STUDY OF THE WASTE STABILIZATION INDEX ON CLOSED SYSTEM DISPOSAL FACILITIES BASED ON FIELD SURVEY DATA 2

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ABSTRACT

We conducted a survey at in-service Closed System Disposal Facilities (hereafter called "CS disposal facilities") to evaluate stabilization of waste. In this study, as the stabilization index, we focused on the landfill gas, temperature of waste layers, waste chemicals (analyzed with elution test) and leachate. This paper reports the results of investigations of two CS disposal facilities and one open type facility that landfill residues from the same incineration facilities and shredding facilities, meaning that the properties of the landfilled wastes from the three disposal facilities are nearly identical.

As a result, the following things were proved.

The CS disposal facilities that are capable of supplying sufficient amount of water to their landfilled wastes layer by controlling the water sprinkling may promote microbial decomposition of organic substances and scouring of inorganic salts by the water, possibly contributing to stabilization of the wastes. On the other hand, for the open type disposal facilities that is not capable of controlling the water supply, water for stabilization of the wastes may be insufficient or excessive, resulting in making interior of the landfilled waste layer anaerobatic, leading to inhibition of promotion of the waste decomposition.

Keywords: Closed System Disposal Facilities, Waste Stabilization, Elusion Test, Leachate

INTRODUCTION

CS disposal facilities contribute to promotion of stabilization of landfilled wastes. However, the method of controlling the stabilization of wastes is not understood well mainly because the components of landfilled wastes and structure of facility vary among individual landfills. As a result, we have conducted investigations and researches for evaluating the state of stabilization of wastes that are landfilled in some CS disposal facilities that are in operation.

As the indices of the stabilization of wastes, we focused on the landfill gas, temperature of waste layers,

Table 1 Outline of disposal facilities

Facilities	N Municipal Disposal Facility	R Municipal Disposal Facility	M Municipal Disposal Facility
Landfill Type	Closed type	Closed type	Open type
Beginning of operation	Dec-02	Dec-02	Nov-02
End of Landfilling	Jun-09	Mar-10	Mar-17
Landfill area	1,000m^2	900m^2	2,800m^2
Landfill capacity	4,500m^3	3,825m^3	7,100m^3
Landfilled waste	Incineration residue, Shredded incombustible waste(wastes are nearly identical)		
Wate sprinkling amount	8m^3/day (equivalent to 8.0mm/day rainfall)	4m^3/day×4day/week (equivalent to 4.4mm/day rainfall)	(average 3.7mm/day rainfall)
Air supply	Not operation	Not operation	Not operation

waste chemicals (analyzed with elution test) and leachate, and have conducted the investigations and researches of the factors in six CS disposal facilities. This paper reports the results of investigations of two CS disposal facilities out of those six facilities that landfill residues from the same incineration facilities and shredding facilities, meaning that the properties of the landfilled wastes from the two disposal facilities are nearly identical, comparing the results with those of similar open type disposal facilities.

This paper also reports the results of investigation of the indices of the stabilization of the landfill gas, waste chemicals (analyzed with elution test) and leachate.

DISPOSAL FACILITIES SURVEYED

Table 1 shows outline of the two CS disposal facilities (N* final disposal facility and R* final disposal facility) and open type disposal facilities (M* final disposal facility). N and R type CS disposal facilities are sprinkled with water except winter with different amount of water and frequency.

The annual mean precipitation of this region including the location of the open type disposal facility over the past twenty years is 1342 mm or 3.7 mm/ day.

RESULTS OF THE SURVEY

Landfilled waste

Landfill gas: Table 2 shows the results of analysis of the landfill gase (averages of concentrations of constituents) that was collected using sampling bags at the gas drainage pipe of each disposal facilities. For N and R disposal facilities, the concentration of CO_2 contained in the gas is higher than the one contained in the atmosphere (approximately 380 ppm), and the concentration of CH_4 contained in the gas is equal to or a little higher than the one contained in the atmosphere (approximately 2 ppm). On the other hand, for M disposal facility, the concentrations of both CO_2 and CH_4 contained in the gas are higher than those contained in the atmosphere, and also higher than those contained in the gases collected from N and R disposal facilities. For M disposal facility, it is estimated that these results were obtained due to significant anerobic decomposition of the wastes because of higher percentage of water content in the waste layer of the facility especially due to melting of snow in the early spring and higher precipitation immediately before the investigation .(See figure 1)

For N disposal facility, ammonia and amines were detected by a gas detected at the concentrations of 1 ppm and 0.5 ppm respectively in the tube buried in the waste layer of the facility.

Elution test for landfilled wastes: Landfilled wastes sampled from individual disposal facilities were

Table 2 Composition of landfill gas (LFG)

Facilities		N Municipal Disposal Facility	R Municipal Disposal Facility	M Municipal Disposal Facility
Measurement date		09/20/07	09/19/07	09/19/07
Bacground	CH_4(ppm)	1.87	1.94	2.12
LFG	CO_2(ppm)	1129	2067	4425
	N_2(%)	78.1	78.5	77.9
	O_2(%)	20.1	20.2	19.9
	CH_4(ppm)	2.67	4.59	169

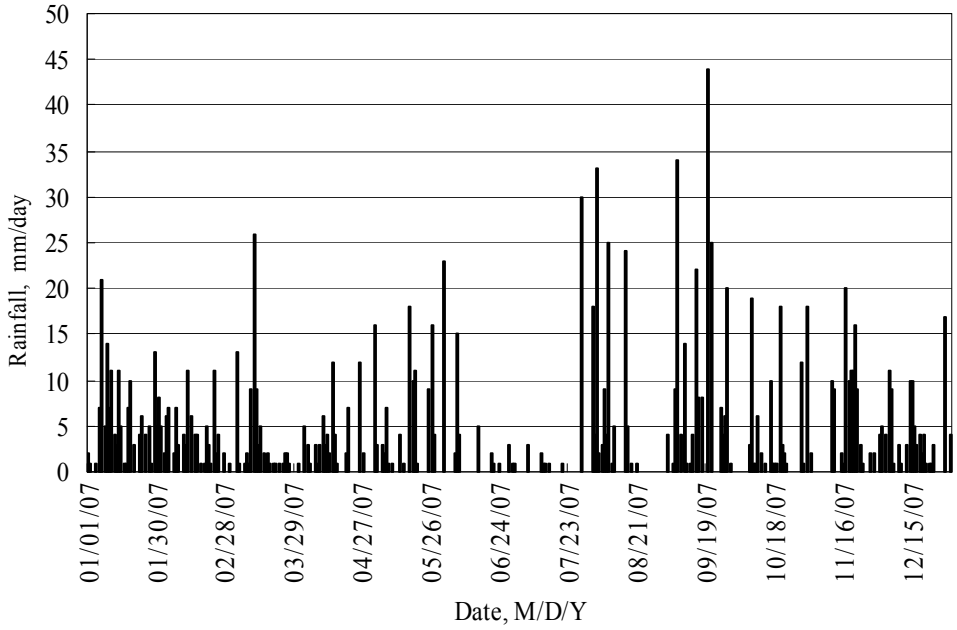

Figure 1 Rainfall in this region

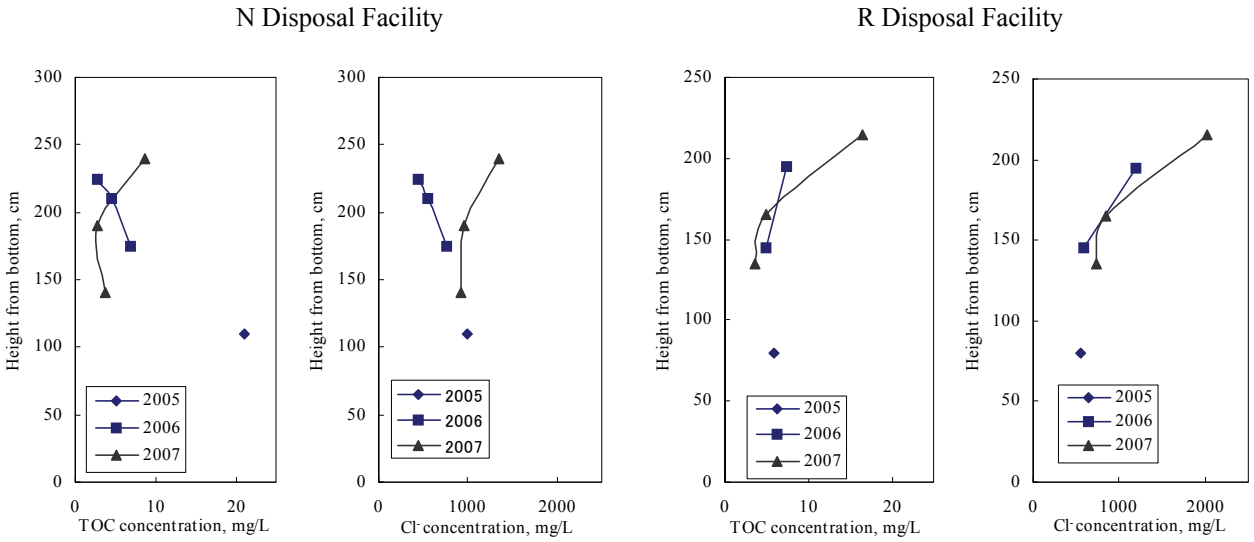

Figure 2 Concentration by elution test on landfilled waste in each depth

subjected to the elution test. Figure 2 shows the results of the test (concentration of chemicals contained in the incineration recidue vs measurement depths) obtained in the points in 2005, 2006 and 2007 that are nearly the same locations. TOC and CL^- are used as indices of organic elements and inorganic salts respectively.

Although the terms of the investigations were too short to identify clear tendencies, N disposal facility in 2006 showed a tendency that the concentrations of TOC and Cl^- are lower in upper layer. Generally, if no wastes are added on the surface layer, water sprinkling over the surface layer reduces the concentrations of the chemicals contained in the layer. The test results of N disposal facility in 2006 seem to show this effect of

water sprinkling. In other than 2006 in N disposal facility, addition of wastes on the top seems to increase the concentration in upper layer. N disposal facility in 2006 shows lower TOC concentration in upper layer, which may the result of the progress of aerobic decomposition caused by the contact of the surface layer of the waste with the atmosphere. The inclination of TOC curve is sharper than that of Cl^-, which may have been caused by reduction of TOC in upper layer due to both microbial decomposition and water sprinkling.

Figure 3 shows the results of analysis performed in 2007 vs depth, comparing with the open type disposal facility. Since the thickness of landfilled wastes varies among individual disposal facilities, the sample depths measured from the surface of the landfilled waste layer were used instead of those measured from the bottom. M disposal facility shows low concentration especially in upper layer, which may have been caused by the sprinkling of much rain water before the investigation. At the depth deeper than –40cm of these disposal facilities, N and R disposal facilities show a tendency that the concentrations of TOC and c Cl^- are both lower as compared with M disposal facility. The lower concentrations at the deeper depth that is affected less by the rain immediately before the measurement in N and R disposal facilities supports that the closed type disposal facilities stabilize their waste earlier than open type.

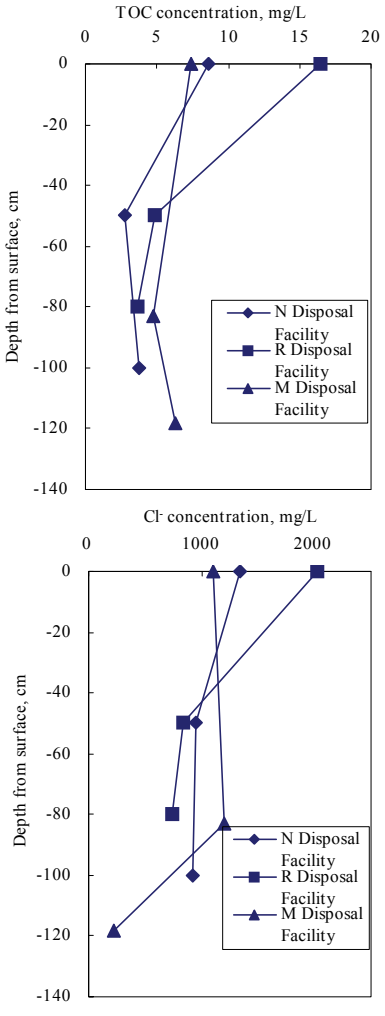

Figure 3 Concentration by elution test on landfilled waste in each depth (Comparison of Closed type and Open type)

Figure 4 shows temporal changes of mean concentrations. Although it is hard to say that the results evaluates the general nature of each facility because the number of samples is small, both TOC and Cl^- show a tendency that their concentrations decrease

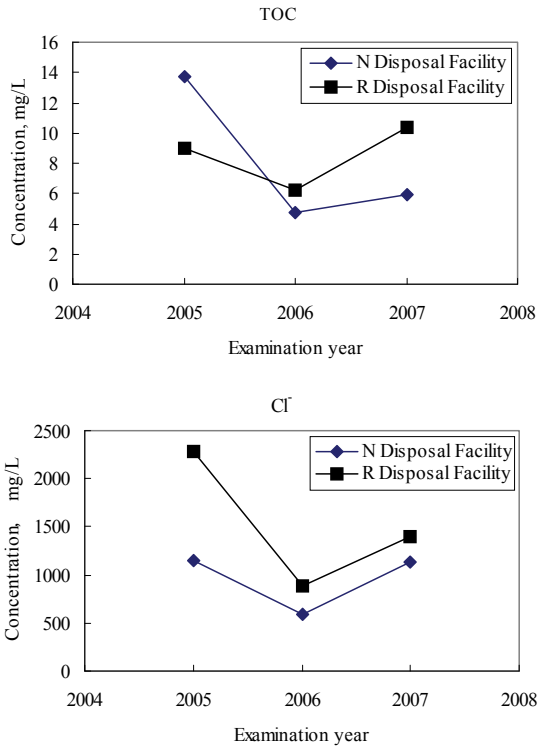

Figure 4 Change in concentration by elution test on landfilled waste

as the time elapses, which possibly demonstrates that the wastes of these facilities are stabilizing. N disposal facility that was sprinkled with water more than R disposal facility shows a tendency that the concentrations are smaller, which possibly expresses that the stabilization is advancing.

Leachate

Figure 5 shows the properties of leachate of CS disposal facilities. N disposal facility shows a remarkable tendency that COD and concentration of total nitrogen (except BOD) is smaller as compared with R disposal facility. On the other hand, for electrical conductivity, concentrations of chlorine ion and calcium, no big difference can be seen between both facilities. These results may express that N disposal facility that was sprinkled with water more than R disposal facility advanced the microbial decomposition of organic substances faster, but, for inorganic salts, the water sprinkling does not affect much on both disposal facilities.

Figure 6 shows the results of analysis conducted in 2007, comparing them between CS disposal facilities and open type one. For BOD and COD, M disposal facility clearly shows higher concentration than N and R disposal facilities, and for electrical conductivity, concentrations of chlorine ion and calcium, they show noticeable tendencies that are inverse to BOD and COD. When evaluating the concentrations except that of total nitrogen, the organic decomposition possibly advanced faster in CS disposal facility, which resulted in reduction of the concentrations in the leachate. On the other hand, CS disposal facilities had water sprinkling for inorganic salts more, which resulted in

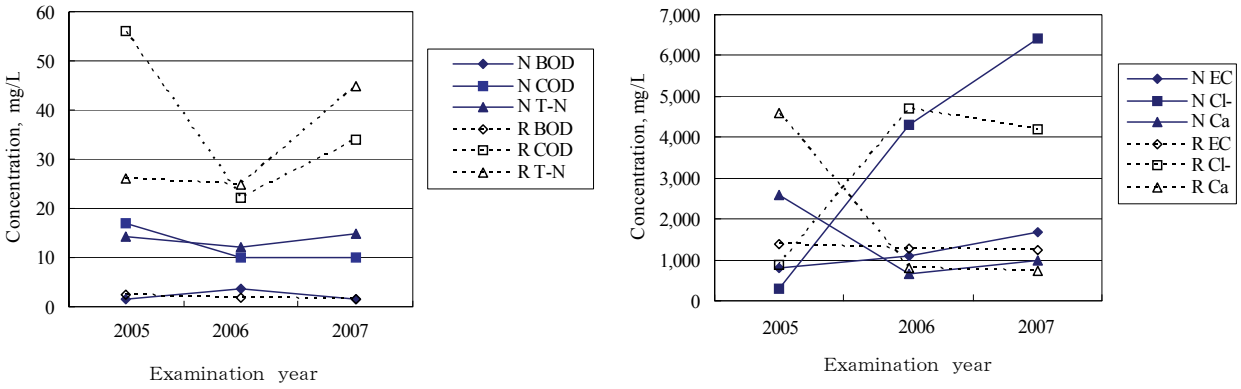

Figure 5 Change in concentration of leachate quality (Closed type)
N:N Disposal Facility, R:R Disposal Facility

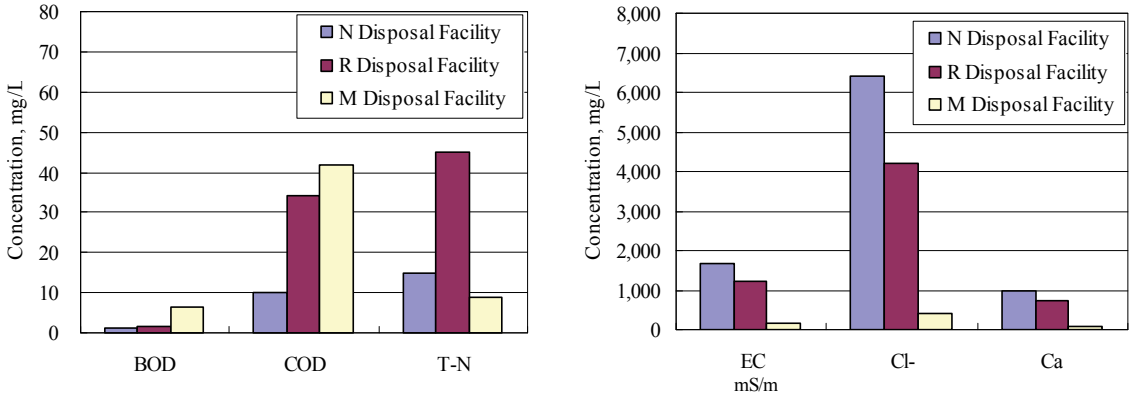

Figure 6 Comparison of leachate quality

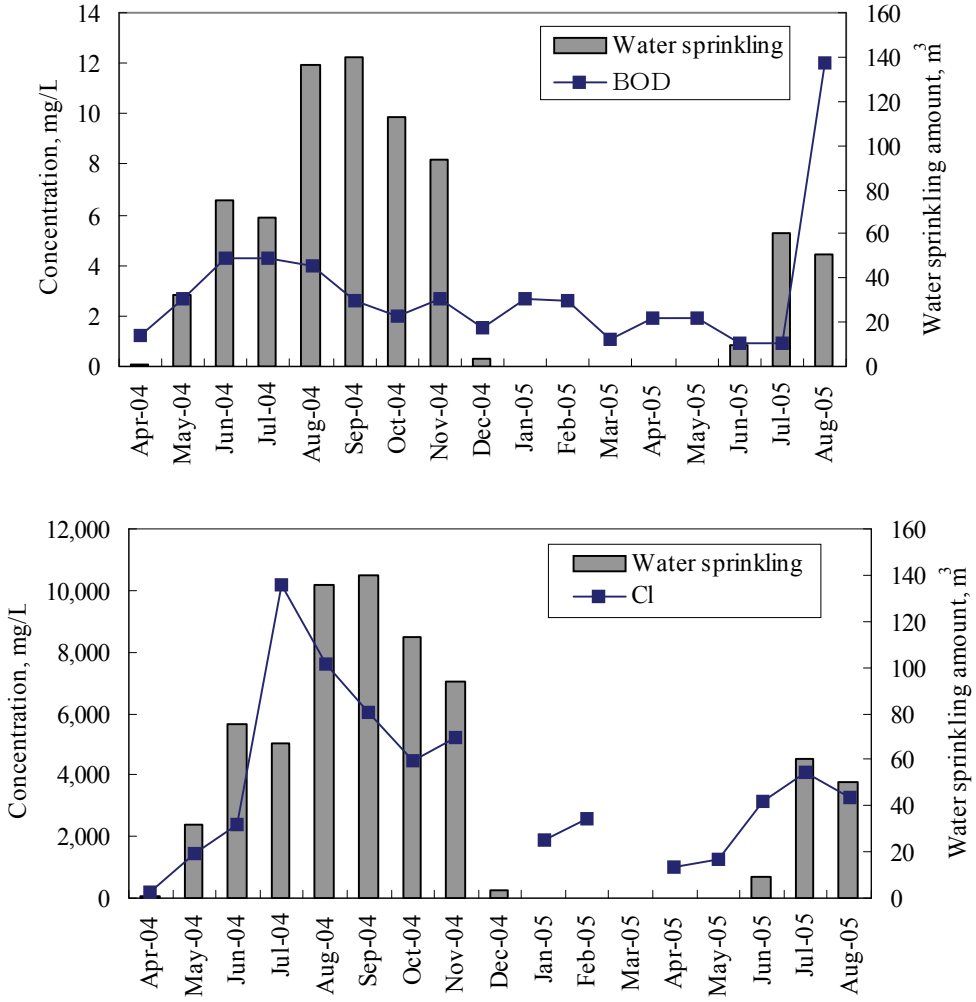

Figure 7 Relationship between water sprinkling amount and properties of the leachate (N Disposal Facility)

increasing the concentration in the leachate in short period.

Figure 7 shows the relationship between monthly water sprinkling amount and properties of the leachate. BOD is affected less by the water sprinkling amount, but the concentration of chlorine ion shows a tendency that it is higher in the months with much water sprinkling amount. These results, together with the results of elution test described before, can lead to the following conclusion.

Within the short term, increasing the water sprinkling amount advances the scouring of inorganic salts, resulting in raising the concentrations in the leachate. As a result, in the long term, the content of inorganic salts in the landfilled wastes is reduced, and the concentrations from the elution test becomes lower. Since the concentration of chlorine ion in the leachate of M disposal facility is extremely low, it is estimated that inorganic salts remains much in the landfilled wastes, resulting in showing high concentrations at -80cm in the elution test.

On the other hand, for the organic substances, proper amount of water sprinkling accelerates the microbial decomposition, resulting in stabilizing the wastes and reducing both the concentrations in the leachate and the concentrations obtained in the elution test. Since the

organic components are also subjected to the water sprinkling, the disposal facilities with much sprinkling water may increase the concentrations of BOD and COD in the leachate. But, for N disposal facility, advance of stabilization of the waste layer may have lowered the concentrations of the BOD and COD though the amount of water sprinkling is much. For M disposal facility, the interior of the landfilled waste layer is prone to anaerobatic, which also possibly leads to high concentrations of BOD and COD.

CONCLUSION

Although it is not appropriate to bring a clear conclusion due to lack of the data, it can possibly be said that the CS disposal facilities that are capable of supplying sufficient amount of water to their landfilled wastes layer by controlling the water sprinkling may promote microbial decomposition of organic substances and scouring of inorganic salts by the water, possibly contributing to stabilization of the wastes. On the other hand, for the open type disposal facilities that is not capable of controlling the water supply, water for stabilization of the wastes may be insufficient or excessive, resulting in making interior of the landfilled waste layer anaerobatic, leading to inhibition of promotion of the waste decomposition.

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