DEVELOPMENT OF CLOSED SYSTEM （COVERED WITH ROOF etc.） DISPOSAL FACILITIES IN JAPAN

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ABSTRACT

In recent years there has been a sharp rise in the number of new final disposal facilities in Japan that are closed systems (hereinafter, "CS disposal facilities ").

This growing acceptance of CS disposal facilities can be attributed to broader public and government awareness regarding the advantages of these sites, including reduced environmental impact on downstream areas through leachate control, elimination of landfills' unclean image through facility coverings, and prevention of flying refuse (debris and dust).

The rise in acceptance can also be ascribed to the achievements realized in the more than fifteen years of research conducted by the Research Committee for Closed System Disposal Facilities.

In this paper, we discuss the committee's activities and endeavors, the concept of CS disposal facilities , trends in adoption of them in Japan as seen in past achievements, and the notable features and outlooks for several different types of systems.

INTRODUCTION

Although Japan has seen a leveling off of waste generation in recent years, the country still produces a total of 236 million tons of domestic and industrial waste annually. Recycling, incineration, and other intermediate processing reduce the quantity of waste disposed in landfills to 55 million tons, or approximately 23 percent of the original amount.

Japan is aiming to become a "recycling-oriented society," by actively inculcating more efficient uses of materials and increased recycling at each stage of the production process from manufacturing to distribution, from consumption to waste disposal. While these measures have resulted in declines in the amount of waste being deposited in landfills, Japan is still far from being free of the need for landfills as a means of final disposal. Meanwhile, remaining landfill capacity has been steadily declining, standing now at 12.2 years for domestic waste and 3.9 years for industrial waste. It seems evident that the country is facing an imminent shortage of capacity in industrial waste landfills. [1)]

But opposition from local residents is delaying construction of newly planned facilities. Among the reasons cited for their opposition are environmental problems, which residents are expressing in terms of a lack of faith in the seepage control work of disposal facilities, fears of leachate contaminating ground water, and concerns about the safety of treated water that will be discharged into rivers and streams. Residents also fear the deleterious effects on the "image" of their communities, which would suffer, in their view, from the notion that landfills are unclean—a view arising from experience with landfills constructed in the past.

For these reasons, in recent years there has been a rapid acceptance in Japan of closed system disposal facilities (hereinafter, "CS disposal facilities"), which have gained an image of cleanliness because of their ability to reduce and control the amount of leachate and consequently to control the amount of treated water discharged downstream. The fact that CS disposal facilities are also hidden from view also contributes to this image.

In this paper, we discuss the concept of CS disposal facilities, their degree of diffusion in Japan, and the attributes and outlooks for a number of different types of systems.

CONCEPT OF CS DISPOSAL FACILITIES

General concept of CS disposal facilities

CS disposal facilities are basically landfills with roofs or other forms of covering above them. Because they incorporate necessary enclosures, they prevent landfill

gases or leachate from affecting the surrounding environment, protect neighboring areas from flying debris and dust caused by the work taking place within the landfill, and keep the elements (wind, rain, etc.) out of the landfill. In a country such as Japan, which averages 1,500 mm of rainfall each year and experiences typhoons and other periods of heavy rain, roofs are the best means of avoiding the effects of the weather. Also, notwithstanding the general view that landfills are unclean, CS disposal facilities blend in harmoniously with the surrounding scenery because they adapt the shapes and colors of their roofs and other coverings to their environments. In addition, because they are enclosed facilities, there is a need to incorporate elements that improve the work environment, which means the addition of ventilation systems and lighting equipment.
A schematic drawing is shown in Fig.1.

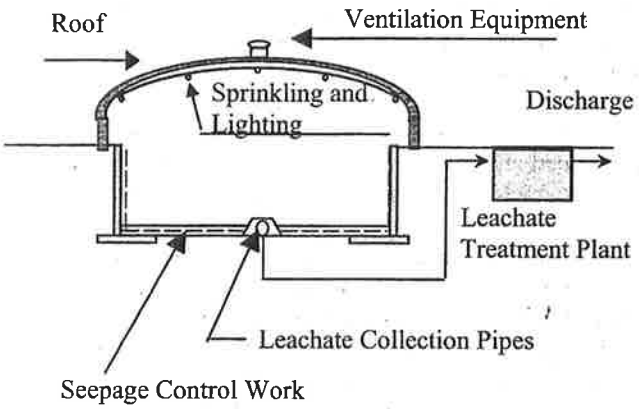


Fig.1 Schematic drawing of CS disposal facility

Special features of CS disposal facilities

As in Europe and the United States, traditional landfills (Traditional landfills means no roof type in this report.) in Japan have consisted of a concavity that is constructed with seepage control work to prevent the contamination of groundwater. CS disposal facilities add a roof or other covering above the concavity. When compared with traditional landfills, CS disposal facilities have the following major characteristics.

· Through innovative uses of shapes and colors of coverings, they can be readily harmonized with the surrounding scenery.

· Because the insides of a CS disposal facility landfill are not visible from surrounding areas, they are not unpleasant or disagreeable and have an image of cleanliness.

· By preventing the scattering of debris, runoff, and the spread of offensive odors, CS disposal facilities protect the environment.

· Because they are not affected by rain or snow, leachate can be minimized and controlled.

· CS disposal facilities enable smaller leachate treatment plants to be used, thus greatly reducing construction and operating costs.

· Through use of systems of artificial rain, flying refuse can be minimized, enabling the control and stabilization of waste.

· When required, the space above the landfill can be used.

· Their minimal impact on the environment opens up the possibility of land use in neighboring areas.

These kinds of characteristics simplify the maintenance and management of landfills, and enable municipalities to reduce costs of operation. Because such systems are also more readily accepted by residents of the community, the concept of CS disposal facilities has come to be defined as follows: "CS disposal facilities are facilities that enable waste to be disposed and stored in closed and controlled spaces, in ways that reduce environmental loads; and because such facilities blend in with the surrounding environment, they facilitate harmony with local communities." Or, in an abbreviated form, CS disposal facilities are "community & controllable closed system disposable facilities."

RESEARCH TO DATE [2)]

The impetus for closed-system disposal facilities came from a number of volunteers led by Professor Emeritus Masataka Hanashima of Fukuoka University (currently, Center Manager of the non-profit foundation, the Fukuoka Research Center for Recycling Systems Foundation), who formed a study group to consider the question "what kinds of landfills are most appropriate for Japan?" Official activity by this group began roughly 15 years ago, in June 1989, with the formal launching of the Research Committee for Closed-System Disposal facilities (hereinafter, "CS Research Committee"), led by Prof. Hanashima as chairman.

The CS Research Committee divides its activities into three-year periods, and is now in its fifth term of operations. In 1998, during its fourth term, Professor Toru Furuichi of Hokkaido University became vice-chairman. The addition of Prof. Furuichi coincided with a review of the group's organization and activities, and set the committee on a new course of operations.

Now The CS Research Committee researches (1) Cost down method, (2) Promoting filled waste and landfill site stabilization, (3) Investigations into the characteristics that will make landfills socially acceptable, and

prognostications about future developments in CS disposal facilities.

NUMBER OF CS DISPOSAL FACILITISE BUILT AND FORECAST FOR FUTURE CONSTRUCTION

Trends in Adoption of CS Disposal facilities

The first CS disposal facilities came into existence within 10 years of the founding of the CS Research Committee. The contracts on these projects were awarded in March 1996 by Yamagata Village, Nagano Prefecture, and in September 1996 by the Minami-Uonuma County Public Association, Niigata Prefecture, both on the basis of technology proposals made to the respective municipalities. Construction was completed on these projects in March and July 1998, respectively. These two landfills were the first in Japan to adopt the CS disposal design. Subsequently, other locales have developed plans for CS disposal facilities, and, as of today, 24 such sites (according to CS Research Committee surveys) have been built and are in joint operation.

Table. 1 shows graphically the trend in number of orders for CS disposal facilities as a percentage of orders for domestic waste disposal facilities from fiscal 1997 (statistics for CS disposal facilities based on tallies by the CS Research Committee). Given that approximately 30~50 landfills are brought into operation each year in Japan, CS disposal facilities accounted for roughly 20 percent of all orders for landfills in fiscal 2003.

Fig. 2 provides a breakdown of construction of CS disposal facilities by prefecture. As the diagram indicates, the construction of a single CS disposal facility in a prefecture is often followed by a second and third CS disposal facility .

Table.1 CS Disposal Facilities as a Percentage of Municipal Waste Disposal Facilities, by Year

Fiscal Year	Ordered Number of Municipal Disposal Facilities by Year		Percentage of CS Type
	CS Type	All Type	CS／All (%)
1997	2	59	3%
1998	0	58	0%
1999	2	46	4%
2000	3	40	8%
2001	7	58	12%
2002	4	35	11%
2003	6	30	20%

※Statistics for CS disposal facilities based on tallies by the CS Research Committee

In terms of landfill capacity among 24 existing CS disposal facilities, 90% of the sites are ranging from several thousand to 20,000 m^3 which are for relatively small municipalities while larger sites ranging from 70,000 to 80,000m^3, which are for mid-size municipalities have been constructed recently.

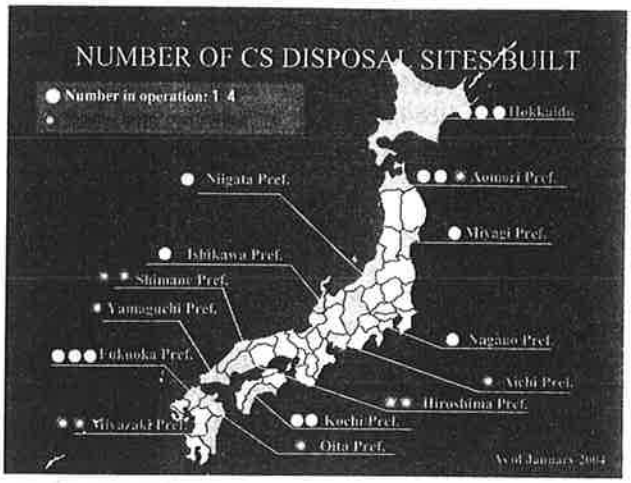


Fig.2 CS Disposal Facilities Built by Prefecture

Forecasts

Our forecasts of rates of adoption of CS disposal facilities hereafter are based on trends to date. On an annual basis, the percentage of CS disposal facilities to total Municipal waste disposal facilities began rising sharply in fiscal 2002. As we indicated through our examination of current trends, we have been witnessing an increase in follow-on adoptions of the technology in individual prefectures, which suggests the possibility of a "chain reaction effect" hereafter. And, as more individual prefectures accelerate their adoption of the technology, we believe that this could provoke a nationwide diffusion of CS disposal facilities. In terms of landfill capacity, municipalities are currently weighing the option of adopting larger-capacity sites, which we believe could lead to the construction of CS disposal facilities serving major metropolitan areas hereafter.

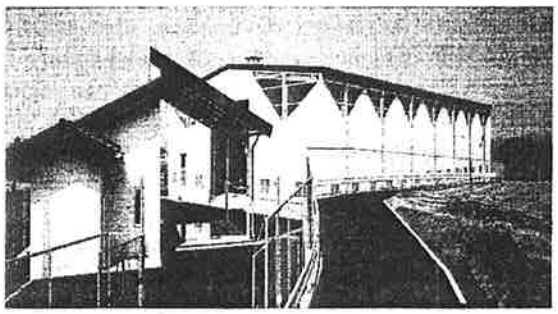
SUMMARY OF "TYPE CHARACTERISTICS" OF CS DISPOSAL FACILITIES BUILT TO DATE

Sites built to harmonize with the surrounding environment ("Thanks BB" municipal waste disposal facility in Yamagata Village)

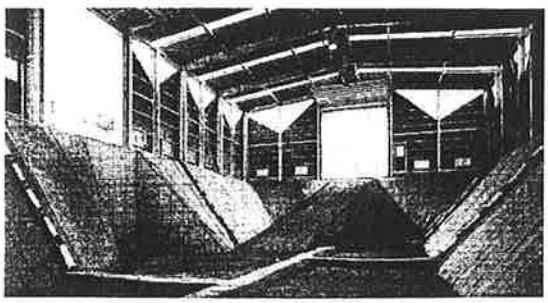
Landfill Area (m^2)	800	Volume (m^3)	2,660
Type of Filling Refuse		Incinerator Residue Shreded Incombustible Refuse	
Perioed of Use (year)		8 years	
Capacity of Leachate Treatment Plant (m^3)		1.5m3/day	

In designing this landfill, planners took into consideration the numerous orchards that existed in the surrounding areas and also the region's windy conditions, which were likely to cause debris from the landfill to be scattered about the area and caught in the fruit trees. Because the water downstream also fed into various municipal uses, residents also commented on the treated water that would be discharged into watercourses. In the end, a CS disposal facility was adopted as a means of harmonizing the needs of the municipality with the concerns of the community, which were principally focused on eliminating impacts on the agricultural products produced in the area.

Accordingly, the landfill is covered by a roof, which prevents the scattering of debris. The leachate resulting from the use of sprinklers in the landfill is treated by a leachate treatment plant prior to being discharged into the sewage system. For the roof, designers used a steel frame, single-story roof covered with shingle boards, which was installed in units. The roof has been designed to be transportable to a neighboring landfill after the current landfill reaches capacity.



Photograph 1 An outside view of Thanks BB



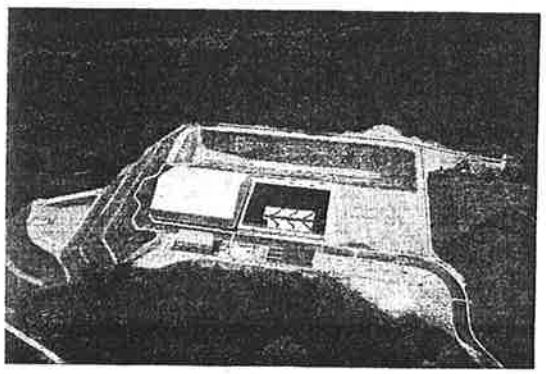
Photograph 2 An inside view of Thanks BB

Sites that do not discharge leachate (Masugata-yama municipal waste disposal facility)

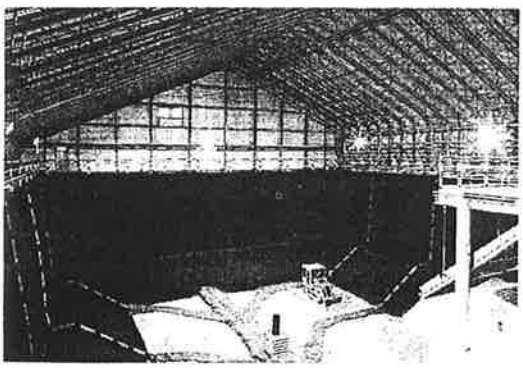
Landfill Area (m^2)	1,904 (952＊2 set)
Volume (m^3)	14,200 (7,100＊2 set)
Type of Filling Refuse	Shreded Incombustible Refuse
Perioed of Use (year)	6 years ＊2set
Capacity of Leachate Treatment Plant (m^3)	$10m^3$/day

In this facility, the landfill is sectioned off and the roof moved to each area of the facility as sections are filled. As Photograph 3 indicates, the bottom of the next section to which the roof will be moved has already been prepared.

The major concern expressed by residents related to the treated water that would be discharged downstream. Consequently, designers adopted a system in which leachate from the landfill would be treated by a leachate treatment plant and then reused within the facility. This resulted in a totally closed system that does not discharge any leachate into the environment. The roof is a frame membrane structure.



Photograph 3 Overall view of the Masugata-yama municipal



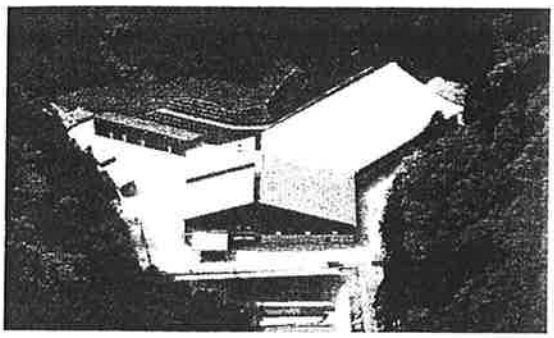
Photograph 4 Internal view of the Masugata-yama

Aerobic landfill (Green City Yamanaka)

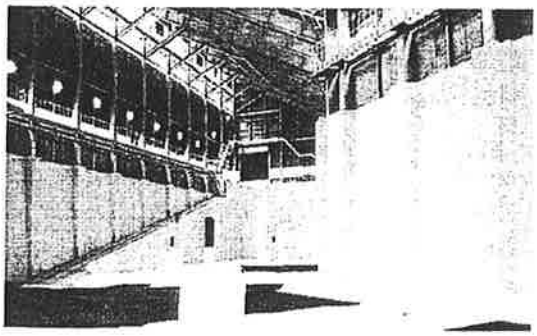
Landfill Area (m^2)	2,300	Volume (m^3)	14,200
Type of Filling Refuse	Incinerator Residue Shreded Incombustible Refuse		
Perioed of Use (year)	15 years		
Capacity of Leachate Treatment Plant (m^3)			$2.0m^3$/day

This facility is located near the town's recycling center. To promote landfill stabilization, the town requires that air be pumped into the waste and, for that purpose, air supply devices have been installed at the facility. The rapid stabilization of landfill waste, a recirculation system that prevents the discharge of any leachates into the environment, and the effective use of the roof contributed to obtaining the consent of the community's residents.

After treatment at the facility's leachate treatment plant, leachate from the landfill are used as coolants that are applied through sprinkling at the Yamanaka Village incinerator. The roof is used for the entire lifecycle of the facility: during operations, after the landfill reaches capacity, during closure, and after discontinuation of use.



Photograph 5 Overall view of Green City Yamanaka



Photograph 6 Internal view of Green City Yamanaka

WHAT THE FUTURE HOLDS FOR CS DIPOSAL FACILITIES

As society imposes ever stricter systems of segregated disposal and waste collection hereafter, "considerable quantities" of such material will be needed to make recycling and reuse economically viable. Municipalities will also have to remove the rapid-decomposer organisms that have adhered to these converted resources. These conditions, in turn, will require that collected material be kept in specified locations for prescribed periods of time. On the other hand, other locations will be needed to dispose of waste that cannot be segregated.

We believe that CS disposal facilities will be effective in meeting these various demands. They are sufficiently isolated from the surrounding environment; they can be built in proximity to human communities with minimal impact on such communities; and they are designed to be able to control the impacts of the natural environment.

For example, CS disposal facilities can be actively equipped with functions that promote the stabilization of disposed waste. This suggests the possibility of such sites becoming not only simple depositories of wastes for future conversion into resources but also into facilities that both convert and store such resources. Fig. 4 and 5 are renderings of this concept of CS disposal facilities as both waste depositories and storage facilities for waste that has been converted into resources.

Fig. 3 Conception of Urban-type storage facility

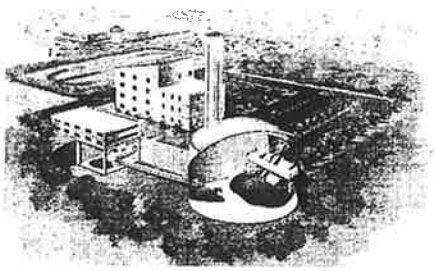


Fig.4 Conception of Waste depository and storage facility for waste converted into resources

CONCLUSION

A major technical issue for CS disposal facilities in the future will be how to promote waste stabilization. Developers of CS disposal facilities are frequently asked by community residents, municipalities, and waste management companies, "When will the waste stabilize?" This is not an issue that concerns only CS disposal facilities. In fact, this has been the major question facing landfills since the system of disposing waste by burial in landfills was first adopted. And the answers to this question continue to be "fuzzy."

The CS Research Committee is a voluntary organization that aims to contribute to the diffusion of CS disposal sites, which it believes represents one of a number of options available to solve the problem of final waste disposal. CS disposal facilities are also known as "covered disposal facilities." Some designers, however, are incorporating designs and methods of maintenance and control that reflect an insufficient understanding of how CS disposal facilities should be utilized. The CS Research Committee will take every opportunity hereafter to make its research findings public and to contribute to the solution of the waste problem.

In closing, we would like to express our appreciation to those members who have taken time from their daily work responsibilities to participate enthusiastically without pay in our research on CS disposal facilities and who have allowed us to use their materials in the preparation of this report. Finally, it is our hope that the material prepared today will contribute to a greater understanding of CS disposal facilities among those involved in the building and operation of waste disposal facilities.

REFFERENCES

1) Regarding discharge and disposal of industrial and domestic wastes (in fiscal 2001), Ministry of the Environment, press release, March 1, 2004.

2) Closed Systems Research Committee, "The 12-year History of the CS Research Committee" (May, 2001)