NO. 52 PROPOSAL OF CLOSED SYSTEM DISPOSAL FACILITIES FOR RESOURCE STORAGE

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ABSTRACT

The closed system disposal facility (CS) allows us to control quality of materials in the facility. In this paper, a new application of the CS as a next generation facility is proposed. For instance, incinerated residue of sewage sludge contains a lot of phosphorus. However, it is not feasible to recover phosphorus as resources from the incinerated residue due to high cost if the present technology is used. Therefore, it may be meaningful to store the incinerated residue in a controlled environment until an appropriate technology will be developed. The proposed CS facility has functions such as that of controlling the water content of the residue. Another example is a storage type CS facility for bottom and fly ashes produced from municipal solid waste, which can be used as raw materials for cement. In this case, the proposed CS has a pre-treatment function in addition to storage function, which removes heavy metals and chlorine from the ashes. This paper describes the background and concept of the proposed storage type CS.

1. INTRODUCTION

According to the White Paper on the Environment for the fiscal year 2002, Japan consumed 50% of timbers, 24% of metals, 25% of crude oil, 27% of coals and 17% of natural gas of the total world consumption. As a result of the consumption of such a vast quantity of resources, an annual quantity of wastes was approximately 850 million tons. If this situation continues, it is obvious that resources will dry up eventually. Because of this, we need to promote resource and energy saving to prevent resources from drying up. In addition, we need to control the exhaustion of resources and convert wastes into resources. These are considered as important ways for alleviating and solving the global environmental issues.

Currently, wastes are eventually disposed of in landfill. However, some of these disposed wastes contain a lot of recoverable resource materials. Although the technology for recovering the resource materials from these wastes are not available currently, if the wastes are stored in appropriate ways, the resource materials may be efficiently obtained from the wastes using future technologies. This concept was also discussed by Yoshida et al. (2004) and Ishii et al. (2005).

This paper proposes an application of closed system disposal facility (CS) to a storage facility of wastes as future resources. The wastes considered in this study are bottom and fly ashes from municipal solid waste (MSW), and incinerated ashes of sewage sludge. Several functions are required to use the CS as a storage facility of wastes as future resources. This paper calls the proposed storage facility "storage type CS". The required functions of the proposed storage type CS are identified.

2. SIGNIFICANCE OF WASTE STORAGE

In Japan, the amount of waste generation has been in

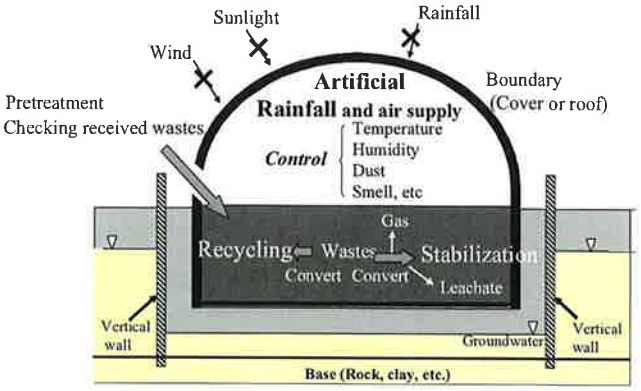

Figure 1. Schematic diagrams of a closed system disposal facility (CS)

high level, although it tends to decrease in recent years. On the other hand, it is getting more and more difficult to construct new landfill sites because of strong oppositions by neighboring people. Under these circumstances, it may be necessary to store wastes under a controlled environment to use them as resources in future. It is considered that this recycling of wastes eventually helps to reduce the net amount of wastes to be disposed of.

The CS is a final disposal facility with a covering facility such as roof, as shown in Figure 1. The covering facility creates a closed space, which is separated from exterior space. It has the following characteristics.

* The CS can prevent waste from scattering, and its smell and gases from spreading.
* The CS can control temperature and humidity inside.
* The CS can prevent rainwater from entering to control the amount of leachate generation.

3. Proposal of the storage type CS

3.1 Proposal of recycle system of bottom and fly ashes from MSW in a region

(1) Actual status on treatment of bottom ashes and fly ashes from MSW

In 2000, 52,000 thousand tons of general wastes were generated in Japan, out of which 42,000 thousand tons of wastes were incinerated, and 5,700 thousand tons of the incinerated residues were landfilled. This amount corresponds to 54% of the total quantity of landfilled wastes. With regards to recycling of these wastes, the incinerated residues are melted or calcinated for construction materials. Bottom ashes and fly ashes have been used as eco-cement materials in recent years. Eco-cement is produced by adding more than 500 kg of ashes to 1 ton of cement products.

(2) Outline of the proposal

Based on the data in survey on recycle system ("Outline of implementation of recycle system and survey of reverse physical distribution system") conducted in 2001 by Chugoku Bureau of Economy, Trade and Industry, "recycle system of ashes" in the region of Seto Inland Sea is examined. It is assumed that bottom and fly ashes are used to produce eco-cement.

The region of Seto Inland Sea consists of 11 prefectures that are Fukuoka, Oita, Yamaguchi, Hiroshima, Okayama, Hyogo, Osaka, Wakayama, Ehime, Kagawa and Tokushima, as shown in Figure 2. At first, the region of Seto Inland Sea is divided into 2 areas, namely "Osaka Bay Area", which includes Osaka, Wakayama and Hyogo prefectures, and "West Area", which includes the rest. The reason why "Osaka Bay Area" has only 3 prefectures is that Osaka Bay Phoenix Plan, in which waste from a lot of municipalities around Osaka Bay is collected and landfilled in Osaka

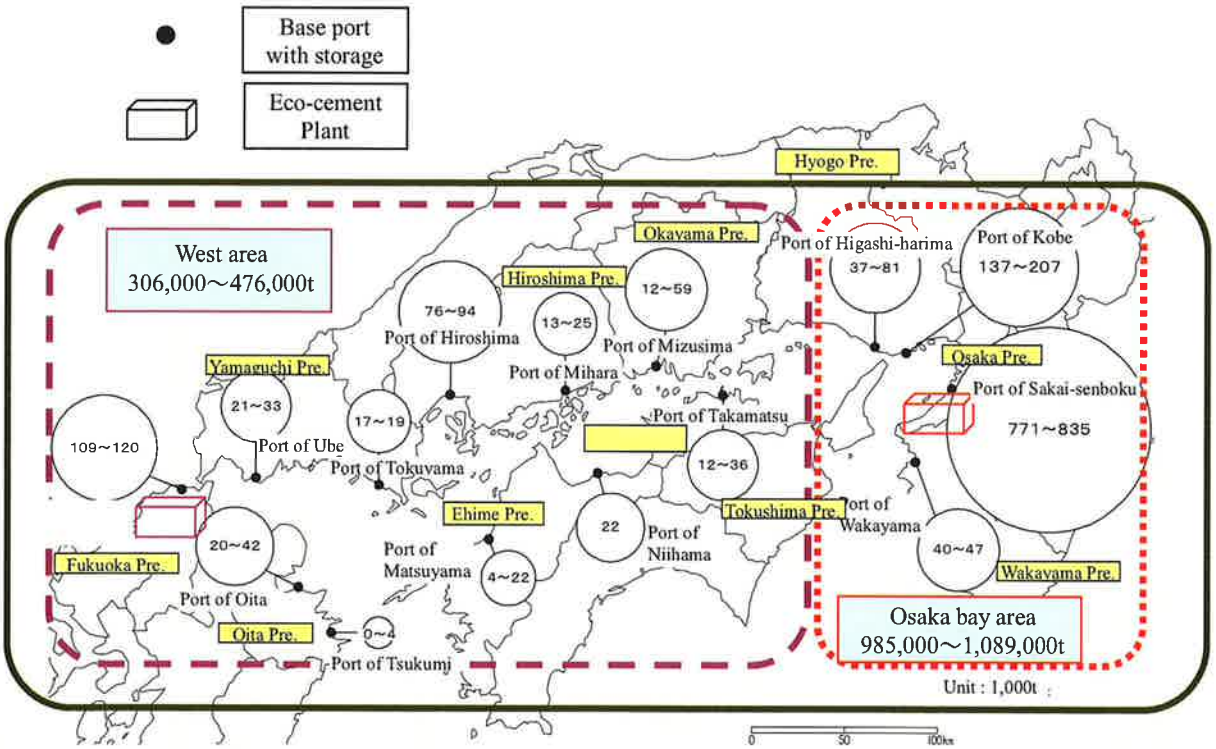

Figure 2. Prediction of the amounts of incinerated residue collected at each of base ports for recycling in Seto Inland Sea area in 2010 and places for eco-cement plant

Bay, has been implemented, and that the total amount of ashes from "Osaka Bay Area" is equivalent to 70% of the total amount from the region of Seto Inland Sea. In this area, it is efficient that an eco-cement plant is constructed at the Sakai-senboku port since a lot of amount of ashes – maximum annual amount of 835,000t – are generated around the port.

On the other hand, it's more efficient to construct an eco-cement plant in Kita-kyushu city than in other places in "West Area" since more ashes (maximum annual amount of 120,000t) is generated from the area of the Kita-kyushu port than other areas. Marine transportation is considered as the most efficient way to transport ashes since the distance between Okayama or Kagawa and Kita-kyushu city is more than 300km.

The prediction of the amount of incinerated residue in 2010 from each of base ports, "Osaka Bay Area" and "West Area", where eco-cement plants are placed are shown in Figure 2.

Incinerated residue that will be transported to the eco-cement plants are planed to be temporarily stored until they are used. Moreover, incinerated residue that will be collected to each of base ports are also temporarily stored until they are transported.

(3) Storage method of ashes

It is appropriate for the storage facilities of incinerated residue to have proper functions of landfills since they contain some harmful substances. Moreover, they should have a covering facility to prevent the incinerated residue and its smell from spreading, and to control the internal environment for preventing incinerated residue from absorbing moisture. With these functions provided, the CS will be suitable for storage of the incinerated residue.

The storage facility of the eco-cement plant will also have a pre-treatment facility, in which heavy metals and chlorine are removed from incinerated residue.

(4) Future tasks

Future tasks are listed as follows.

*To establish consensus with people around planned site for plants and base ports on collecting wastes from other prefectures and treating them.

*To establish the way to maintain the quality of incinerated residue and to stabilize the amount of incinerated residue collected.

*To establish the safe and economical transportation.

*To increase the consumption of eco-cement.

*To construct plants for storage, pre-treatment and processing of incinerated residue.

3.2 Proposal of the storage type CS for incinerated residue generated from sewage sludge

(1) Actual status on recycling of sewage sludge

In recent years, the recycling of sewage sludge has increased and consequently 60% of the total amount of sewage sludge was recycled in 2000. The usage of sewage sludge recycled is shown in Figure 3. While the amount of sewage sludge used for agriculture has been constant, the amount of sewage sludge used for construction materials has increased rapidly. In 1996, the amount of sewage sludge used for construction materials exceeded that used for agriculture. On the other hand, 40% of the total amount is not recycled and disposed of in landfill. New recycling technologies of sewage sludge are needed.

Sewage sludge contains a large amount of phosphorous and it has been considered as a potential resource of phosphorous. It is expected that new technologies for extracting phosphorous from sewage sludge will be developed successfully. Therefore, we propose a storage type CS facility for storing sewage sludge until it will be used in future.

(2) Background of the proposal

The quantity of phosphorous (P_2O_5) contained in incinerated residue of sewage sludge in Japan corresponds to 15-30% of the total amount of the residue. The generated amount of sewage sludge is 1,980 thousand tons by dry weight per annum, out of which 79% are treated at incineration plants. This results in generation of 300-350 thousand tons of incinerated residue. The quantity of P_2O_5 contained in the incinerated residue is as much as 50 to 100 thousand tons per annum.

Phosphorous is well known as one of exhaustible resources. Therefore, it is meaningful to recover phosphorous from the incinerated residue of sewage sludge. Currently, the recovery technology of phosphorous from the incinerated residue of sewage sludge is under development. However, it has good potential to be available in near future. Therefore, it is important to store the incinerated ashes of sewage sludge in an appropriate state until the recovery

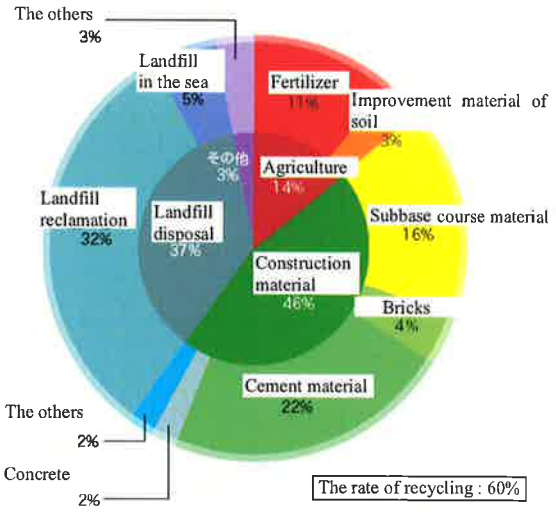

Figure 3. State of efficient use of sewerage sludge in 2000

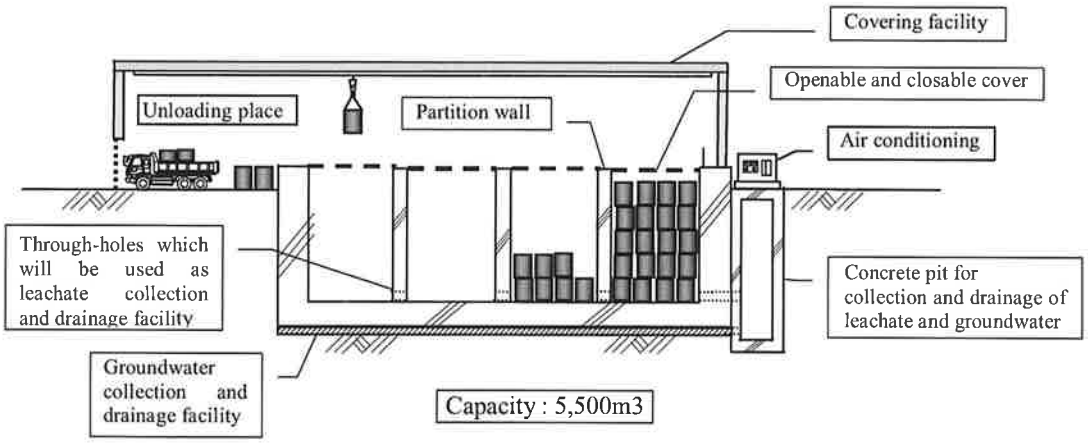

Figure 4. Scheme of a storage type CS for storing incinerated ashes of

technology of phosphorous is fully developed.

(3) Facility planning

1) Conditions for the study

It is assumed that the recovery technologies of phosphorous from incinerated residue of sewage sludge will be fully developed in 10 years. Therefore, the residue will be stored in the facility for 10 years. During this period, the residue should be in powder so that they can be treated readily by the recovery technology. After the facility is used for the storage purpose, it will be continuously used as a normal CS.

2) Outline of the proposed storage type CS

The scheme of the proposed storage type CS is shown in Figure 4. The outline is described below.

a. Covering facility

A covering facility will be installed to control dust generation and prevent rainwater from entering into the CS. In addition, the covering facility will help to control the internal conditions such as temperature and humidity.

b. Structure

A concrete pit will be installed to store ashes for controlling the moisture. The pit will be divided into a several sections separated with concrete walls to control moisture efficiently. Each section will be equipped with a cover to control the internal conditions independently. The sectioned pit will be also useful to landfill waste by types when the CS will be used as a landfill.

c. Facilities needed to use as a landfill

Through-holes for leachate collection and a leachate collection pit, which are necessary for a normal CS, will also be installed during the construction stage of the CS. Groundwater collection and drainage facilities will also be installed below the storage pit.

d. Storing and removing of ashes

The incinerated residue of sewage sludge will be packed in flexible containers to control the generation of dust and for easier transportation. A crane, which is attached to the covering facility, will be used for the transportation of ashes in the CS.

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