Ⅶ-275 Assesment of Heavy Metal Contamination of Landfill Leachates

（廃棄物処分場浸出水の重金属汚染の計測と評価）

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Introduction

Leachate from landfill site of solid wastes including municipal solid wastes, sludge, incineration ashes, etc is of one of the major source of heavy metals discharged to the surrounding environment. Recent increase in incinerator wastes may cause composition change of the heavy metals in the leachate. But till now, few studies have been conducted about the actual heavy metal concentration of landfill leachates. The objective of this research is to characterize the landfill leachates with regards to mainly the various heavy metal contaminants from the different sources and to find out the possible methods of their treatment.

Materials and Methods

It was selected for the measurement items of Pb, Cr, As, Hg, Se, Cd, Cu, Fe,Mn, Zn based on discharge standard of Japan and Ni, Mo, Sb based on environmental standard of Japan. Sn does not appear in the regulations, but we selected Sn for measurement item, because little information is available for Sn. The above heavy metals were measured by using Hitachi model Z-8270 Polarized Zeeman Atomic Absorption Specrtophotometer considering to mainly the original samples, because of the reduction of blank level and AA-640-13 Atomic Absorption/ Flame Emission Spectrophotometer considering to mainly HCl-HNO_3 digested samples, because of the removal of matrix effect. Other compounds were analyzed by using such as CIA for anions, TOC detector for TOC, indophenole method for NH_4-N and pH meter for pH. Different type of samples were tested by collecting from different locations and measurement techniques were developed to set the optimum condition condition for the measurement of each heavy metal of landfill leachates. The waste composition, sampling point and treatment processes of the leachate of three different landfill sites are shown in table-1.

Table-1; Waste composition, sampling point and leachate treatment in the landfill sites.

Landfill Site	Nature of Waste Composition in Dumping Area	Treatment Type and Sampling Point (RL, T1, T2,...)
Site-I	Municipal wastes including sludge and incinerator ash.	Raw leachate-(RL)-> Acid+ Alkali+Degas -(T1)-> Biofilm -(T2)-> Coagulation -(T3)-> Sand Filtration -(T4)-> Activated Carbon -(T5)-> Effluent.
Site-II	Mainly sludge.	Raw leachate - (RL)-> Biological + Coagulation + Chemical Oxidation + Filtration + Activated carbon -(TL)-> Effluent.
Site-III	Construction wastes including sludge, slug and ash.	Raw Leachate -(RL)-> Coagulation +Filtration + Activated Carbon -(TL)-> Effluent.

Foot note: Rl-Raw Leachate, T1....T5-Treatment stage-1....Treatment stage-5, TL-Treated Leachate.

Results and Discussion

The general properties of landfill leachate, both from raw and treated are shown in table-2 and it is observed that the concentrations of every item in this table are very high, particularly in the raw leachates. In all sites, TOC is reduced by the treatments, but nitrogen compounds are not removed so much. High salt concentration is also observed and this may cause difficulty of treatment.

The heavy metal concentration level of leachate from each landfill site is shown in Fig.1. The concentration of heavy metals in leachates are dependent on their source materials, geography of the landfill and heavy metal content of wastes. Fe, Mn, Ni and Sn are comparatively high (between 100-10000 *ug*/l) in almost all locations. Besides these, Cr in site-I and Mo, Zn in site-III are higher than 100 *ug*/l.

Table-2; Other items, except the target heavy metals (All items are as mg/l).

Sample	Item	TOC	NH_4-N	NO_3-N	Cl^-	SO_4^{2-}	Ca	Na	Mg
Site-I	Raw	488	410	71	3698	NPM	30.17	2205	1741
	Treated	92	458	20	4232	2191	31.13	2210	149
Site-II	Raw	250	20	1631	9228	531	96.70	3944	306
	Treated	66	273	241	5886	358	114.46	4090	421
Site-III	Raw	262	643	64	10500	4178	311.80	5820	690
	Treated	29	518	322	8854	3723	290.20	5150	138

Foot-Note: NPM-Not Possible to Measure.

All of the finding results from raw leachates of all sites and from treated ones are below the discharge standard of Japan. But the discharge standard of Mo, Ni, Sn, and Sb are not settled yet. Although leachate concentration is within the discharge standard, this concentration is not enough low as compared to environmental standard of Japan. The concentration of some heavy metals in raw leachate are at the same level (Cd , Sb of site-I, Cd, Hg of site -II and

Cu, Hg of site-III) or at the higher level (As, Cr, Fe, Ni, Pb, Hg of site-I, As, Fe, Ni, Pb, Sb of site-II and As, Fe, Mo, Ni, Pb, Sb, Se of site-III) as compared to Japan environmental standard. It is observed in the treated leachates that Fe, Sb, Ni of site-I; Sb, Pb, Ni of site-II and Sb, Pb, Mo, Se of site-III are contained higher than the value of Japan environmental standard.

The concentration change along treatment process in site-I is shown in Fig.2 and Fig.3. Fig.2 shows Cd, Cr, Cu, Pb and Sn are significantly removed, but as shown in Fig.3 As, Fe, Mn, Mo and Zn are not reduced even after several stages of treatment. On the other hand, Fig.4 shows TOC and NO_3-N are significantly removed; but NH_4-N is almost constant, because biological capacity is not sufficient for removal of NH_3.

As a whole, it is appeared that the treatment facilities are not sufficient for removal of heavy metals except for some elements. These may be partly because of the treatment systems of these sites are not designedfor the removal of heavy metals. These are designed mainly for the reduction of COD.

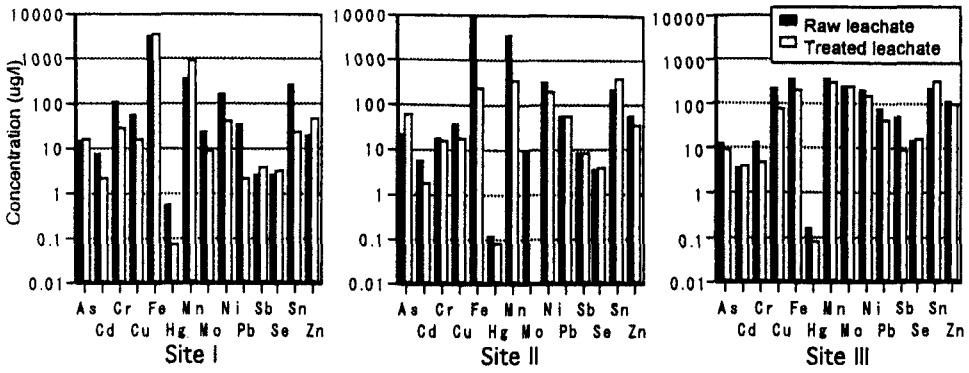

Fig. 1. Concentrations of heavy metals in leachate of different sites.

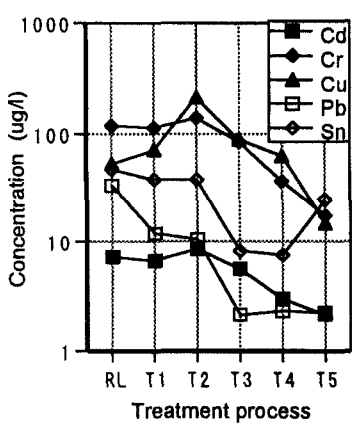

Fig:2; Concentration change along treatment process.

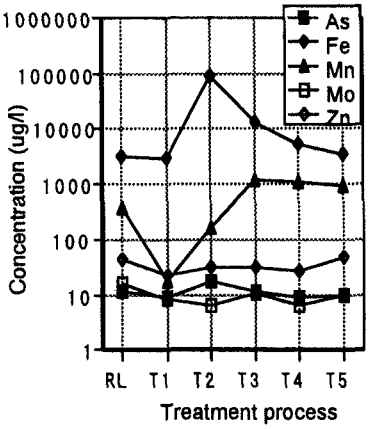

Fig:3; Concentration change along treatment process.

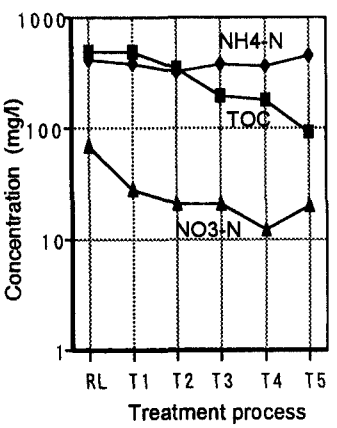

Fig:4; Concentration change along treatment process.

Conclusion

Significant amount of various heavy metals are exist in the raw and treated leachate of landfills, although their concentration level is lower than the discharge standard of Japan. The adopted treatment systems in all landfill sites were not based upon the treatment of heavy metals. But some plant has coagulation process to treat heavy metals as well as COD, these treatment facilities are not able to treat all heavy metals upto the level within environmental standard of Japan. Considering recent change in composition of waste, it will be necessary to pay much attention to heavy metal control in leachate.