# STUDY OF RISK MINIMIZATION AT FINAL WASTE DISPOSAL SITES

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**ABSTRACT**

The risk at a final waste disposal site is not limited to the structure and specifications of the facility. At a final waste disposal site, there are risks in the waste itself, transportation, and information transmission. Appropriate recognition and response to these risks can increase public understanding and satisfaction with the final waste disposal sites.

In this study, we first extract and organize the transportation and the detectable risks at the time of acceptance. Next, we extracted and organized the technologies introduced or that could be introduced for risk minimization. Finally, we aimed to compile these, compile consensus and formulate the risk commitment of final waste disposal site management, to raise public understanding and satisfaction.

The following issues are discussed:

1. Extraction of risks during waste transport.
2. Extraction of risks that can be dealt with by detection at acceptance time.
3. Extraction of risks that can be prevented by information communication.
4. A study of the technologies introduced or that could be introduced for risk minimization.
5. A concrete example of risk solutions or basic data for risk communication tools.

At the next stage, we will consider risk management at a site of final waste disposal that combines risk minimization solutions and will propose one form of final disposal site that could be easily accepted by local residents with high understanding and satisfaction.

*Keywords: the risk at final waste disposal sites, risk countermeasures, risk communication tools*

## INTRODUCTION

In this study, we first extract and organize transportation risks and detectable risks at the time of acceptance. Next, we extract and organize the technologies introduced or that can be introduced for risk minimization. Finally, we aimed to compile these, compile consensus and formulate the risk commitment of final waste disposal site management to raise public understanding and satisfaction.

## EXTRACTION OF RISKS DURING WASTE TRANSPORT

**Inappropriate treatment, contamination risk**

Risks in waste management arise when there is a mistake or a change in waste at the source. Accidents occur during waste transportation or acceptance, or during difficult leachate treatments, long stability periods, land-filling problems, or because of environmental deterioration.

Figure 1 Image of wastewater generation because of foreign matter contamination

Figure 2 Image of infectious waste contamination

**Transport route deviation • illegal dumping • illegal carry-in risk**

The amount of illegally dumped waste has decreased drastically in recent years, but it is still at a level of 30,000 t per year and there is a risk of illegal dumping at the time of transportation.

Figure 3 Illegal dumping in the Teshima case

Figure 4 A case of illegal dumping in Chiba City HP

**Risk of traffic environment deterioration by transport vehicles**

Safety is given priority during waste transportation. However, when there are pedestrians or cyclists on the road, near schools, in high traffic areas, narrow roads, roads in poor condition, or bad weather, there is a risk that the traffic environment may easily deteriorate in heavy traffic when numerous transport vehicles may drive dangerously.

Figure 5 Transportation environment with numerous transport vehicles

Figure 6 Crosswalk without traffic lights

**EXTRACTION OF RISKS THAT CAN BE RESOLVED BY DETECTION AT ACCEPTANCE TIME**

**Risk of deteriorating landfill work environment or contaminating the surrounding environment due to odor products**

When the received waste generates unpleasant odor, such as garbage and sludge, livestock excrement, animal carcasses, chemical substances, or if such odors are mixed in, if the odor diffuses, there is a risk of harmful effects on landfill workers and on the surrounding environment.


Figure 7 Protest against malodor

**Fire caused by a mixture of ignition or fire-spreader substances, risk of damaging waterproofing work**

When materials such as paint, spray cans, gas bottles, waste oil, putrefactive waste, chemically reactive substances are accepted or mixed in the accepted waste, they can become an ignition factor. Therefore, fires could occur at the time of transportation and final disposal causing destruction of the vehicle, the facility, or the landfill workers.

Figure 8 Fire from waste

Figure 9 Firefighting activity of a transport vehicle (Higashimurayama City HP)

Figure 10 Fire spreaders in transport vehicle (Higashimurayama City HP)

Figure 11 Lighters and spray cans (Higashimurayama City HP)

**Risk of deteriorating landfill work environment or surrounding environment because of contamination with gas generators**

Large amounts of waste gypsum (e.g., hydrogen sulfide) boards, spray cans, foam insulation (volatile organic compounds, including toluene, benzene, freon, dichloromethane, and the like are included in various solvents, adhesives, detergents, disinfectants, or pesticides, among others), or biodegradable organic matter (e.g., methane) may generate harmful gases, which can ignite and cause fire. There is a risk of adversely affecting the landfill workers' environment and the surrounding landfill environment.

Figure 12 Waste gypsum board

Figure 13 Foam and waste foam insulation products

**Risk of deterioration of the surrounding environment because of contamination**

When easily scattered waste is accepted, there is a risk that the scattering will adversely affect the surrounding landfill environment.

Figure 14 Situation at a final waste disposal site

Figure 15 Scattered waste

**Risks from waterproof sheet damage, drainage pipe damage, and landfill operation obstruction because of the inclusion of large-size wastes**

Risk arises when large-size wastes are mixed above the standard. This includes the risks of waterproof sheet damage, drainage pipe damage, and landfill operation obstruction.

Figure 16 Large-size wastes

Figure 17 Landfill compactor crushing large waste

**Processing difficulty due to contamination of high-concentration wastes and long-term risk to landfill stability**

There are risks of difficult processing and long-term risk to landfill stability when receiving high concentration substances and waste other than acceptance standards.

Example: Receipt of incineration ash or fly ash not subject to acceptance.

Figure 18 Incineration ash

Figure 19 Fly ash

**Processing difficulty because of mixed hazardous materials or harmful substances and long-term risk to landfill stability**

When receiving toxic and harmful waste, such as volatile substances and chemicals, there is a risk that this may affect the landfill's stabilization period, which can be difficult to handle properly.

Figure 20 Gas cylinders

Figure 21 Batteries and other products

Figure 23 Civic briefing session

## IDENTIFYING RISKS THAT CAN BE PREVENTED BY INFORMATION COMMUNICATION

**NIMBY deterioration risk because of a lack of understanding**

Recent final waste disposal sites are equipped with the latest technologies to ensure safety, such as multiple safeguards, water-containing systems, and water leakage detection systems. However, the facility structure and system may not be understood by local residents and there is a risk of protestors opposing construction at the disposal site and opposition campaigns to stop landfill construction.


Figure 22 Action against the construction of a final waste disposal site

**NIMBY deterioration risk due to lack of information**

Facility and management information for the final waste disposal sites may be insufficient. There is a risk that the image the local residents have will be bad, that the information about the facility will not be understood correctly, and there will be an opposition campaign against the disposal site under operation, and damage to the reputation of final waste disposal will occur.


Figure 24 Protest action seeking cancellation of waste disposal facility

## CONSIDERATION OF RISK COUNTERMEASURES

Investigation of transport risk countermeasures is shown in Table 1. Countermeasures to detectable risk at acceptance time are shown in Table 2. Countermeasures to cope with the risk that prevention activities can be

expected by information communication are shown in Table 3.

The electronic manifest was started in Japan in 1998. The information to be managed is matters concerning waste disposal companies, types and quantities of wastes, transporters, and disposers. In Japan as of FY 2017, 190,000 companies joined, the introduction rate of electronic manifests has increased 5 times to 53% in the past 10 years. However, from the aspect of site agreement on the final waste disposal site, improvement of introduction rate and introduction into general waste are considered necessary.

GPS navigation management systems are being introduced to logistics, road transportation and construction vehicles including transportation of industrial waste. This system is also a point to improve the introduction rate. If the introduction rate increases, it can be said that it is a very effective measure in terms of agreement on final waste disposal site location.

Determining the risk by sensor of water quality, gas, temperature, odor and image, the method of dumping for risk detection, the accuracy of sensor and the operation method are important. Sensor introduction cases are confirmed. However, there is no example of introducing multiple sensor systems, it is necessary to conduct research in conjunction with the transportation form, receiving dumping, reloading and transporting method.

In recent years, a lot of information dissemination in real time utilizing ICT has been adopted as a countermeasure against anticipated risk due to information transmission and communication. However, it is also important to repeatedly transmit necessary information according to each stage at the time of planning, construction and operation of the final disposal site, and to provide direct information in which the face and face are combined.

Table 1 Investigation of transport risk countermeasures

| Risk | Risk countermeasures | Overview of risk countermeasures |
|---|---|---|
| Inappropriate treatment, contamination | Tracking system with electronic manifest | The electronic manifest system performs the responsibilities of the waste disposer by discharging, handling, and disposing of persons, and sharing processing and final waste disposal information. |
| | A tracking system by electronic manifest using an integrated circuit (IC) tag | Store the waste in a container with an IC tag and confirm proper treatment from the stage of transportation to final waste disposal. |
| Transport route deviation, illegal dumping, illegal waste carry-in | GPS navigation management system of haul vehicles (route monitoring) | Route monitoring of predetermined route travel and deviation in real time, to prevent deviation from specified routes, illegal dumping, and illegal receipt. |
| Traffic environment deterioration by transport vehicles | Safety operation monitoring of transport vehicles | Promote safe driving by managing route, speed, sudden departure, sudden steering, sudden braking in real time. |

Table 2 Countermeasures to detectable risk at acceptance time

| Risk | Risk countermeasures | Overview of risk countermeasures |
|---|---|---|
| Environmental deterioration because of generation of factors such as malodor, high-temperature, gas, obstruction of landfilling work, occurrence of damage to waterproofing equipment | Determination of acceptance risk by sensor | Install sensors in the reception area to prevent waste from entering with odor, high temperature and gas. |
| Risk of improper processing because of contamination from substances with high concentration, long-term risk of landfill stability | Survey of water quality of leachate by water sensor | Analyze water quality of leachate generated by sprinkling water, and detect the effect of leachate treatment and landfill stability. |
| Exacerbation of landfill work environment and surrounding environment due to dangerous goods and harmful substances | Removal of dangerous and harmful substances by sensor + AI | Expand the waste at the reception site and examine the image with sensors + AI to remove hazardous materials and harmful substances. |

Table 3 Countermeasures to cope with the risk that occurrence prevention can be expected by information transmission and communication

| Risk | Risk countermeasures | Overview of risk countermeasures |
|---|---|---|
| NIMBY deterioration risk because of lack of understanding | Facility tour | Improve understanding of structure and system by tour of final waste disposal site and improve mutual understanding through direct dialogue with residents. |
| | Improve understanding through explanation of facility structure and system | Pamphlets, models, image diagrams to improve understanding of facility structure, system, site planning. |
| NIMBY deterioration risk because of lack of information | Information dissemination on operation status | Increase understanding of facilities and facility management by publishing operation information in a publicity magazine to provide operation information for HP and improving accessibility. |
| | Operation information dissemination by information communication technologies | ITV, helmet, or drone cameras improve understanding of facility management by providing images, improving the landfill's image by checking and preventing inappropriate management. |

## CONCLUSION

This study focused on vague risks to the final waste disposal site, such as "will it survive an earthquake?" "what will happen in case of heavy rain?" or "worried about pollution!" The subcommittee members appreciated the local residents' anxiety, anxiety relief, and understanding of the information communicated about the site. However, because the risk associated with the final waste disposal site is related not only to the structure and specification of the facility, the risks that may occur at the time of transportation, acceptance, location, and operation of the waste and its countermeasure was focused in this study.

At the next stage, we will consider risk management at a final waste disposal site combining these risk countermeasures. We will propose one form of a final

waste disposal site that is technically acceptable and is also acceptable for citizens.

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