Incineration of Municipal Waste and Measures against Dioxin in Japan

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Introduction

It was in 1983 that dioxin was detected from fly ash emitted from municipal solid waste(MSW) incinerators in Japan. Since then, the Ministry of Health and Welfare has executed numerous researches on the generation mechanism and control of dioxin. Based upon the results of the researches, the Ministry entrusted a group of experts to conduct a study on measures to be taken against dioxin, and finally issued "the Guidelines for the Prevention of Dioxin Generation from MSW Incinerators" in December 1990.In June 1996,"The Conference for examining the measures to reduce dioxin in connection with waste disposal" was established ; and in January 1997,the Guidelines was amended

The present situation of MSW management in Japan

(1) Measures currently implemented in Japan

In Japan, we are reducing the volume of waste and promoting recycling along with incineration of combustible waste; in addition, we are promoting "recyclic treatment of waste " which involves the use of heat generated from incineration.

The Ministry of Health and Welfare has been pursuing an initiative through a project which subsidizes the waste disposal facilities established by municipalities with public funds. In 1994, the project for creating a recyclid waste treatment infrastructure was started, in order to subsidize incineration facilities, which supply other facilities with electric power by power generators of their own, as well as RDF (refuse derived fuel) facilities and facilities related to recycling.

In "The 5-year Plan for Establishing Waste Disposal Facilities(8^{th})" started in 1996, the target for project by the year 2000 is given based on the assumption that the annual growth rate of waste volume per capita is 0.5%.

Moreover, under the Law for Promotion of Separate Collection and Recycling of Containers and Packages that will actually come into force in April 1997, recycling of containers and packages, which accounts for about 60% of the total volume of municipal waste, will be promoted by classifying the role of individuals as follows: (1) Consumers shall cooperate with separate collection of MSW; (2) Municipalities shall collect containers and packages by type; and (3)

Enterprises shall recycle containers and packages collected by municipalities by themselves or subcontract such operations to designated recycling corporations.

(2) Volume of waste and the situations of waste disposal

The total volume of municipal waste was 50.3 million tons in a year (up 0.2% from the previous year) and the daily volume of waste per capita was 1,103 g, both of which have leveled off in the last few years, as shown in Fig. 1.

The rate of intermediate treatment, which accounted for 85.6%(Fig.2), has been increasing steadily year by year. This shows that as the waste treatment facilities have been established, intermediate treatment has been actively implemented. On the other hand, the volume of waste directly landfilled was 7.12 million tons, accounting for 14.4%, which decreased from the previous year(Fig.3).

The volume of recycled waste through separate collection in each municipality totaled 2.2 million tons, showing an increase from the previous year. The volume of recycable waste collected by local residents' organizations was 1.92 million tons. Fig. 4 shows the rate of recycling through resource recovery and group collection in each municipality was 8.0%, increasing year by year.

(3) Waste disposal facilities

As Fig. 5 shows, the number of incineration facilities in 1993 was 1,854, remaining at the same level over the past few years. Table 1 shows a change in the number of facilities according to the type of incinerator. There were 433 continuous type incinerators, 324 semi-continuous type incinerators, 866 mechanical-grate batch type incinerators, and 231 fixed-grate batch type incinerators. Those numbers have hardly changed over the past few years.

There were 2,321 final disposal facilities with residual volume at 149.31 million m^3, showing a tendency to decrease(Fig.6).

In order to obtain understanding and cooperation from residents, it is essential to carry out

any assessment. In a growing number of cases, it has become necessary to improve the environment around disposal facilities as well as facilities themselves.

Forming part of such efforts is the building of parks and green zones, swimming pools utilizing heat generated by incineration plants, tropical plant gardens, welfare for the elderly, rehabilitation facilities and city halls and supply of hot water and area-wide air conditioning.

(4) Significance of incineration as a method of intermediate disposal

The basic rule in waste disposal is to reduce waste through resource recovery and recycling, then treat waste with considerations for sanitary and environmental preservation. Since Japan is narrow country, it is difficult to keep sufficient landfill sites, it is common practice in Japan to incinerate waste then conduct final disposal with environmental considerations. Intermediate disposal is an effective and important process where waste can be reduced in terms of weight and volume, stabilized and made harmless. In particular, waste in terms of weight can be reduced to about 1/6 or 1/7 through incineration, thereby contributing significantly to environmental preservation in our daily life. Therefore, about 3/4 of the total waste is currently disposed through incineration.

(5)Use of heat from waste incineration

Heat generated by waste incineration plants is used in various ways; power generation, air conditioning and hot water supply, hot water swimming pools, hot water and energy supply to social welfare facilities like facilities for elderly, and energy supply to local air conditioning. Surplus heat is most widely used for air conditioning and water supply to facilities.

Waste power generation is an effective way of using surplus generated by waste incineration plants. Under the system, thermal energy from high-temperature exhaust gas generated from waste incineration is collected by boilers, which generate steam to rotate facilities.

It is at Nishiyodo Plant of Osaka City in 1965 that surplus heat was first used for power generation. The national government has since promoted power generation by surplus heat. For example, it has extended subsidies to local governments which have built facilities to use surplus

heat when they built new waste incineration plants or renewed existing plants.

As of the end of fiscal 1994, power was produced at 135 waste incineration plants. Total power generation capacity stood at some 450,000 kW, equivalent to the power consumption of about 1.2 million households or Yokohama City. Moreover,50 to 60 incineration plants sell excess power to electric power companies, accounting for 40% of the plants with power generation(Fig. 7 and Fig.8)

Guidelines for preventing dioxin generation in MSW treatment

(1) Background

There seems to be diverse sources of dioxin (and the like), as it is generated during combustion of materials. In Japan, the volume of dioxin generated at incineration facilities accounts for 80% to 90% of total dioxin. Therefore, it is imperative that dioxin generated at incineration facilities be reduced.

The Ministry of Health and Welfare set out "Guidelines for preventing dioxin generation" (hereinafter referred to as "Old Guidelines") in 1990 to guide local governments. In response to a suggestion from the public welfare study group to use 10pg-TEQ/kg/day instead of TDI currently used, "The Conference for examining the measures to reduce dioxin in connection with waste disposal" was established in June 1996; and in January 1997, "Guidelines for preventing dioxin generation in connection with municipal waste disposal" (hereinafter referred to as "New Guidelines") were established.

(2) The salient points of the guidelines

New Guidelines, not only to reduce generated dioxin but also to prevent the generation itself as much as possible, aim at adopting the best available technology to prevent adverse effects on our health. In order to reduce dioxin at MSW incinerators established by municipalities, the New Guidelines require the following measures:

[1] Promotion of recycling and Reduction of waste. It is important to reduce the amount of waste to be incinerated by restricting waste discharge and promoting recycling.

[2] Measures adopted against emitted gas.

(i) New incinerators. Incinerators which will be constructed in the future, in principle, must be continuous type incinerators. By setting the standard of dioxin density at 0.1ng-TEQ/Nm^3, which is at the same level as western developed countries, the New Guidelines show some measures to achieve this standard.

The measures include homogenization of waste content, stabilization of operation load, good combustion practice, low temperature at the entrance of dust collectors, and exhaust gas disposal using advanced technology such as activated carbon absorption.

(ii) Existing incinerators. Measures will be adopted at the following two stages:

○ From the viewpoints of adverse effects on human health, the standard for judging whether emergency measures are necessary or not is given as 80ng-TEQ/Nm^3, based on TDI at 10pg-TEQ/kg/day. Emergency measures should be implemented immediately at the facilities where the emission density exceeds 80ng-TEQ/Nm^3. The measures include appropriate combustion management, changing from intermittent operation to continuous operation, improvement of facilities (such as changing from electric precipitators to fabric filter dust collectors), and suspension of operations or closure of facilities.

○ From the viewpoint of adopting the best available technology, even when the emission density is less than 80ng-TEQ/Nm^3, permanent measures will be adopted systematically, with an aim towards achieving the following standards through the similar measures adopted for new incinerators. Under the Old Guidelines standards for existing incinerators are: 0.5ng-TEQ/Nm^3 for continuous type incinerators, 1ng-TEQ/Nm^3 for semi-continuous type incinerators, and 5ng-TEQ/Nm^3 for intermittent operation incinerators.

[3] Broader-based waste disposal. As combustion in small-scale intermittent running incinerators is unstable, it is difficult to adopt measures against dioxin. Therefore, neighboring municipalities work in cooperation to put them together for combustion in large-scaled continuous type incinerators. In order to actualize this, each local government will establish the broader-based project for waste disposal; and based on the project, each municipality will promote broader-based waste disposal regardless of the municipal boundaries.

[4] Disposal of bottom ash and fly ash. In order to reduce dioxin from bottom ash and fly ash, the decomposition treatment, such as melting solidification method, should be promoted.

[5] Measures adopted at landfill sites. The measures, such as soil capping, and reduction of the SS of leachate from disposal facilities, will be implemented at final disposal facilities in order to prevent scattering of bottom ash and fly ash which may contain dioxin.

[6] Follow-up measures. In order to steadily, promote above-mentioned measures it is indispensable to adopt follow-up measures as well. In each municipality, density of dioxin generated at incineration facilities must be measured on a regular basis (once a year in principle), the results of the measurement must be announced publicly, and the measures adopt must be constantly reviewed.

The Ministry of Health and Welfare will provide guidance to local governments in promoting the measures to be adopted against dioxin based on the New Guidelines.

Measures adopted against dioxin, and waste disposal system in the future

(1) Broader-based waste disposal

Each municipality has responsibility for municipal waste disposal. Therefore, in general, disposal of waste was performed within each jurisdiction. However, due to the transition to recyclic waste treatment and the advanced technology in waste disposal, it is also necessary to discuss the broader-based waste disposal. In particular, in local areas, when pursuing the following measures such as (1) the promotion of recycling, (2) the promotion of incineration and the maximum utilization of the residual heat, and (3) the implementation of measures against dioxin.

In short, we are now entering a period of revolution of the waste disposal system. Therefore, as shown in Fig. 9, measures adopted against dioxin are closely related to the waste disposal system as a whole in the future.

(i) Promotion of recycling. Compared to the current situation where facilities are located in

different areas, a broader-based system will facilitate recycling, as recyclable material can be collected at one place. This leads to a reduction in the volume of waste to be incinerated. Moreover, based on the Law for promotion of recycling of containers and packages, collection by type will be actively implemented; thus, it would be possible to recycle containers and packages on a broader basis.

(ii) Promotion of incineration and the maximum utilization of the residual heat. Combustible waste excluding material recycle waste should be incinerated as much as possible, thereby reducing the volume of waste for final disposal. The utilization of the residual heat results in the continuous operation of incinerators; in addition, thermal recycling enhances the conservation of primary fuel. This will eventually reduce the generation of greenhouse gases.

(iii) Measures adopted against dioxin. The New Guidelines state that incineration facilities, which will be constructed in the future, must be continuous type incinerators to reduce the quantity of dioxin. In order to employ continuous type incinerators, a certain volume of waste, in other words, a certain scale of population is required. Therefore, in a sparsely populated area, a broader-based system is necessary.

(2) Considerations for broader-based waste disposal

When broader-based waste disposal is carried out, a high cost as well as the measures beyond municipal boundaries will be often required. Therefore, each municipality must include the measures against dioxin in their respective waste disposal projects, adjust the measures between neighboring municipalities, and promote broader-based efforts toward systematically solving dioxin problems. For a well-balanced broader-based waste disposal, prefectural governments are required to adjust the measures between municipalities.

When examining broader-based waste disposal, it is necessary to consider the following matters: a scale for the broader-based waste disposal, timing for implementation, selection of a site where incineration facilities will be established, a combination with other facilities, preparation of various elements for implementation, effects of broader-based waste disposal and evaluation, and the methods for implementation.

(3) Broader-based waste disposal using RDF

When waste is disposed as proper RDF, it has a more stabilized quality than waste itself, thereby facilitating combustion control. Moreover, as RDF can be stored in a stable form over a relatively long period, RDF produced at each RDF facility can be collected at one place, used as fuel, and incinerated.

Therefore, because of these characteristics, the introduction of RDF facilities is highly recommended in the following cases:

(i) The case in which the transportation of waste is problematic since incineration facilities are located far away as a result of broader-based waste disposal;

(ii) The case in which the geographically condition make the implementation of broader-based incineration unfeasible (such as a solitary island); and

(iii) The case in which the utilization of RDF is widely promoted.

(4) Follow-up measures

In order to implement the above-mentioned measures steadily, follow-up measures must be adopted on a continuous basis. For this purpose, municipalities and prefectural governments must make concerted efforts; as a nation, it is necessary to review the state subsidy for waste disposal facilities with focusing on recycling, broader-based waste disposal, and disposal employing advanced technology.

Conclusion

In 1996, total discharge of dioxin from municipal waste incinerators is estimated about 4300g-TEQ/year. By taking measures against existing incinerators, constructing new full-continuous type incinerators, putting small-scaled facilities together, introducing RDF plants ,etc. It is possible to reduce most of discharge as Fig.10. Since it is said that discharge of dioxin from municipal waste incinerators occupies 80~90% of total, we expect that total concentration of dioxin in environment and our daily intake of dioxin will be greatly reduced.

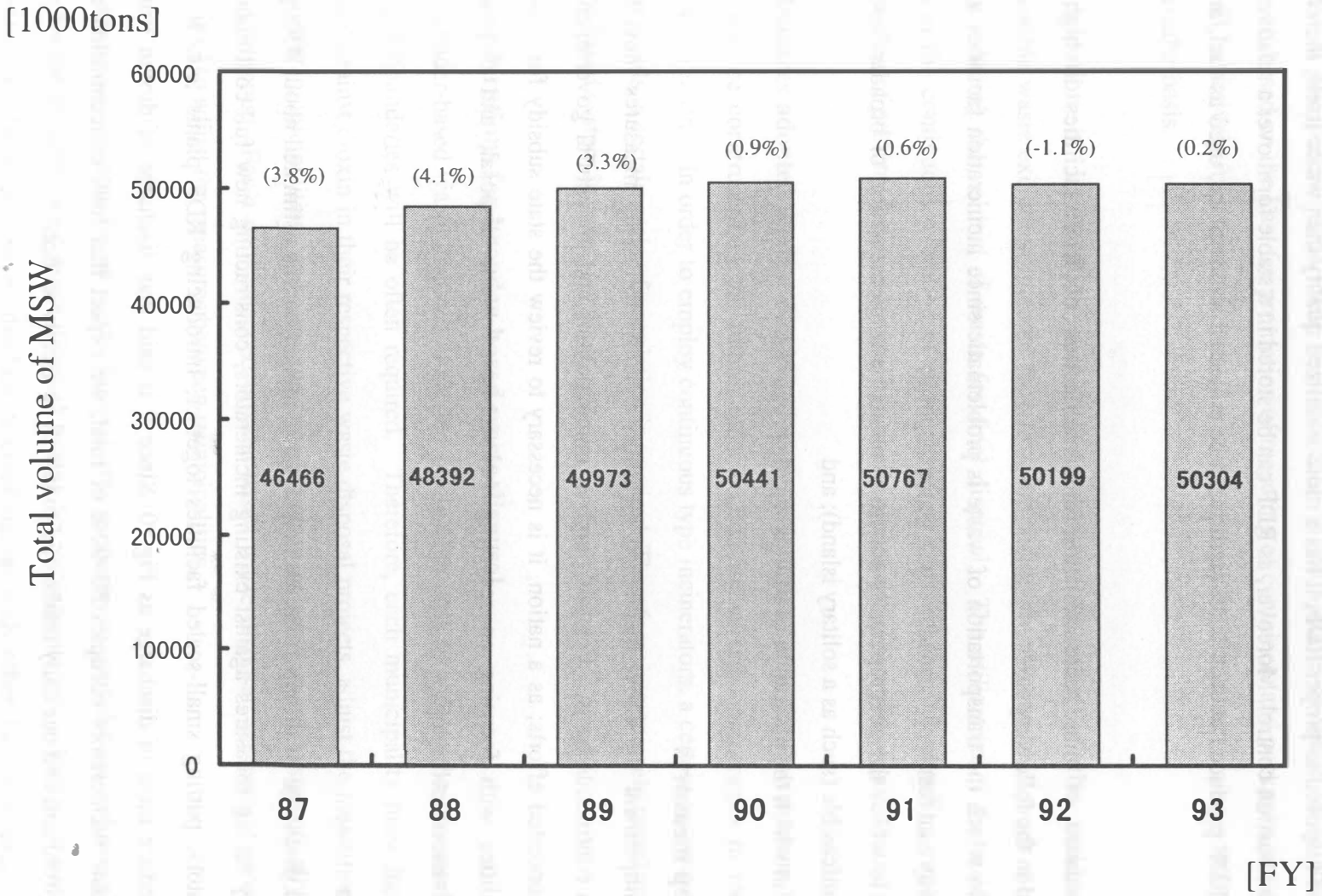


Figure 1. Change in total volume of MSW

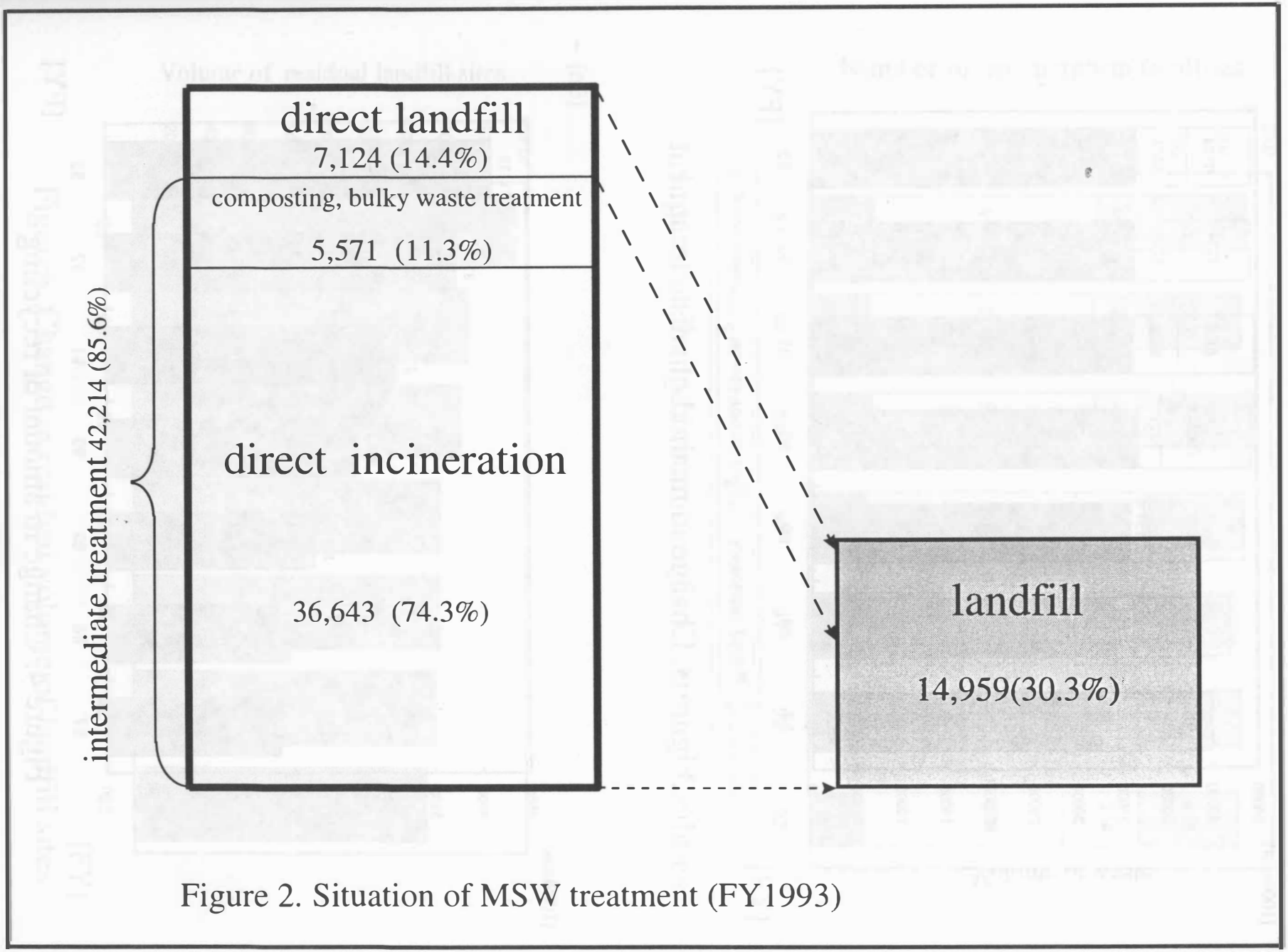


Figure 2. Situation of MSW treatment (FY1993)

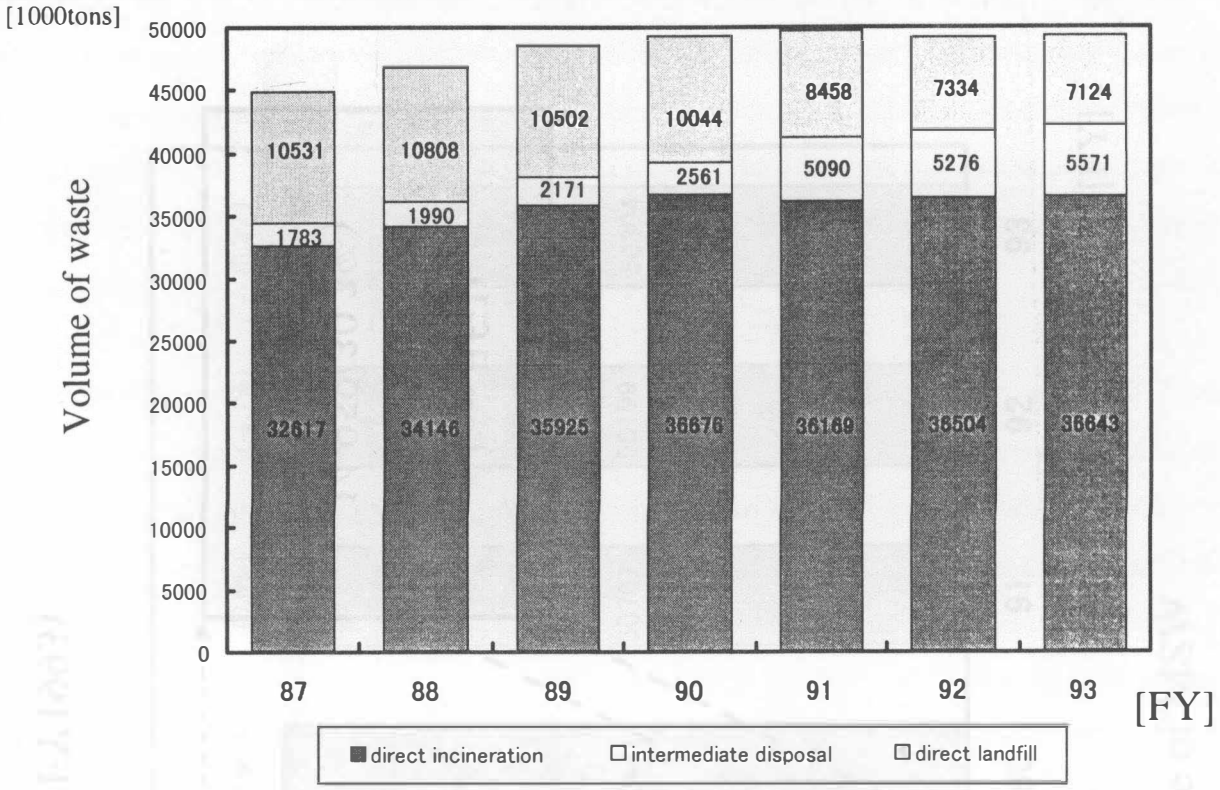


Figure 3. Change in method of waste treatment

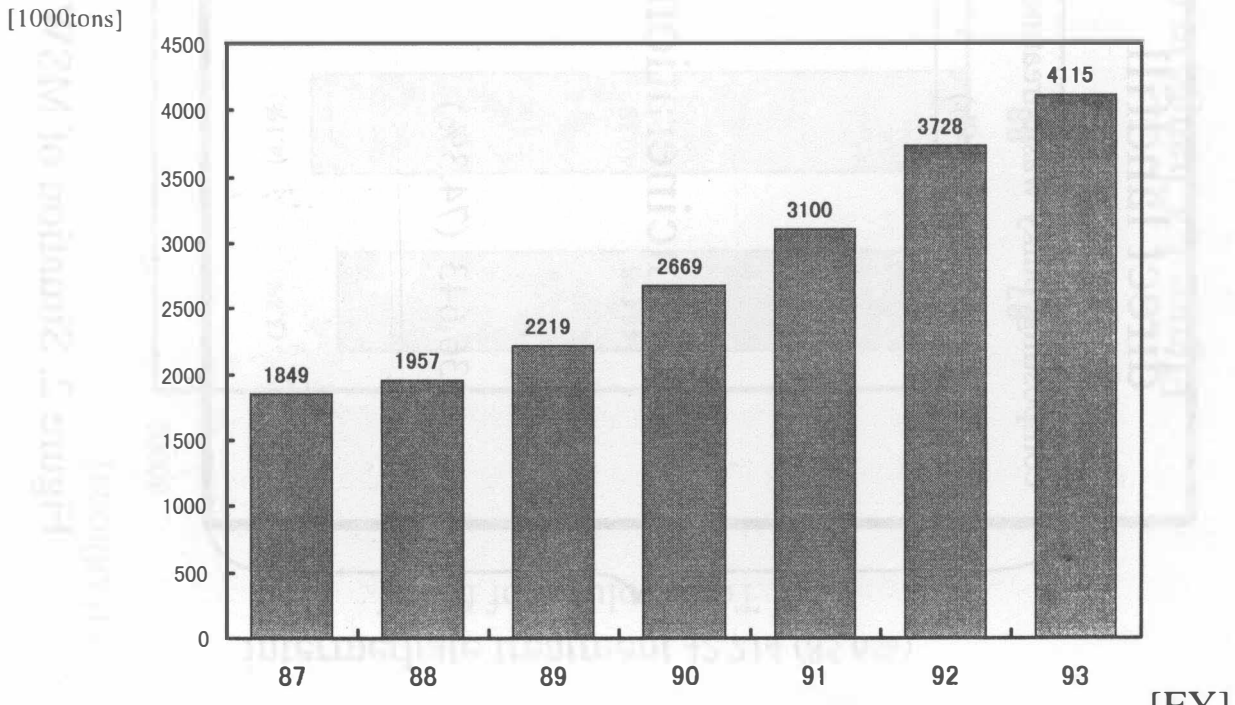


Figure 4. Change in amount of recycling

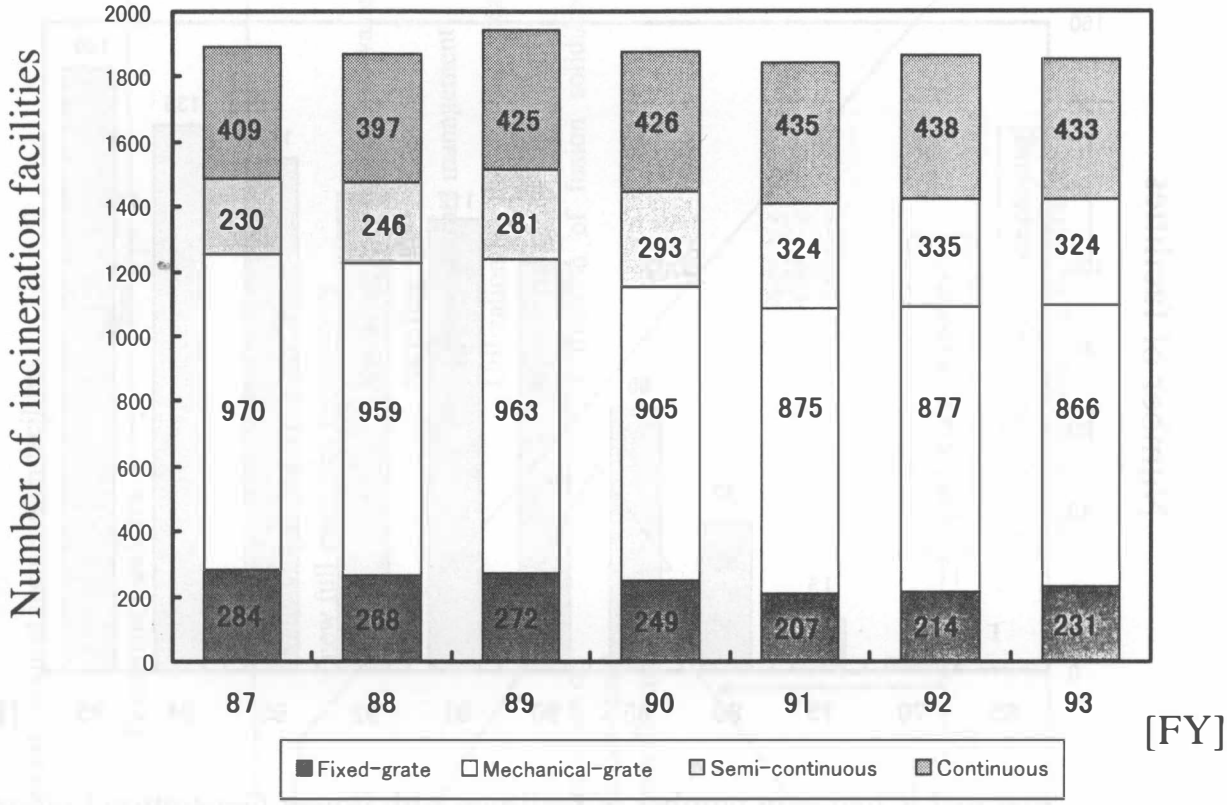


Figure 5. Change in number of incineration facilities

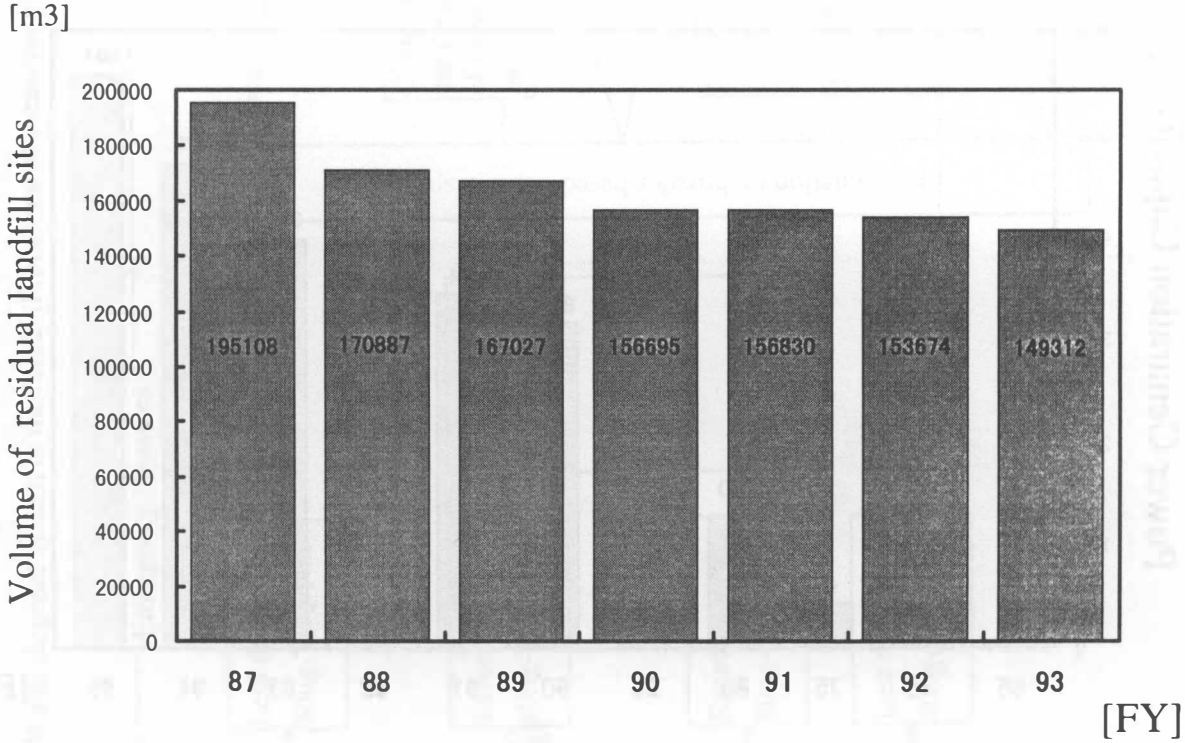


Figure6. Change in residual volume of landfill sites

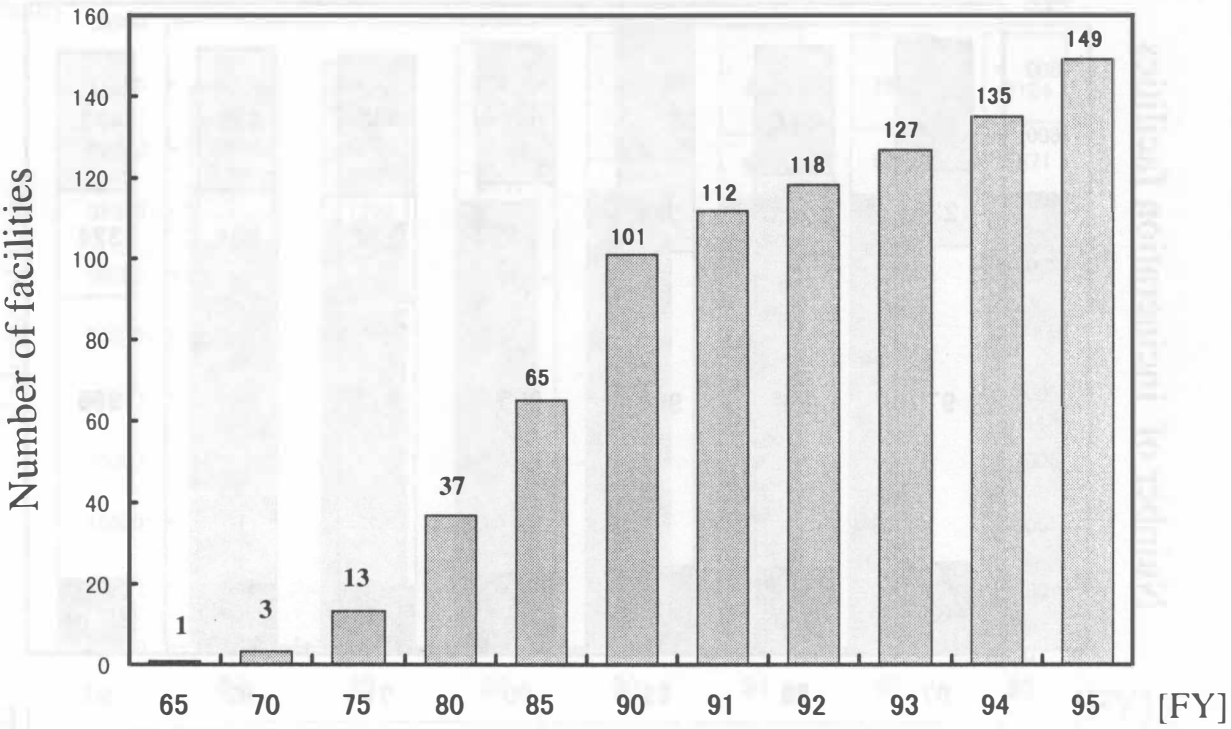


Figure 7. Change in number of facilities with Power Generation Equipment

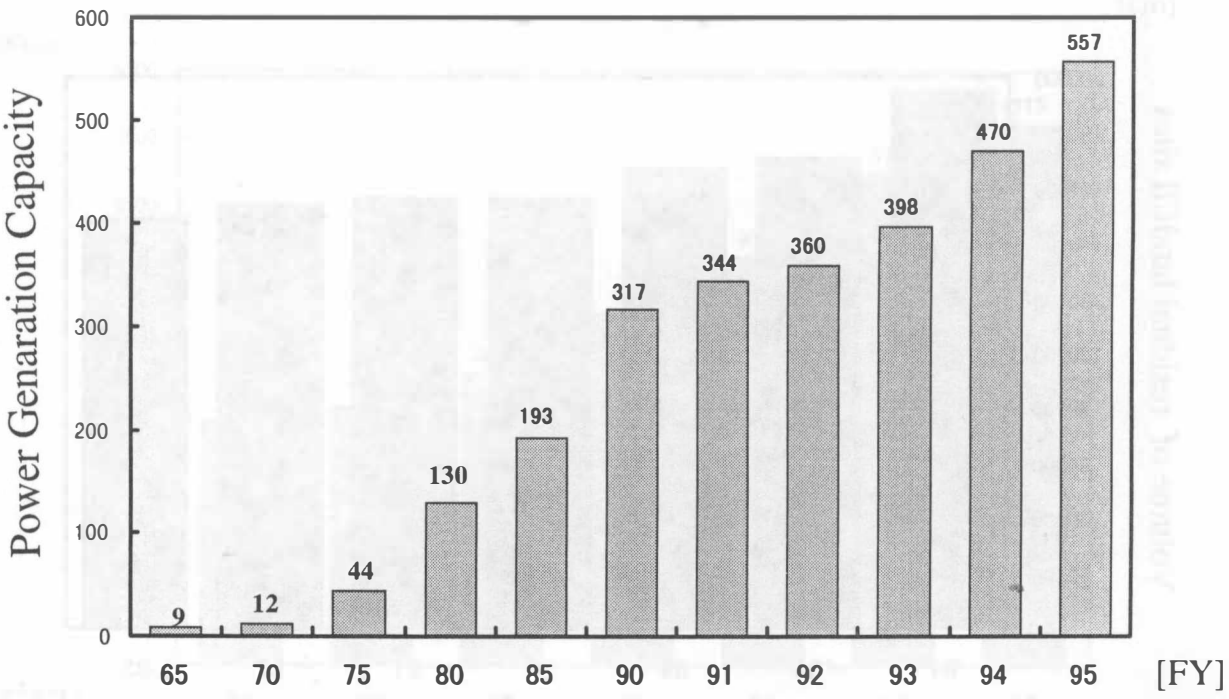
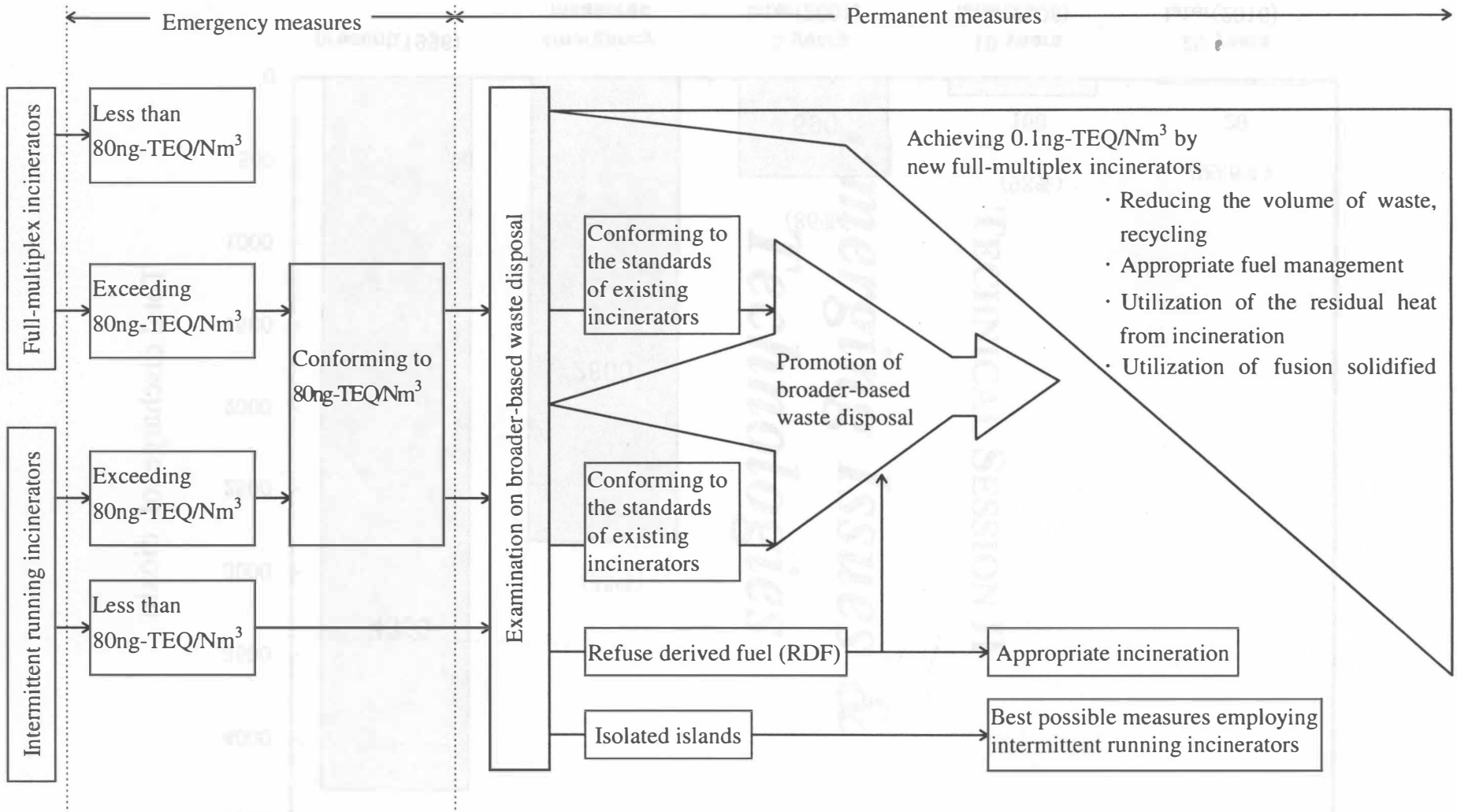


Figure 8. Change in Power Generation Capacity of waste incineration facilities

Fig. 9 Waste disposal system in the future (Promotion of measures to be adopted against dioxin at incineration facilities)



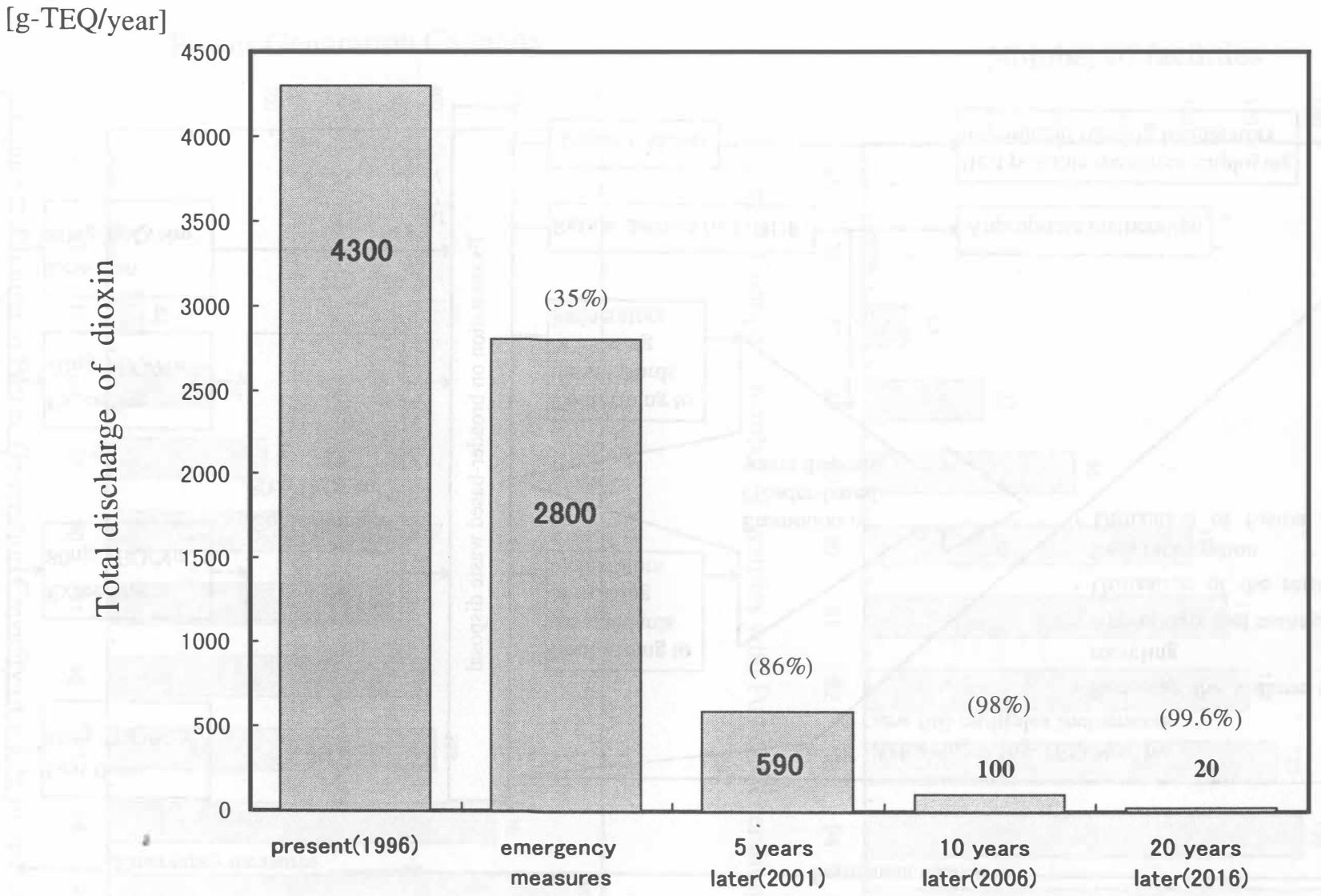


Figure 10. Total discharge and reduction rate of dioxin