

# MSWI Ash Management and Dioxins in Japan

4th International Conference on Final Sinks

October 24-27th, 2017, Kyoto, Japan

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# Legal Conditions Regarding Residues and Dioxins

## History of Dioxins Issues in Japan

**1983**

**Report on dioxins in fly ash**

**1990**

**Guidelines to Prevent Formation of Dioxins Relating to Waste Treatment  
late 1990's Increase of public concern**

**1997**

**Revised Guidelines for Prevention of Dioxin Formation Relating to Waste  
Treatment**

**1999**

**Law Concerning Special Measures Against Dioxins (**Dioxin Special Measures Law**),  
Setting Environmental Standards and Regulations**

**2000**

**National Dioxin Reduction Plan (almost 90 % reduction from 1997 by FY 2002)**

**2005**

**Revision of National Dioxin Reduction Plan (15% reduction from 2003 by FY 2010) ,  
National Implementation Plan of POPs Convention**

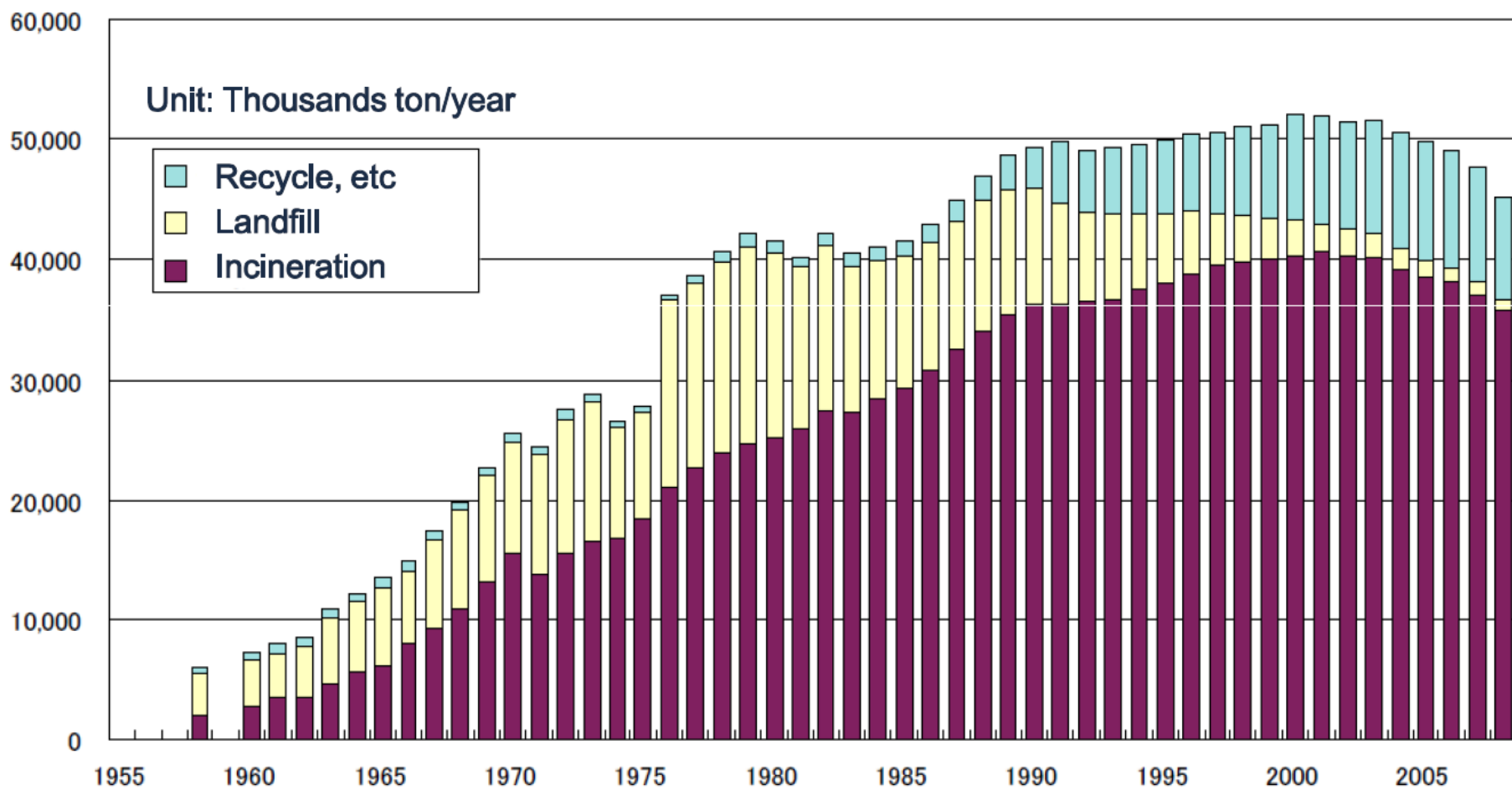
# Legal Conditions Regarding Residues and Dioxins

## Fly Ash from Waste Incinerators

- In 1992, fly ash collected from waste incinerators was designated as one of the "**General Waste Requiring Special Treatment**".
- It must be treated by one out of four methods of intermediate treatment determined by the Minister of Health and Welfare. These are:
  - (1) Melting and Solidifying,
  - (2) Solidifying in Cement,
  - (3) Chemical Treatment, and
  - (4) Stabilization by Acid or other Solvents.

MSWI ashes contain high concentrations of **heavy metals, salts, chloride and organic pollutants**, which may limit the applications of reuse. The treatment of ashes will improve the environmental characteristics and enhance the possibility for reuse.<sup>1</sup>

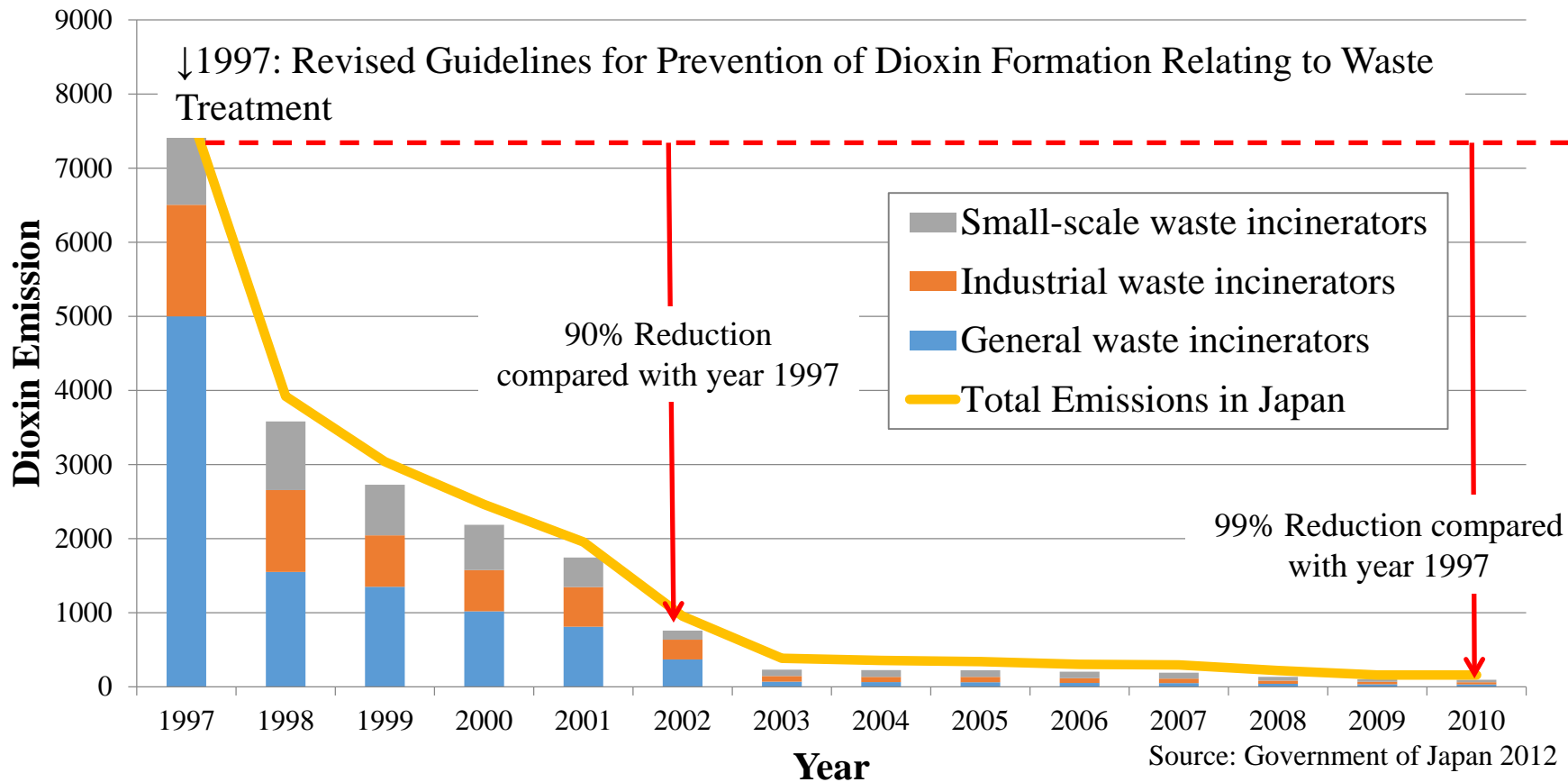
# Waste Incineration & Dioxins Emissions in Japan



Source: 3R Forum

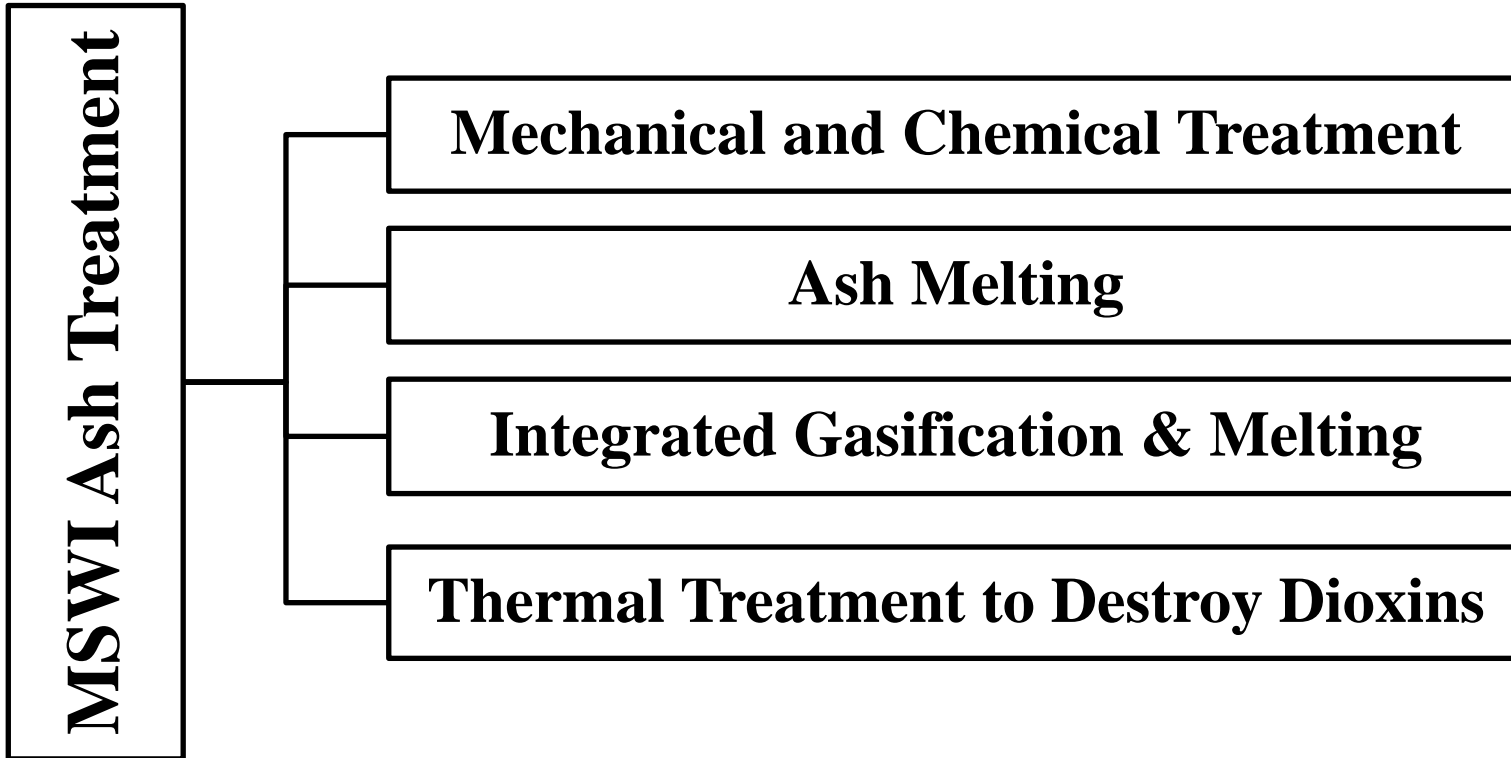
# Waste Incineration & Dioxins Emissions in Japan

## Dioxin Emissions from Waste Incinerators in Japan (g-TEQ/year)



# MSWI Ash Treatment in Japan

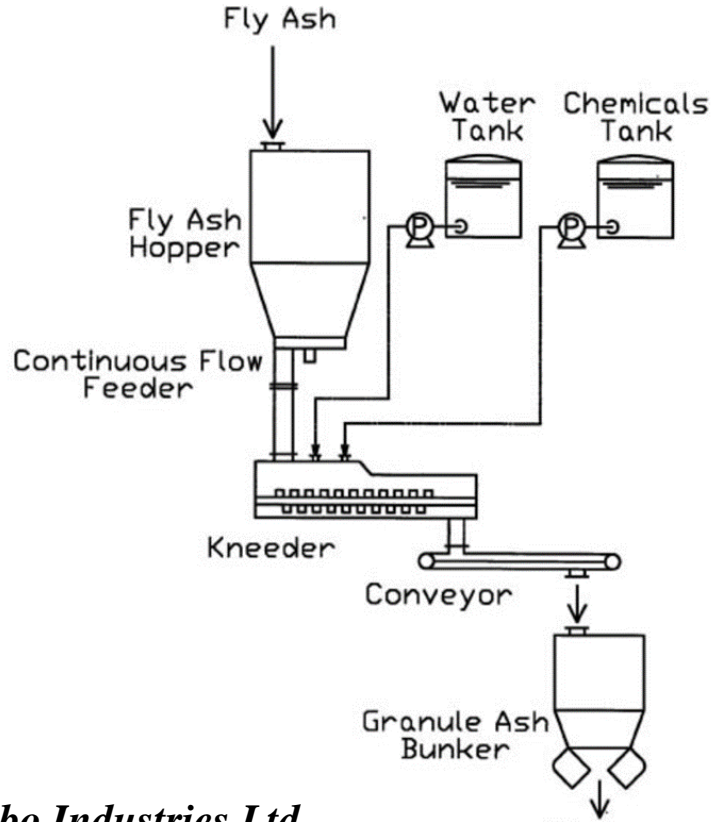
- In order to reduce the environmental impact and possibly utilise ash from MSWI, three treatment methods are mainly used:  
separation processes, solidification/stabilization and thermal methods.



# MSWI Ash Treatment in Japan

## Mechanical and Chemical Treatment

### *Aspal Fly Ash Treatment System*



Aspal fly ash treatment system, by using a chelating agent or the like, immobilizes at a normal temperature, hazardous heavy metals such as Pb and Cd contained in fly ash, in order to limit the level of eluted heavy metal ions below the regulation.

- A fly ash chemical treatment;
- Leaching is reduced and density of fly ash is higher.

# MSWI Ash Treatment in Japan

## Mechanical and Chemical Treatment

### Removal of Dioxins

#### ➤ Mechanochemical treatment

The most commonly form used is ball milling, during which the collision, compression, friction, and shear change effectively the physicochemical properties and reactivity of POPs and dehalogenation additives being grinded, causing their degradation. Preferably, dechlorination additives (calcium oxide, CaO;) should be introduced during or before milling, to react with the toxic substrates and convert organic chlorine into inorganic chlorides.

- Research at Tokyo University of Agriculture and Technology<sup>2,3,4</sup>
- Research ongoing at Zhejiang University<sup>5,6</sup>

#### ➤ Flotation

Organohalogen contaminants in MSWI fly ash are enriched in the unburnt carbon fraction. The flotation of carbonaceous fragments to some extent cleans fly ash from dioxins:

- Research at Kyoto University<sup>7</sup>

# MSWI Ash Treatment in Japan

## Ash Melting

In Japan, the melting process was developed in the 1980's.<sup>8</sup>

- The melting technology reduces the volume of incinerator residues, bottom ash and fly ash, making the melted slag stable and non-toxic.
- Moreover, this type of treatment allows the melted slag to be used as a resource again.

Melting systems can be divided roughly into two categories: systems using fuels as an energy source and those using electricity.

Technique	Number of units (2015)	Capacity (tonnes per year)
Thermal Plasma	30	10569
Surface melting	37	4473
Electric Arc	11	4411
Electric-resistance	12	3630
Rotary kiln	8	833
Other Fuel	6	815
Swirling melting	4	416
Coke bed	4	160

<sup>8</sup>S. Sakai, M. Hiraoka, WASTE MANAGE, 20(2000) 249-258.

# MSWI Ash Treatment in Japan

## Ash Melting

### Use of Slag

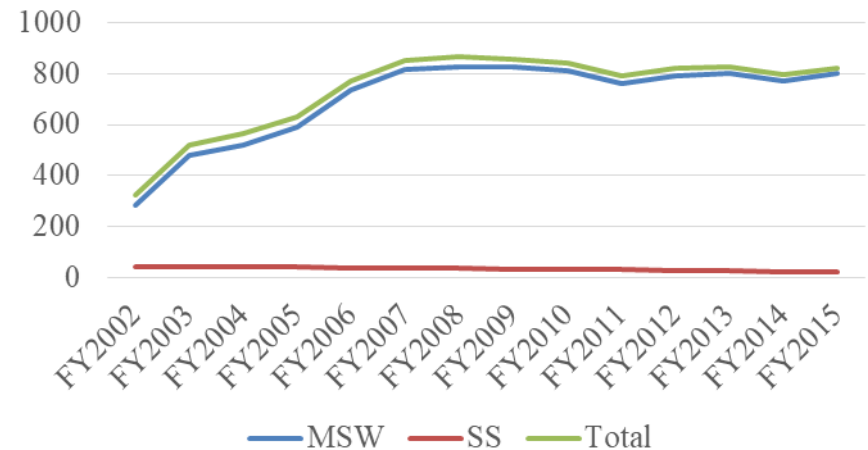
- The slag is glass-like black granule that does not elute heavy metals. It is stable both physically and chemically. Its uses currently considered are construction material as a primary product, and concrete items as secondary products.

Eco slag includes slag made from general waste or its incineration ash and slag made from sewage sludge or its incinerated ash.

Eco-slag formation, FY2015 = 100



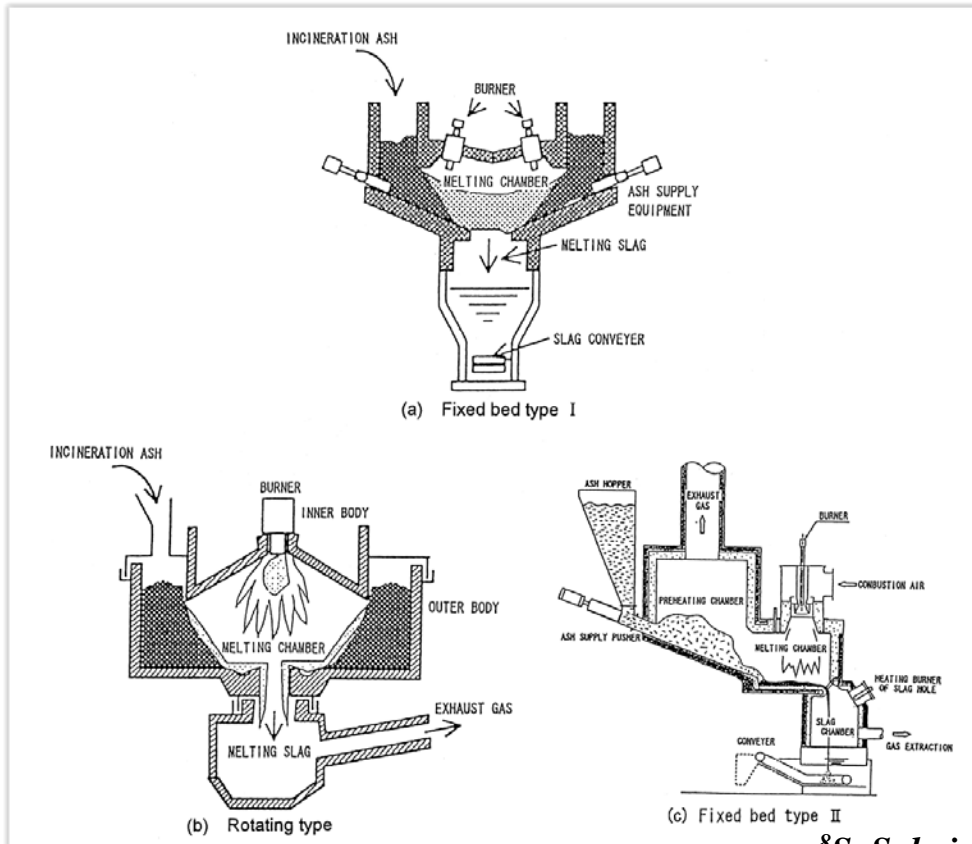
Eco-slag formation (kt/a)



# MSWI Ash Treatment in Japan

## Ash Melting

### Surface Melting Furnace



## Performance<sup>8</sup>

- Elution of heavy metals is prevented,
- Most dioxin in the slag is decomposed;
- Dioxin in the waste gas is decomposed making the gas completely harmless.

# MSWI Ash Treatment in Japan

## Ash Melting

### Plasma Melting Furnace

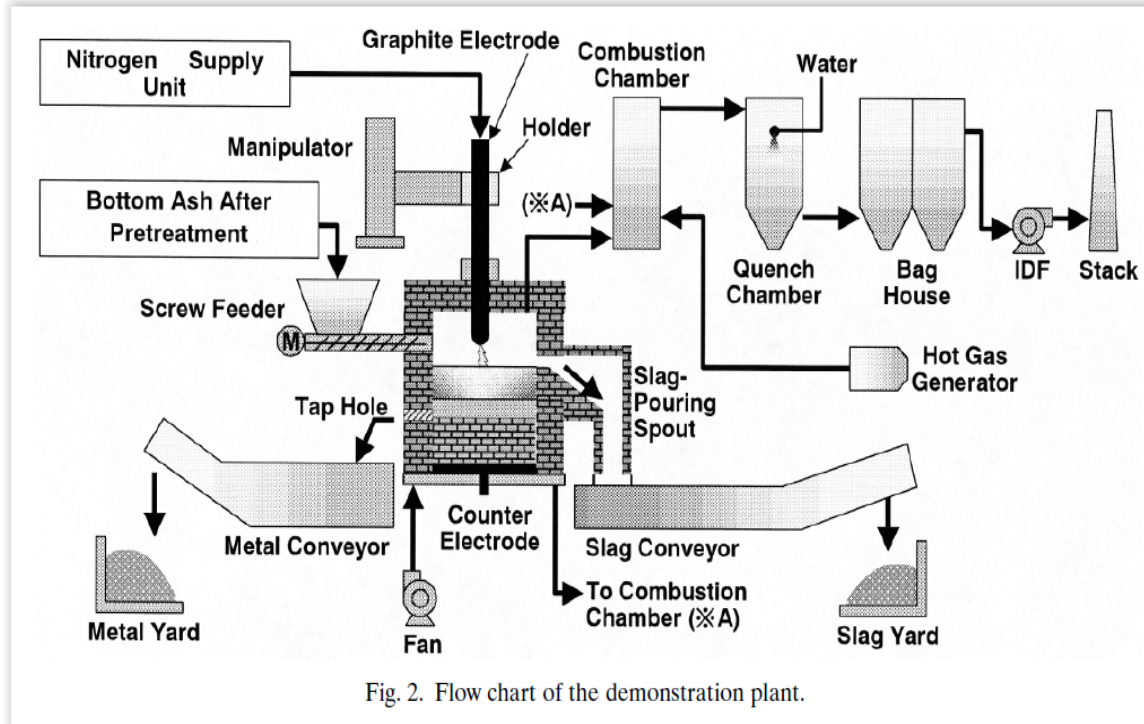


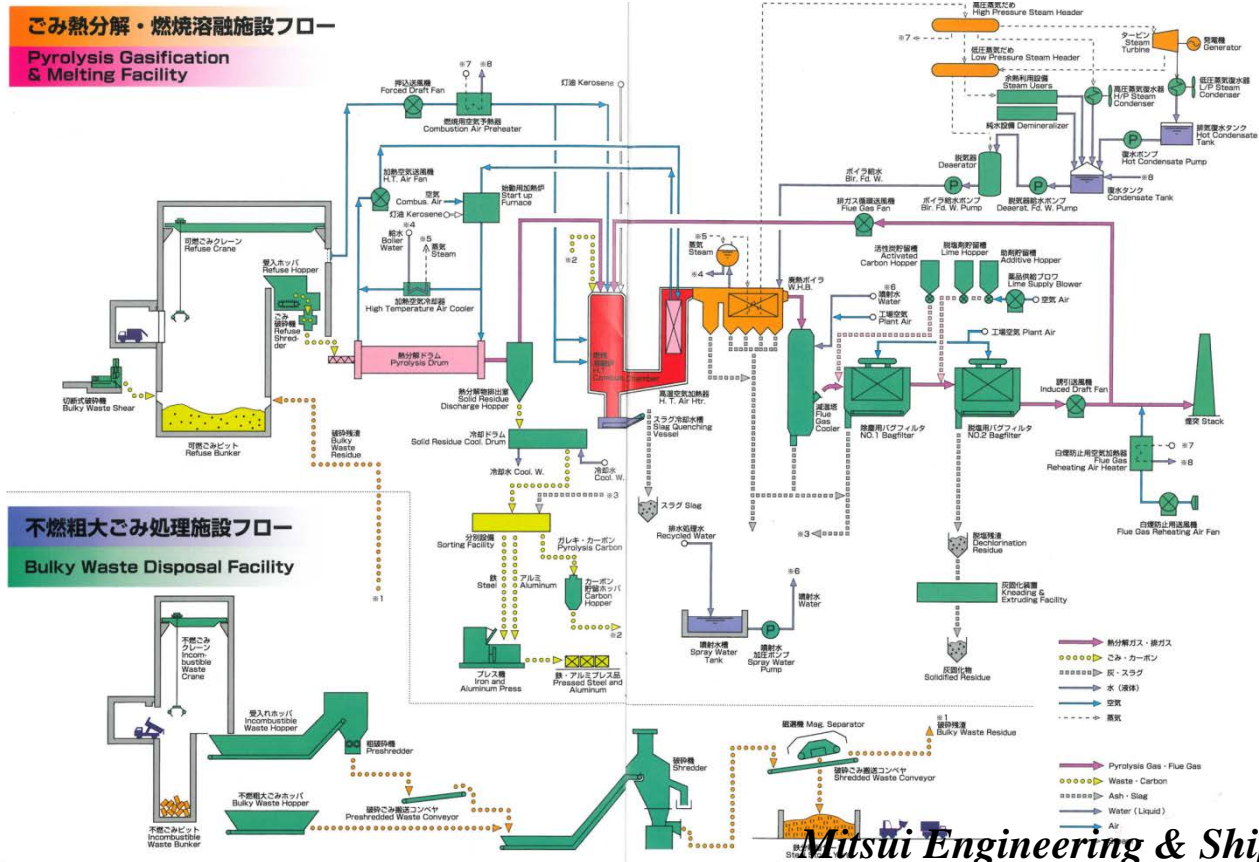
Fig. 2. Flow chart of the demonstration plant.

Item	Specification <sup>9</sup>
Melting furnace type	Graphite-electrode plasma melting furnace
Electric power source	1710 kW max. (450 V × 3800 A)
Ash throughput	16 tonnes/day rated capacity (25 tonnes/day max.)
Plasma gas	Nitrogen

# MSWI Ash Treatment in Japan

## Integrated Gasification & Melting

### 1. Rotary Kiln Technology



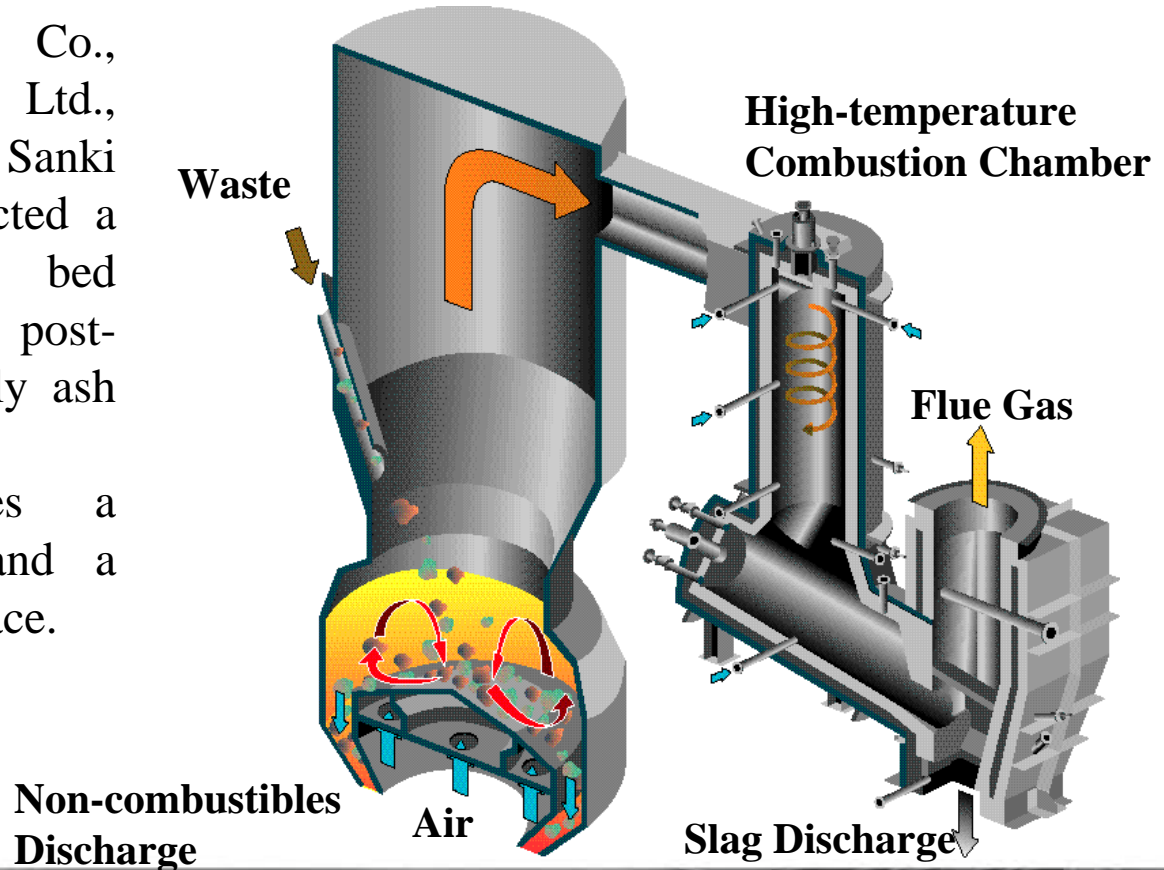
# MSWI Ash Treatment in Japan

## Integrated Gasification & Melting

### 2. Fluidised Bed Gasification + Post-combustion + Fly Ash Melting System

Ebara Co., Hitachi Zosen Co., Kawasaki Heavy Industries Ltd., Kurimoto, Ltd. and Sanki Engineering Co., Ltd. selected a major route: fluidised bed gasification followed by post-combustion incorporating fly ash melting.

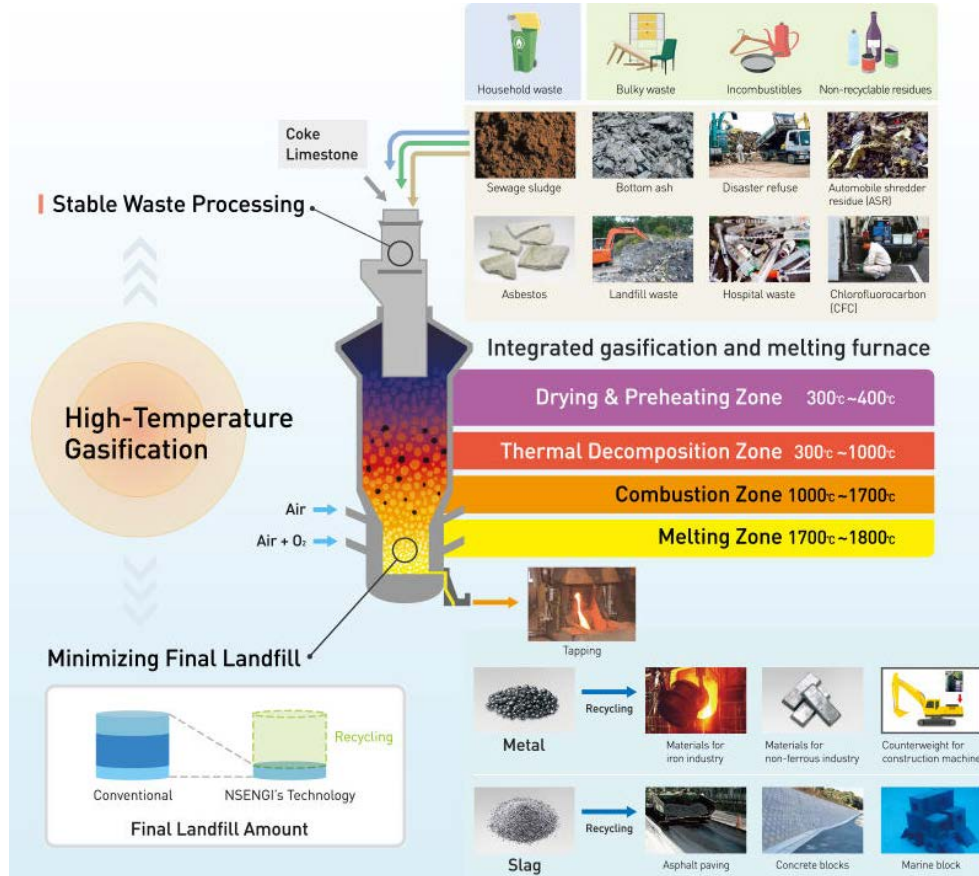
- The TIFG comprises a fluidized-bed gasifier and a circular ash-melting furnace.



# MSWI Ash Treatment in Japan

## Integrated Gasification & Melting

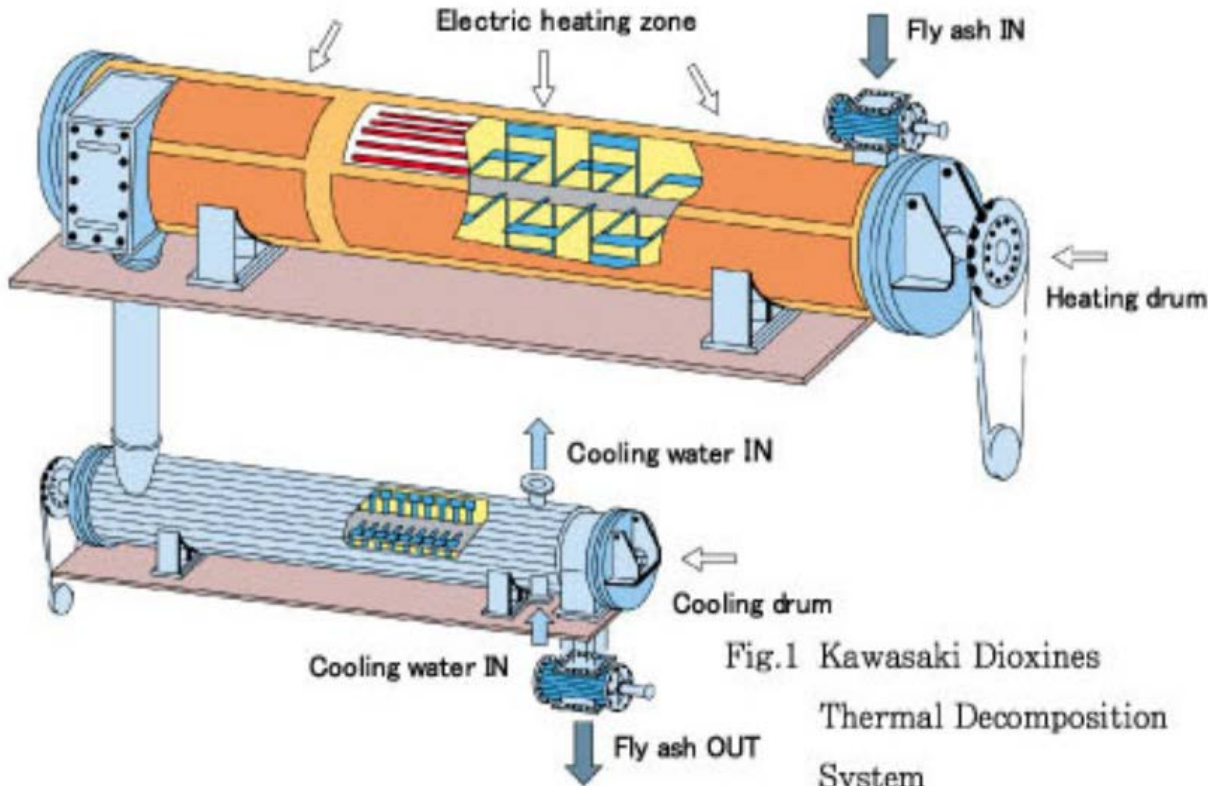
### 3. Gasifying and Direct Melting System



*Nippon Steel & Sumikin  
Engineering Co., Ltd  
JFE Engineering Corporation*

# MSWI Ash Treatment in Japan

## Thermal Treatment to Destroy Dioxins Hagenmaier Drum Treatment

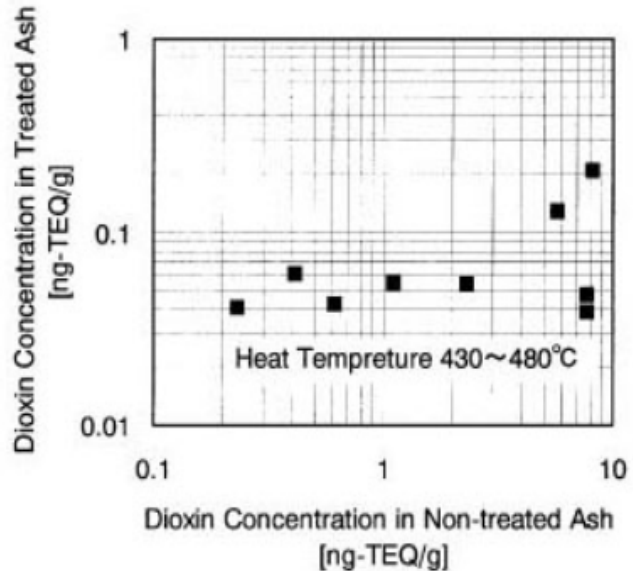
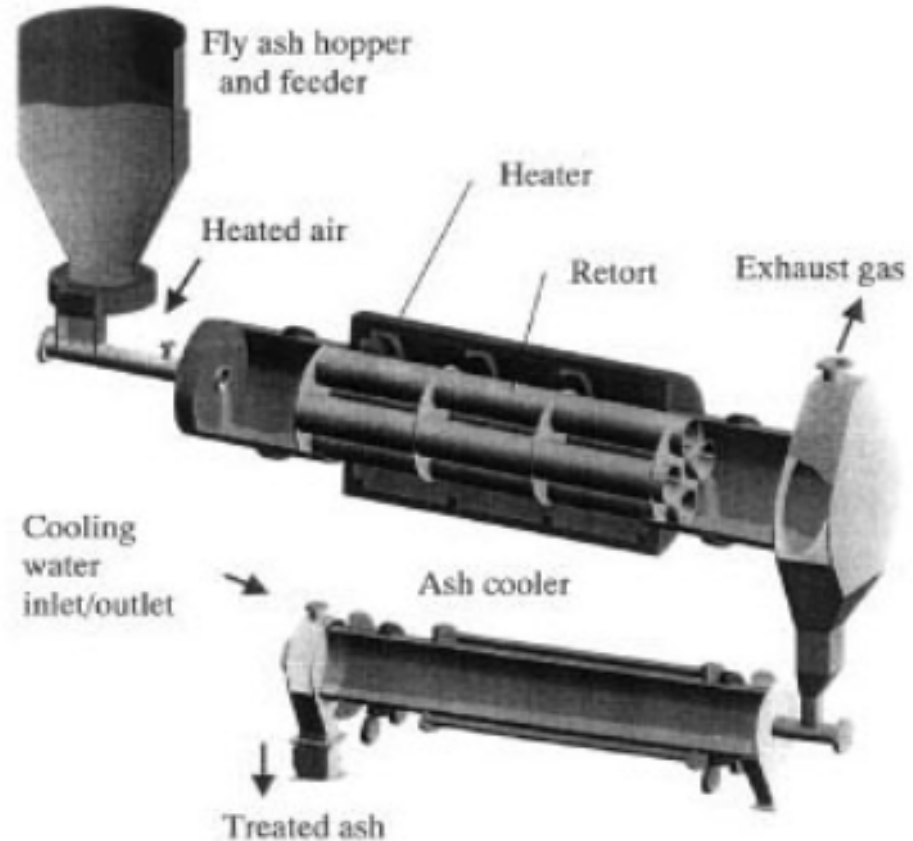


- Used to thermally decompose dioxins contained in fly ash from electrostatic precipitator or bag filters, under oxygen-deficient condition. Fly ash temperature is up to 400°C, for at least 30 minutes, followed by rapid cooling to 100°C.
- This solution is offered by:  
Kawasaki Heavy Industries Ltd.  
Hitachi Zosen Corporation  
EBARA Corporation

# MSWI Ash Treatment in Japan

## Thermal Treatment to Destroy Dioxins

- Diobreaker unit
- Temperature 450 °C (400-550°C) followed by rapid cooling.
- Circulation of air



# Summary

- Dioxin emission has rapidly decreased in Japan.
- Many kinds of ash treatment techniques have been developed in Japan.
- MSWI ash is recycled as eco-slag after thermal treatment.
- MSWI ash is also used as cement raw material in Japan.
- In some cases, MSWI ash is economically processed by specialized manufacturers of thermal treatment.
- Above techniques can be used for minimizing dioxins emission in the world.

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# Thank you for your attention!

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