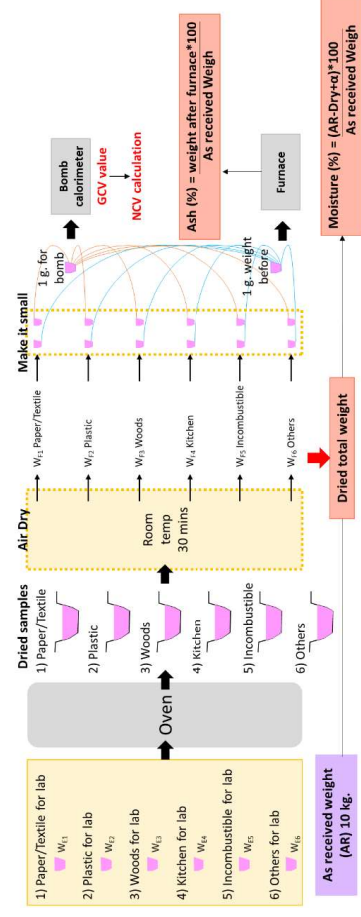
- In order to receive government subsidies, the amount of waste needs to be reduced from the current level.
=> The national and prefectural governments have set targets for waste generation unit rate, recycling rate, final disposal rate, etc., and Local governments need to strive to meet those target values.
- Only waste after 2R (Reduce, Reuse) is delivered to the WTE plant.



2. What are the requirements in WTE Project?

(1) Input conditions; **Quality of Waste**

- 3 Components (Moisture, Ash and Combustible), Elemental Composition and Calorific Value are measured from the sample after physical composition survey.



2. What are the requirements in WTE Project?

(1) Input conditions; **Quality of Waste**

- Present 3 components, Elemental composition, LCV and Bulk density of Target Waste for WTE Plant.
- Ratio of Higher limit and Lower limit of LCV range of Target Waste (H/L ratio) is generally less than 2.5.

3 Components

	Low	Standard	High
Moisture (%)	59.69	50.06	40.43
Ash (%)	5.79	6.54	7.29
Combustible (%)	34.52	43.40	52.28
Carbon (%)	19.10	24.16	29.22
Hydrogen (%)	2.20	2.73	3.25
Oxygen (%)	12.00	15.22	18.44
Sulfur (%)	0.01	0.01	0.01
Nitrogen (%)	1.20	1.27	1.35
Chlorine (%)	0.01	0.01	0.01
Lower Calorific Value (LCV) (kcal/kg)	1,480	2,250	3,040
or Net Calorific Value (NCV) (kJ/kg)	L 6,100	9,400	H 12,700
Bulk Density (t/m ³)	0.234	0.220	0.205

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2. What are the requirements in WTE Project?

(2) Output conditions

Main contents of "Employer's Requirement" in Bidding Document

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1. Capacity of the Facility, Project scheme	1. Quantity and quality of waste	1. Project implementation structure
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3. Project period, time schedule	(1) Power generation efficiency	3. Operation and maintenance contents;
4. Topography and geology conditions	(2) Pollution control standards, etc.	(1) Operation management
5. Surrounding infrastructure, city planning related matters	3. Performance guarantee method	(2) Inspection, testing, repair and renewal
	4. Defect Liability Period	(3) Disposal of removed materials
	5. Equipment specifications	(4) Information management
	(1) Mechanical equipment specifications	4. Handling after the Project Period
	(2) Electrical instrumentation equipment specifications	
	(3) Civil engineering and building works specifications	

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2. What are the requirements in WTE Project?

(1) Input conditions; **Surrounding infrastructure, City planning related matters**

If possible...we want to select a location where the surrounding infrastructure is as good as possible.
If possible...we want to select a location with few restrictions of city planning, and also to gain the understanding of residents.
=> Constraints on the location of the WTE plant are one of the factors that determine the success or failure of the project.

■ Surrounding infrastructure

Electricity	Status of transmission lines, availability of reverse power flow
Water	Water supply, groundwater, rainwater
Waste water	Domestic wastewater, plant wastewater, Discharge to river, sewerage, or treated water discharge not allowed (close-type: no wastewater discharge)
Fuel	City gas grid, kerosene, heavy oil

■ Qty planning matters

Building coverage ratio	Ratio of building area to site area
Floor area ratio	Ratio of total floor area to site area
Height restriction	Height restriction of building and chimney
Residents' understanding	Development of compensation facilities to the community, holding the explanatory meetings for residents

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2. What are the requirements in WTE Project?

(2) Output conditions: Power generation efficiency

Conditions to obtain National Subsidy on Energy Recovery Ratio (Revised every year)

Facility size x t/d)	Energy recovery rate (%)
x ≤ 100	17.0
100 < x ≤ 150	18.0
150 < x ≤ 200	19.0
200 < x ≤ 300	20.5
300 < x ≤ 450	22.0
450 < x ≤ 600	23.0
600 < x ≤ 800	24.0
800 < x ≤ 1,000	25.0
1,000 < x ≤ 1,400	26.0
1,400 < x ≤ 1,800	27.0
1,800 < x	28.0

Energy recovery ratio
= Power generation efficiency + Heat utilization rate

■ Power generation efficiency
[power generation output × 100%]
÷ [input energy (waste + external fuel)]

■ Heat utilization rate
[effective calorific value × 0.46 × 100%]
÷ [input energy (waste + external fuel)]

[Example] In case if facility size 600t/d, waste LCV is 9,000kJ/kg.
Energy recovery ratio shall be 23.0% or more.

23% = [power generation output(kW) × 3,600(kJ/kWh) × 100%]
÷ [9,000(kJ/kg) × 600(t/d) × 1,000(kg/t) ÷ 24(h/d)]

[power generation output(kW)] = 14,375(kW)

Turbine generator rated output of 14,375 (kW) or more is required.
(when no heat is used)

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2. What are the requirements in WTE Project?

(2) Output conditions: Pollution control standards

As a means of gaining the understanding of nearby residents, WtE owners often voluntarily impose regulatory values that are stricter than legal standards.

WtE Plant

■ Exhaust gas standards;

Particulate matter	Less than 0.04g/Nm ³ (depending on facility size)
Hydrogen chloride	Less than 430 ppm
SOx	K-value regulation (depending on chimney height and exhaust gas volume)
NOx	Less than 250 ppm
Dioxins	Less than 0.1ng-TEQ/Nm ³
Mercury	30μg/Nm ³

■ Effluent standards;

Standards for hazardous substances	28 items
Standards related to living environment items	16 items

■ Noise standards;

Set standards in Daytime, Morning & Evening, Night (divided into 4 types of land use categories)

■ Vibration standards;

Set standards in Daytime, Morning & Evening (divided into 2 types of land use categories)

■ Odor

Standards at site boundaries, outlets and drainage

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2. What are the requirements in WTE Project?

(3) Plant conditions

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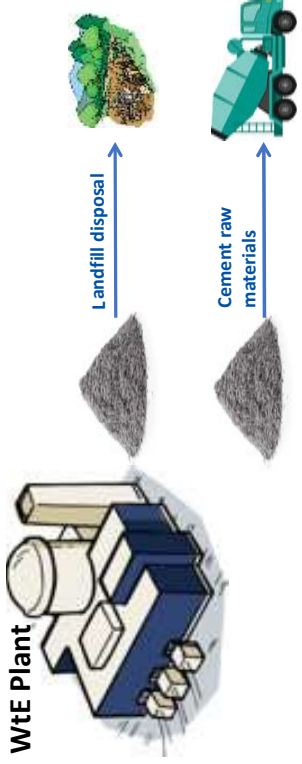
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2. What are the requirements in WTE Project?

(2) Output conditions: Disposal of removed materials (Bottom / fly ash)

The unburned component must be sufficiently low for both landfill disposal and conversion to cement raw materials.

WtE Plant



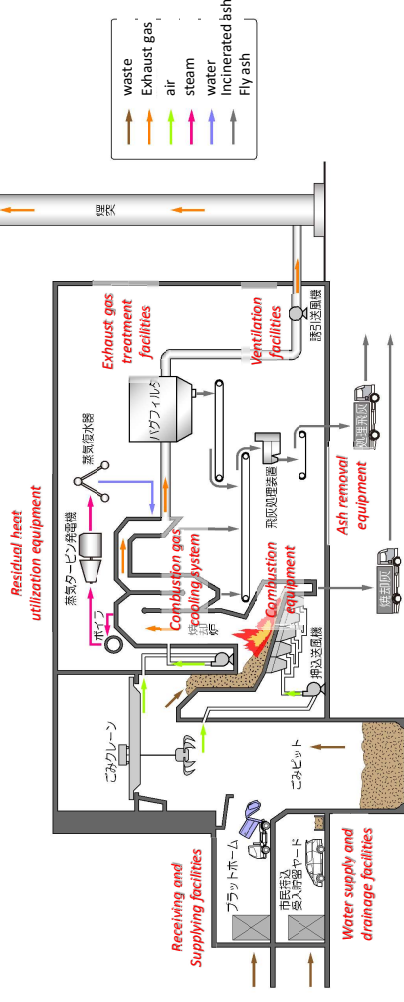
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2. What are the requirements in WTE Project?

(3) Plant conditions; Equipment specifications (1)



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2. What are the requirements in WTE Project?

(3) Plant conditions; Equipment specifications (2)

Name of Equipment	Main Items as Example	Major purpose
Receiving and supplying facility	Weighing bridge, garbage crane, garbage pit	Weight measurement, storage and homogenization
Combustion equipment	Waste feeder, Combustion chamber	Constant supply, complete combustion
Combustion gas cooling system	Boilers, steam condensers	Cooling for exhaust gas treatment, and heat recovery
Exhaust gas treatment facilities	Dust collection equipment, hazardous gas removal equipment	Removal of hazardous components
Residual heat utilization equipment	Steam turbine	Heat recovery, power generation, hot water use
Ventilation facilities	Forced Draft Fan, Induced Draft Fan, Chimney	Air supply for combustion, exhaust gas induction
Ash extraction equipment	Ash pit, ash crane	Ash storage, stabilization of fly ash
Water supply and drainage facilities	Cooling water cooling tower, wastewater treatment equipment	Equipment cooling, water quality improvement
Electrical equipment	Power transforming equipment, emergency power generation equipment	Stable power supply in normal and emergency situations
Instrumentation equipment	DCS, ITV, pollution monitoring display panel	FB control, SQ control
Architecture	Plant/administration building plan, interior/exterior	Worker/visitor flow line efficiency
Building machineries/electrics	Air conditioning, ventilation, lighting, fire alarm	Fire prevention, odor prevention, work environment improvement
Civil engineering and exterior structures	Parking lot, gate, fence	Vehicle flow line efficiency

2. What are the requirements in WTE Project?

(3) Plant conditions; Defect Liability Period

- During the first few years after the completion of facility construction, it is easy for basic performance to be underachieved or for equipment to malfunction due to defective construction or unfamiliarity with operation.
- A certain period of time is set as the defect liability period (2-3 years).
=> During this period, EPC contractor shall be responsible for improvement of the equipment.

	1 st year from COD*	2 nd year	3 rd year	4 th year	5 th year
Equipment (A)	Underachieved to the performance	Remedied			
Equipment (B)		Strange noise	Remedied		
	Completion of Construction				
COD: Commercial Operation Date					

Performance Test at the end of Defect Liability Period (In case of 3 years of DLP)

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2. What are the requirements in WTE Project?

Case Study (1)

Major Items in WTE Planning	Unit	A city	B city	C city	D city
Project Scheme	-	DBO	DBO	DBO	DBO
Quantity of Waste (=Capacity of facility)	t/d	600	420	330	339
Quality of Waste	H/L ratio	2.0	2.0	1.86	2.03
Higher Limit	KJ/kg	12,000	12,800	12,100	13,200
Standard	KJ/kg	9,000	9,600	9,300	9,900
	kcal/kg	2,142	2,285	2,214	2,357
Lower Limit	KJ/kg	6,000	6,400	6,500	6,500
Power Gen. Efficiency	%	26.5	25.8	25.3	24.0
Power Gen. Capacity	KW	16,800	10,640	9,550	8,400
Steam conditions	MPa	6.0	4.8	4.85	3.9
	dC	450	425	415	445

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2. What are the requirements in WTE Project?

Case Study (2)

Major Items in WTE Planning	Unit	A city	B city	C city	D city
DLP* for Building	Year	3	2	2	2
DLP for Plant	Year	3	3	2	2
Discussion for post concession	-	3 years before	N/A	N/A	N/A
O&M Concession Period	Years	20	15	20	15
Target Durable Years	Years	> 30	> 30	> 30	> 30
Exhaust gas PM	g/Nm3	0.04**	0.01	0.01	0.01
SOX	ppm	100	20	30	20
NOx	ppm	150	50	50	50
HCL	ppm	40	30	50	20
DXNs	ng-TEQ/Nm3	0.1	0.01	0.1	0.05
Mercury	mg/Nm3	30	30	N/A	N/A

* DLP: Defect Liability Period

** National exhaust gas emission standards regulated by Air Pollution Prevention Act.

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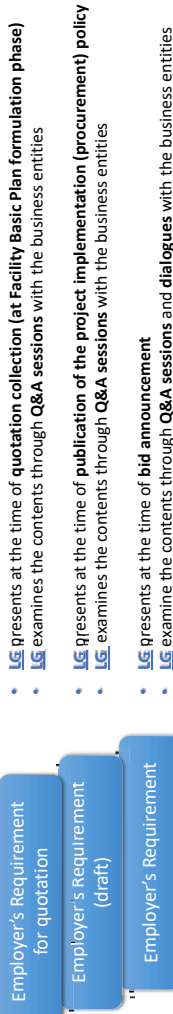
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3. How to succeed in WtE project?

(1) Is the content of the Employer's Requirement feasible? - Don't make it armchair plan

Embody the product image through Q&A and dialogues with private partner + have a common understanding
⇒ Don't leave everything up to the business entity!



- **LE** presents at the time of **quotation collection (at Facility Basic Plan formulation phase)**
- **LE** examines the contents through **Q&A sessions** with the business entities
- **LE** presents at the time of **publication of the project implementation (procurement) policy**
- **LE** examines the contents through **Q&A sessions** with the business entities
- **LE** presents at the time of **bid announcement**
- **LE** examine the contents through **Q&A sessions** and **dialogues** with the business entities
- **Bidders** submit as a **part of proposal by the bidders**
- **LE** determines whether or not to accept the proposal after **Q&A sessions** with the bidders
- **EPC contractor** submits **after the discussions based on approved Basic Design Document**
- **LE** finalize the design values after **Q&A sessions** with the business entity
- **EPC contractor** submits upon **completion of facility construction**.
- Contains finalized **detailed design docs** and the specifications of the delivered equipment.

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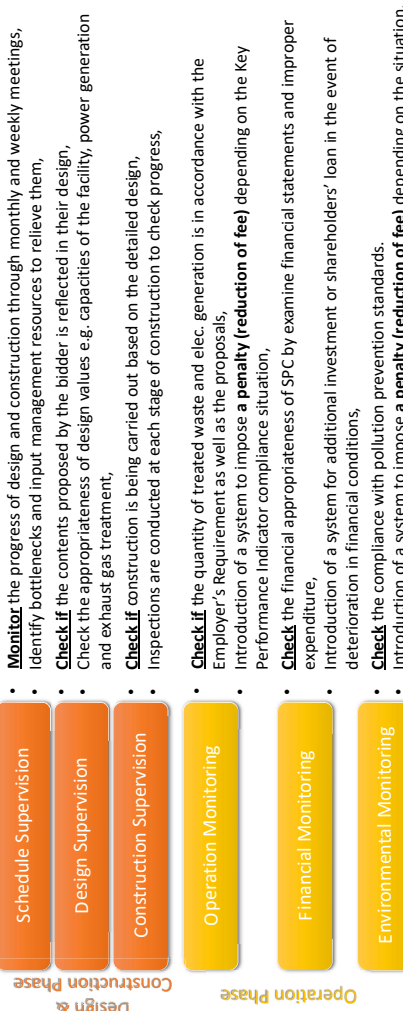
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3. How to succeed in WTE project?

(2) Can the contents of Employer's Requirement be executed as requested?

A system to ensure that Employer's Requirement are implemented is necessary
⇒ Make a good use of experts (consultants)!



- **Monitor** the progress of design and construction through monthly and weekly meetings, identify bottlenecks and input management resources to relieve them,
- **Check** if the contents proposed by the bidder is reflected in their design, Check the appropriateness of design values e.g. capacities of the facility, power generation and exhaust gas treatment,
- **Check** if construction is being carried out based on the detailed design,
- **Inspections** are conducted at each stage of construction to check progress,
- **Check** if the quantity of treated waste and elec. generation is in accordance with the Employer's Requirement as well as the proposals,
- Introduction of a system to impose a **penalty (reduction of fee)** depending on the Key Performance Indicator compliance situation,
- **Check** the financial appropriateness of SPC by examine financial statements and improper expenditure,
- Introduction of a system for additional investment or shareholders' loan in the event of deterioration in financial conditions,
- **Check** the compliance with pollution prevention standards.
- Introduction of a system to impose a **penalty (reduction of fee)** depending on the situation,

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Sample description of "Employer's Requirement" for Garbage Pit

7. Garbage pit (included in civil engineering and construction work)

- (a) Form : watertight reinforced concrete
 (b) Quantity : 1 unit
 (c) Main items (per line)

a Capacity : 3.010m3 or more (7 days or more of the rated capacity)

b Dimensions : Width [] m× depth [] m× depth [] m

c Main material : Watertight reinforced concrete

(d) Accessories Fallar rescue device

(e) Special Notes

- Ensure both the length and width of the pit does not interfere with the stable operation of the waste crane.
- The reference level for calculating the effective capacity of the pit shall be less than or equal to the horizontal line on the lower level of the input gate (in the case of the 2 pits method, only the first pit (receiving pit) side shall be subject to this condition.) In addition, do not calculate the chute, etc. into capacity after considering the angle of repose.
- The depth of the garbage pit should be 2.5 times or more in principle with respect to the opening dimensions of the crane bucket in consideration of autonomous driving.
- The chute of the inlet is fitted with a 12 mm steel plate as a countermeasure against wear.
- For lighting, provide a high side light or top light as necessary.
- Each pit bottom illuminance shall be 150 lux or more.
- For lighting, an energy-saving type such as LED equipment is adopted. Lighting fixtures attached to high places shall be in a position that can be safely replaced.
- Provide an appropriate water gradient and bottom shape so that wastewater is discharged quickly. In addition, the screen is made of stainless steel and has an easy-to-clean structure.
- Set up a typed garbage level display scale on the three-way sidewall of the inner wall of the pit.

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Sample description of "Employer's Requirement" for Garbage Pit

7. Garbage pit (included in civil engineering and construction work)

(e) Special Notes (CONT.)

- Even when the furnace is stopped from operation, deodorization measures shall be taken to prevent odor leakage to the platform, visitor passage, etc.
- Install a combustion air intake to keep the pit chamber at a negative pressure. Regarding the position of the intake, sufficient consideration should be given to preventing blockage due to scattered dust.
- Plan an infrared fire detection system that can detect the occurrence of a fire at an early stage in the entire range of the pit to be installed, and install the required number of water cannon devices that can extinguish the detected fire at an early stage. The water cannon device will allow remote and field operation.
- The reinforcing bar cover thickness at inner surface of the pit should be thick enough to protect it from wastewater and the collision of the crane bucket.
- Since the pit has a humid atmosphere, the equipment in the pit should be considered for corrosion prevention.
- The skeleton of the garbage pit shall be steel-framed reinforced concrete or reinforced concrete up to a height higher than the garbage crane receiving beam. Since it is mass concrete, control temperature cracks. For steel-framed parts, consider wall thickness (thick panel in the case of ALC), moisture penetration, and pollution control measures when confirming seismic performance and selecting wall materials.
- Install a fallen rescue device in the pit.
- From the viewpoint of preventing the vehicle from falling into the pit, the structure is such that the tailgate of the garbage-carrying vehicle does not go out to the pit side as much as possible when it is put in.

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