A COMPARATIVE STUDY ON THE DISTRIBUTION OF HUMIC SUBSTANCES IN LEACHATE FROM LANDFILLS MAINLY DISPOSED WITH MSW AND MSWIR

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1. Introduction

The characteristics of leachates generated from municipal solid waste (MSW) and municipal solid waste incineration residues (MSWIR) landfills, in which a variety of organic pollutants and heavy metals are included, makes them potentially hazardous for the environment and therefore is an issue of great concern in the field of wastewater control. Within the variety of pollutants included in the leachate, special attention should be pay to humic substances (HS), considering their ability to bind with heavy metals, adsorb hydrophobic organic pollutants and leach out from the landfill site[1),2)].

Although other researchers had characterized different landfill leachates, the leaching behavior of different components is not completely clear due to the several factors that influence the characteristics of leachate such as: the landfill`s type of waste, pH, moisture content, age of the landfill, climate and many more. Therefore, this study was focused on clarifying the effect of some of these factors over the leaching out of HS in a landfill site; considering the importance for engineers to have a clear knowledge about the composition of leachate in order to be able to evaluate the landfill stabilization.

2. Materials and Method

Raw leachates (F, B & H) were taken during two different periods of time from T wastewater treatment facility located in Fukuoka city. The first sampling was carried out on September 10th, 2003 and the second on December 20th, 2005. Leachate F is discharged from a landfill mainly disposed with MSWIR since 1988 until now. Leachate B and H are originated in landfills mainly disposed with MSW during 1977～1988 and 1973～1976 respectively. The specific composition of the waste landfilled in each landfill as well as the landfill type is shown in Table 1. After sampling, DOC concentration was measured by TOC analyzer (TOC-V, Shimadzu co.) as well as the heavy metals concentration (ICPS-7000 Ver.2, Shimadzu co.). HS were extracted from the leachates following the isolation procedure of aquatic HS implemented by the International Humic Substances Society (IHSS).

3. Results and Discussions

The results presented in Figure 1 shows that leachate B (MSW) had the highest concentration of HS, while leachate F (MSWIR) had the lowest concentration of HS. In the case of leachate H, discharged from an anaerobic landfill and composed with 59% of MSW, its age (29 years old) might explain its low concentration of HS compared with leachate B. Also, comparing the samples taken in both periods of time it can be noticed that December 2005 samples had higher HS concentrations compared with the same leachate taken in September 2003.The statistical data from T landfill sites[3)] provided information about the monthly average volume of leachate discharged from T landfill sites from the years 1995 to 2004. The report shows that due to

Table 1. Landfills Characteristics

Landfill sites		H	B	F
Wastes composition	MSW	59 %	70 %	30 %
	MSWIR	13 %	29 %	60 %
	CISW	28 %	1 %	10 %
Landfill period		1973～1976	1977～1988	1988～now
Landfill type		Anaerobic	Semi-aerobic	Semi-aerobic

Table 2. Leachates characteristics used for this study

Sampling date	September 10th 2003			December 20th 2005		
Leachates	H	B	F	H	B	F
Used volume (L)	39.1	39.0	17.8	22	22	22
Color	Light Yellow	Yellow	No color	Light Yellow	Yellow	No color
pH	7.4	7.8	7. 7	7.5	8.2	8.4
EC (mS/cm)	1.5	5.9	5.8	2.3	6.5	5.5
Eh (mV)	147	128	135	196	199	265
DOC (mg/L)	11.0	52.6	10.5	109	65.2	2.2

precipitations, almost double amount of leachate is discharged during the month of September compared with December (25,828m^3 and 13,027m^3 respectively). This might be the main explanation for the variation in the HS and DOC concentrations for leachates B and H. Nevertheless, also other factors might influence in the HS concentration in leachate. The regularity in which the leachate is pumped from the landfill site affects the concentration of their components. Finally, it should be mention that while HS concentration in leachates from 2003 were calculated from the isolated amount of FA and HA, HS concentrations in leachates from 2005 were calculated from FA and HA fractions obtained before the purification process. According to Christensen et al. (1998)[1]; some amount of HS is lost during the purification and isolation process.

The distribution of HS in filtrated solution and suspended solids (SS) in leachates B (Sept. 2003), F and H (Dec. 2005) are shown in Figure 2. It can be noticed that HS was commonly present in SS <0.45μm of leachate. Nevertheless, while in leachate F (MSWIR), a significant 48% of HS was present in SS >0.45μm, in leachates H and B (MSW), HS in SS represents less than 10% of the total HS in leachate. Moreover, in leachates H and F`s SS, HS was more contained in 0.45μm <SS < 1μm. If HS distribution is discussed considering FA and HA, an unquestionable predominance of FA over HA can be observed in SS <0.45μm. In SS, although there is still a predominance of FA over HA in leachates H and F, in the case of leachate B a predominance of HA over FA can be noticed. In general, HA in leachate is commonly present in SS>0.45μm due to its binding capacity with SS while FA is more soluble due to its low molecular weight and more carboxylic content compared with HA (Stevenson 1994)[4]. Finally, the results from ICP measurements showed that the concentration of Cd, Cu, Pb and Zn were below 0.1mg/l while Mn and Cr showed concentrations below 0.4 mg/l.

4. Conclusions

Leachate samples from landfills landfilled with MSWIR has low concentration of HS. In the case of old samples the concentration of HS might be also low because of the degradation of HS. FA has predominance in dissolved part of leachate and HA is commonly present in SS of leachate. In the case of leachates mainly MSWIR a higher amount of HS could be found in SS especially between 0.45 and 1 μm, compared with leachates containing MSW. When the characteristics of raw leachate is being studied, because of its influence over the concentration of HS its important to consider the flow rate and the discharged volume of leachate.

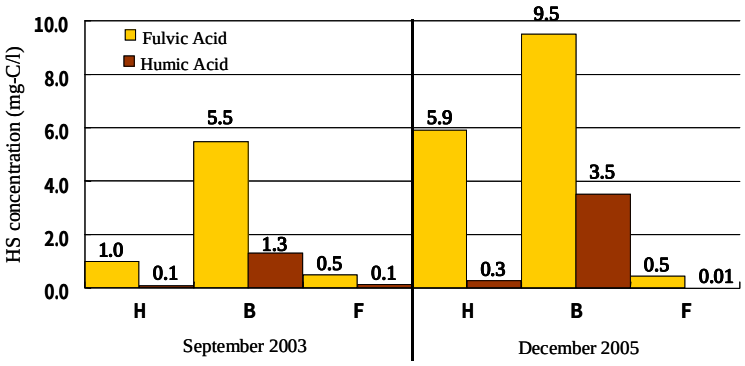

Figure 1. HS concentrations in leachates

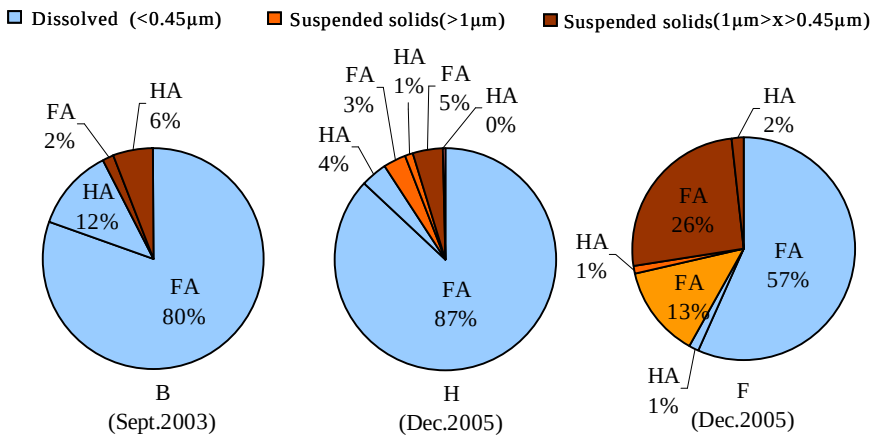

Figure 2. Distribution of HS in leachates

References

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