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Plastic Waste Management Institute
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Plastic Waste in Tokyo: From Landfilling to Recycling

For Tokyo's 23 wards (the 23 administrative wards making up central Tokyo), household plastic waste that up to now has been disposed of in landfills will be recycled by either material recycling, chemical recycling, or energy recovery from October 2008.

In 2004, the Tokyo Metropolitan Government (TMG) received a report titled "Plastic Waste: A Valuable Resource Inappropriate for Landfills" from the Tokyo Waste Management Council (chairman: Professor Tanaka Masaru of Tottori University of Environmental Studies). This report led to a major shift in thinking about plastic waste and put Tokyo on the path toward discontinuing the disposal of plastic waste in landfills and playing a bigger role in the creation of a recycling-oriented society.

It has also been decided that industrial plastic waste that up to now has been disposed of in a Tokyo landfill will be gradually phased out as landfill from 2008 with the aim of achieving zero landfill disposal by 2011.

To deal with industrial plastic waste that will no longer be accepted at the Tokyo landfill, a world-class gasification system and melting furnace has began operation near the landfill signaling a major move from landfilling to recycling for plastic waste discharged from Tokyo.

1 2004: Tokyo Waste Management Council Reports That Plastic Waste is Unsuitable for Landfills

Relegation of plastic waste to landfills

The reason why most plastic waste generated in Tokyo's 23 wards has been disposed of in landfills up to now (some plastic waste like PET bottles and white food trays has been collected for material recycling) originates in the 1973 decision by the TMG that "plastic waste is unsuitable for incineration."

At that time, incineration facilities within Tokyo were meager and lacked the capacity to handle the ever increasing volume of plastic waste. There was therefore no other choice but to dispose of plastic waste in landfills.

Landfill sites become scarce

In recent years, however, the lives of remaining final disposal sites (landfills or reclaimed land) for industrial waste has become a major problem as land suitable for such sites becomes scare and obtaining consent from local residents for creating new sites becomes difficult. For Tokyo, which is mostly urban,

this problem is particularly grave compared to other regions.

In Tokyo, the 230ha Chuo Bohatei landfill lies outside the central breakwater in Tokyo Bay (see photo). This disposal site is said to have 30 years left in its life under present conditions.

Considering, however, the extreme difficulty of creating new disposal sites in Tokyo, finding a way to extend the life of this disposal site has become a major issue.

The above circumstances generated discussion on whether disposing of ever increasing plastic waste is good after all. The argument was that plastic waste is a valuable resource, that disposing of it in landfills is a waste, and that such disposal should be discontinued to extend the life of final disposal sites.

At the same time, the upgrading of existing incineration sites and the construction of new sites in Tokyo has been progressing in recent years, and the total incineration of plastic waste from households has become a possibility. New incineration facilities, moreover, are equipped with a function for preventing the generation of dioxins and other pollutants. As a result, they sufficiently clear regulations with regard to environmental pollution, and this has prompted Tokyo residents to accept the use of plastic waste for energy recovery (the generation of electric power from the heat produced by burning plastic waste at incineration facilities).

Against this background, the Tokyo Waste Management Council issued a report in 2004 titled "Plastic Waste: A Valuable Resource Inappropriate for Landfills" advocating the goal of zero disposal of plastic waste in landfills.

Tokyo Harbor Chuo Bohatei Landfill (the area afloat on the ocean surface at the bottom of the photo is the landfill)

2 Almost All Household Plastic Waste to Be Recycled or Used for Energy Recovery from Fall 2008

Trial collection commences in various areas in fiscal 2006

On receiving the report from the Tokyo Waste Management Council, the General Assembly of Ward Mayors of Tokyo's 23 wards decided in October 2005 that household plastic waste, which up to then had been disposed in landfills as nonburnable trash, would be recycled. This decision was followed in fiscal 2006 by the start of trial collections in some areas based on a new trash sorting system.

In 2008, as full implementation nears, trial collections are being performed in all 23 wards, and from October, collection will begin in all areas based on new sorting standards and almost all types of plastic waste will be recycled.

In this way, plastic waste polices have taken a major change in direction from landfilling to recycling, and since plastic waste that was formerly treated as nonburnable trash will now be treated as a resource or burnable trash (for energy recovery), it has been essential that Tokyo residents be well informed and that understanding of this matter be promoted.

For more than two years now, concerned departments in Tokyo's 23 wards have been conducting meetings to explain the collection of plastic waste based on new sorting rules and have been engaged in PR activities such as creating compelling posters and distributing explanatory pamphlets.

Differences in collecting and processing methods between wards

Although full implementation of plastic waste recycling is to go into effect from October 2008, the methods used differ from one ward to the next. (See the table "Methods of collecting plastic waste in Tokyo's 23 wards" below.)

For example, in Minato ward, one of Tokyo's three central wards, all types of plastic waste discharged from households—including plastic waste other than containers and packaging—are lumped together for collection with the exception of PET bottles. The plastic waste so collected is brought to a trash disposal facility where it is then sorted and used mostly for chemical recycling.

In contrast, six wards including Setagaya collect plastic waste other than PET bottles as burnable trash and use it for energy recovery (power generation).

Which methods to adopt depend on a ward's finances (shorting and collection expenses) and state of intermediate processing facilities (sorting, compression, packing).

Methods of collecting plastic waste in Tokyo's 23 wards

○: Collected as a resource
△: partially collected as a resource with remainder for energy recovery
★: Collected as burnable trash for energy recovery

Type / Ward	PET Bottles	Food Trays	Plastic Containers and Packaging	Other Types of Plastic
Chiyoda	○	○	○	★
Chuo	○	○	○	★
Minato	○	○	○	○
Shinjuku	○	○	○	★
Bunkyo	○	△	★	★
Taito	○	○	△	△
Sumida	○	○	★	★
Koto	○	○	★	★
Shinagawa	○	○	○	★
Meguro	○	○	○	★
Ota	○	○	★	★
Setagaya	○	★	★	★
Shibuya	○	○	★	★
Nakano	○	○	○	★
Suginami	○	○	○	★
Toshima	○	○	△	★
Kita	○	★	★	★
Arakawa	○	△	★	★
Itabashi	○	○	△	★
Nerima	○	○	○	★
Adachi	○	★	★	★
Katsushika	○	○	○	★
Edogawa	○	○	○	★

Effect of energy recovery

According to estimations made by departments processing household trash in Tokyo's 23 wards, changing the disposal of household plastic waste from landfilling to energy recovery will reduce processing expenses by about 5.2 billion yen.

On the other hand, there are those that think that energy recovery will increase greenhouse gases significantly compared to landfilling, but initial calculations estimate only a slight increase of about 7,000 tons annually.

Future issues

Starting in the fall of 2008, nearly all plastic waste discharged from households in Tokyo's 23 wards will be recycled in some form or another.

But, as described above, the methods used to achieve this are not uniform. From a WLCA (Waste Life Cycle Assessment) perspective, this can be viewed as a great experiment in evaluating which method or methods are superior.

In two or three years time, this great experiment may clarify the efficiency of sorted collection, the morale of dischargers (residents), the costs associated with collecting and processing (recycling), etc.

At any rate, the issue of the future will be finding out to how to make good use of the results of this great experiment to construct a more efficient processing system.

Expense Reduction Effect (Estimation)

Outlay	Cost of processing burnable trash (incineration)	▶ Increased use of chemical agents, power, etc.	▶	**Increase of about 0.7 billion yen**
	Cost of processing nonburnable trash	▶ Decrease in nonburnable trash	▶	**Decrease of about 3.8 billion yen**
	Outsourcing cost of landfill disposal	▶ Decrease in landfill disposal	▶	**Decrease of about 1.0 billion yen**
Income	Increase in income from power sales	▶ Increase in trash and generated heat	▶	**Increase of about 1.1 billion yen**

Total reduction in outlay (trash processing expenses) of about 5.2 billion yen

Greenhouse Gases (Estimation)

	Amount of greenhouse gases generated in fiscal 2008 (full-scale implementationof energy recovery)		
Compared with fiscal 2007 prior to implementation of energy recovery	Increase in greenhouse gases due to incineration of plastic waste	▶	**Increase of about 166 thousand tons**
	Decrease in greenhouse gases generated from final disposal sites (methane)	▶	**Decrease of about 96 thousand tons**
	Effect of controlling greenhouse gases at power company	▶	**Decrease of about 63 thousand tons**

Greenhouse gases increase slightly by about 7 thousand tons

3 Toward Zero Disposal of Industrial Plastic Waste in Landfills by 2011

Recycling as described above does not target only trash discharged from households. Progress is being made in recycling industrial plastic waste and reducing its disposal in landfills to zero by 2011.

Restricting landfill amounts gradually from fiscal 2008

Up to now, most of the industrial plastic waste generated in Tokyo has been disposed in the Chuo Bohatei landfill the same as domestic waste (waste from households).

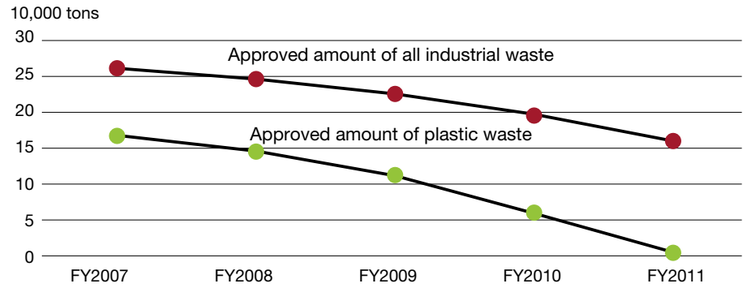
Starting in January 2008, however, the amount of industrial plastic waste accepted at the landfill will be gradually reduced with the aim of achieving zero landfill for this type of waste by 2011.

From landfilling to recycling promotion

It is said that most of the plastic waste that is currently being disposed of in the Chuo Bohatei landfill is suitable for energy recovery.

The TMG has consequently instructed that plastic waste that has nowhere to go due to reduction in approved landfilling amounts is first to be collected for material and chemical recycling while plastic waste not suitable for those types of recycling is to be used for energy recovery.

Plan for reducing approved amounts of industrial waste (approved amounts for landfilling) at Chuo Bohatei landfill



4 Tokyo Waterfront Recycle Power: A New Large-scale Plant at the Frontline of Energy Recovery from Industrial Waste

Featuring world-class waste melting facilities, Tokyo Waterfront Recycle Power Co., Ltd. shows great promise as a new means of handling industrial plastic waste that will eventually be refused at the Chuo Bohatei landfill.

Turning industrial waste into slug by gasification and melting

Tokyo Waterfront Recycle Power is a cutting-edge industrial waste treatment plant that began operation in August 2006. It is located very near the Chuo Bohatei landfill where plastic waste has traditionally been brought for final disposal.

The plant features a gasification furnace and melting furnace for industrial waste having a capacity of 550 tons/day and a vertical furnace for treating infectious medical waste having a capacity of 50 tons/day. The heat generated by both furnaces is used

for generating power.

The former capacity of 550 tons/day corresponds to one third of the industrial plastic waste discharged in one day within Tokyo while the latter capacity of 50 tons/day corresponds to two thirds of the medical waste generated in one day in Tokyo.

The gasification and melting furnaces melt construction debris (mostly interior finishing material that includes plastic), shredder dust from electrical appliances, office-related plastic waste, etc. at 1,450° C and collects the final result as slag.

In the process flow, waste that has been cut down to a fixed size or smaller at an intermediate processing plant is first treated in the gasification furnace to extract iron and aluminum. Remaining waste is then conveyed to the melting furnace where it is melted and recovered as slag.

About 50 tons of this slag is shipped out daily as an alternative product to sand for use as base material in road beds, backfill material, etc. The demand for this slag is such that the plant is hard pressed to keep up with orders. Of course, the iron and aluminum recovered from the gasification furnace are sold as valuable resources.

* Size of accepted waste

Wires and metal waste must be broken down to 15 cm or less; nets, ropes, polyethylene tanks, etc. to 30 cm or less; and interior finishing material, sheets, tent material, tatami (straw matting), bedding, blankets, cloth, etc. to 50 cm or less.

Processing capacity of 50 tons/day for infectious medical waste

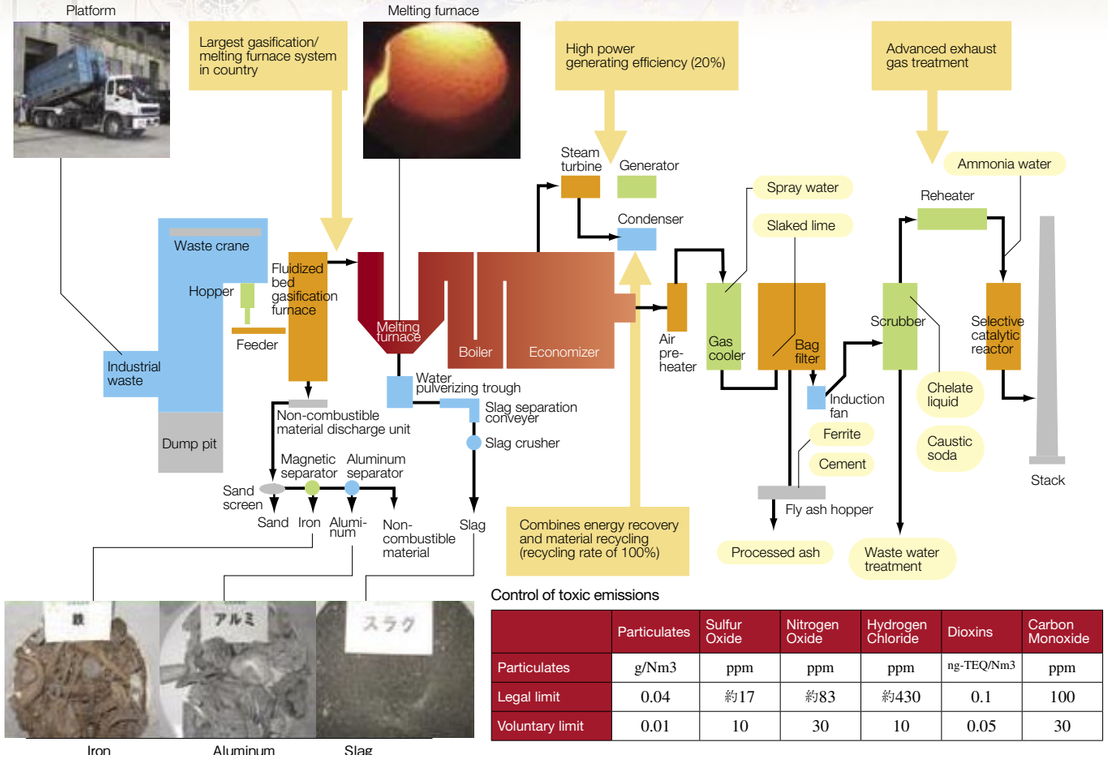
This plant is also designed to treat medical waste such as syringes, needles, and gauze including plastic products with an incineration capacity of 50 tons/day.

The medical waste brought into this plant comes from about 2,000 hospitals and clinics located in Tokyo and three neighboring prefectures. To get such waste to the plant, a medical institution inserts the waste into a specially prepared container, seals the container, and consigns it to a carrier for transport.

Then, at the plant, the medical waste is thrown into a special furnace container and all to prevent infection from that waste.

View of plant

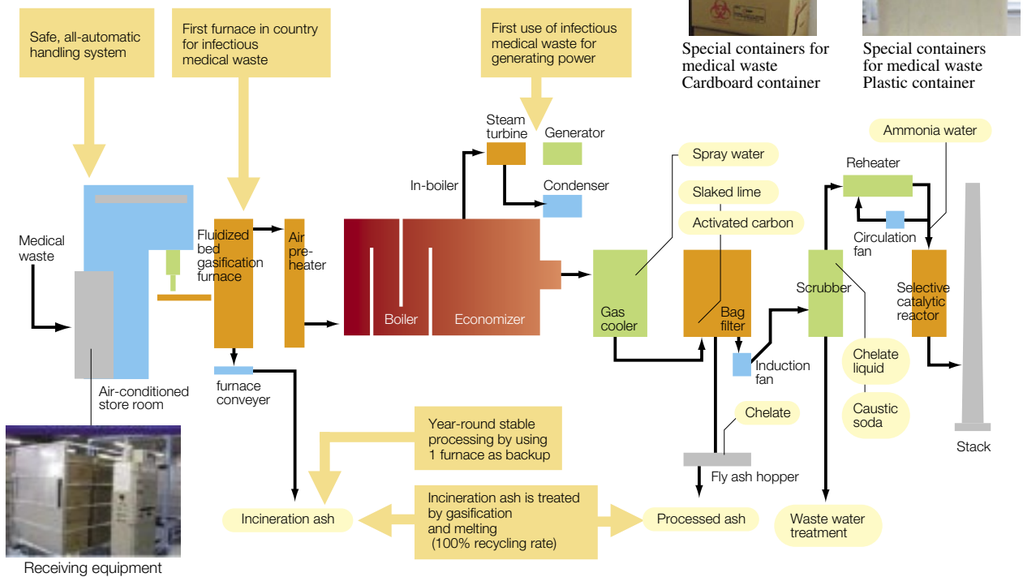
Process flow of industrial waste treatment



Control of toxic emissions

	Particulates	Sulfur Oxide	Nitrogen Oxide	Hydrogen Chloride	Dioxins	Carbon Monoxide
Particulates	g/Nm3	ppm	ppm	ppm	ng-TEQ/Nm3	ppm
Legal limit	0.04	約17	約83	約430	0.1	100
Voluntary limit	0.01	10	30	10	0.05	30

Process flow of medical waste treatment



Receiving equipment

Special containers for medical waste Cardboard container

Special containers for medical waste Plastic container

Power generation from the gasification and melting system and from the medical waste furnace too

Tokyo Waterfront Recycle Power has a steam turbine generator having a capacity of 23,000 kW (55,000 households worth). It generates power using the steam from boilers connected to the gasification/melting furnace and medical waste furnace.

At present, the plant generates about 15,000 kW of electric power with about 6000 kW of that used for the plant itself and the remaining 9,000 kW sold as excess power to Tokyo Electric Power Co.

The power generating efficiency of this plant is high at 20%. This is due to the 400°C high-temperature steam produced by the gasification/melting furnace.

The special furnace used for medical waste requires that a chlorine gas countermeasure be taken since medical waste includes products with vinyl chloride. This holds down steam temperature to 257°C.

Helping to prevent global warming by reducing CO_2 emissions

An important feature of power generation from waste at Tokyo Waterfront Recycle Power is that it contributes to reducing carbon dioxide emissions.

But, in actuality, the system generates carbon dioxide as an incineration process. However, the plant's large power-generating capacity means that it can sell excess power to Tokyo Electric Power resulting in less power generated by that company thereby contributing, though indirectly, to a reduction of carbon dioxide emissions. Calculations show that reduction effects of about 86% and 60% are achieved by the gasification/melting furnace and medical waste furnace, respectively, the latter being lower due to the somewhat poorer efficiency of that furnace.

Another feature that should be mentioned here is that the power generated by the plant has been approved as a Renewable Portfolio Standard (RPS). This is because biomass (paper scraps, wood chips, etc.) included in industrial waste has been deemed useful in generating power as an alternative form of energy. The price of this power is consequently a bit higher than that generated by ordinary industrial waste.

The mixture rate of biomass is calculated twice a month from analysis. It was found to be at the 39% level last year, but recent data have shown it to have dropped below 30%. As part of the electric power sold, this 30% is power targeted as RPS.

Japan's RPS law obligates power companies to self-generate or purchase alternative forms of energy at or above a certain amount. Biomass including paper scraps, wood chips, etc. is considered to be one type of alternative energy.

Dynamo

Tokyo Waterfront Recycle Power Co., Ltd. Business Scheme

Shareholders
Tokyo Electric Power Company (largest power company in Japan): 73%
Tokyo Electric Power Environmental Engineering Co., Inc. (subsidiary of Tokyo Electric Power): 7%
Ebara Corporation (environmental facilities manufacturer): 12%
SHIMIZU CORPORATION (general construction firm): 5%
ORIX Eco Services (environmental management and consulting firm): 3%

Premises
Reclaimed land being purchased from Tokyo Metropolitan Government (basic agreement concluded)

Funding
Funds received from Ministry of Economy, Trade and Industry and Ministry of the Environment

Business Scope
Acceptance of waste
Waste treatment and power generation
Facilities operation and management

Processing Facilities
Industrial waste
Fluidized bed gasification system with melting furnace
Capacity: 275 tons/year × 2 trains
Infectious medical waste incinerator
Capacity: 50 tons/year × 2 trains; one for regular use, one for backup

Power Capacity
23,000 kW; excess power sold to Tokyo Electric Power

Processing Capacity
Industrial waste
550 tons/year (about 165 thousand tons/year)
Infectious medical waste
50 tons/year (about 18 thousand tons/year)