Kossge International Symposium on Soil & Groundwater Environment
October 27-28, 2005 Mayfield Hotel, Seoul, Korea

A study on the characteristic of adsorption of DEHP on residual soils

In-Ho Jung[1] · Jai-Young Lee[1] · Byung-Taek Oh[2]

[1]Department of Environmental Engineering, The University of Seoul, Seoul South Korea
e-mail; wind9887@hanmail.net, leejy@uos.ac.kr
[2]Dept. of Environmental Sciences & Biotechnology, Hallym University, Chuncheun, South Korea
e-mail; btoh@hallym.ac.kr

ABSTRACT

Plastics and vinyl resin have been commonly used in the various fields of industry and daily life. Plastics contain plasticizers to enhance the flexibility of material. Since most of the plastic products become waste at the end of their life cycles except for some incinerated wastes, most wastes have been finally disposed in landfill. Accordingly, the possibility causing the leaching of plasticizer as a DEHP (bis(2-ethylhexyl) phthalate) in the municipal landfill has been raising. A large part of plasticizer including a DEHP is phthalate ester compounds.

In this study, the characteristics of adsorption and residue were investigated using three residual soils which had been gathered from terminated landfills. The terminated landfills have been currently sorting and transferring under stabilization.

The residual soils were dried by exposing to the air and passed through a sieve(#10, 2mm). Characteristics and particle-size distribution curves on residual soils tested are shown in Table 1 and Fig. 1.

Table 1. Characteristics of residual soils.

Item	G Landfill	M Landfill	J Landfill
Specific Gravity	2.51	2.53	2.38
Moisture Content (%)	20.90	36.33	81.97
Physical Properties	SM	SM	SM
Passing No. 200 sieve (%)	16.61	28.35	42.78
CEC(cmol/kg)	10.22	15.54	22.30
TKN (%)	0.10	0.26	0.23
Organic matter content (%)	2.307	6.206	7.22
T-P (mg/kg)	231.47	611.59	899.04
pH	7.31	7.65	7.85

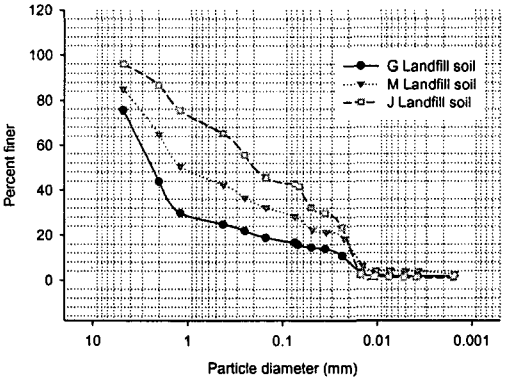

Fig. 1. Particle-size distribution curves.

The residual soils sampled from terminated landfills contained waste materials such as rubber, leather, vinyl, plastics

and fiber. The content of waste materials in G-, J-, and M-landfill was 16.29, 13.25, and 34.51%, respectively.

Fig. 2 shows chromatogram(SCAN mode) of the extract obtained from residual soil(M landfill). Mass spectra from GC-MSD analyses of sample peak(DEHP) were compared with the reference spectra(NIST) and indicated that both mass spectra matched(Fig. 3). In addition, the content of phthalate esters in the residual soils and general soils are given in Table 2.

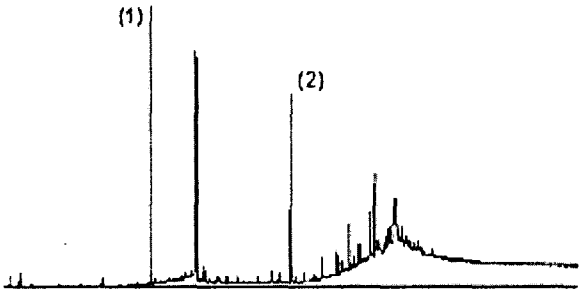

Fig. 2. GC chromatogram of residual soil (M Landfill soil)

(MSD: m/z 35~540 full scan).

1) ISTD: Benzyl benzoate

2) DEHP (bis-2-Ethylhexyl phthalate)

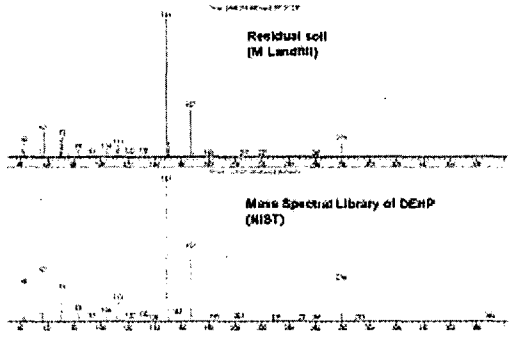

Fig. 3. Mass spectra of residual soil (M Landfill soil) and DEHP from library (NIST).

Table 2. Content of Phthalate ester in the residual soil and general soil (standard deviation, n=3).

Sample	Dibutyl phthalate (mg/kg)	bis(2-ethylhexyl) phthalate (mg/kg)
G landfill residual soil	0.15 (0.02)	6.27 (0.65)
M landfill residual soil	0.28 (0.04)	20.05 (1.34)
J landfill residual soil	0.37 (0.03)	10.73 (1.37)
G landfill general soil	0.02 (0.01)	0.01 (0.01)
M landfill general soil	0.06 (0.05)	0.02 (0.03)
J landfill general soil	Not detected	Not detected

DBP(di-*n*-butyl phthalate) and DEHP were detected in all of residual soils tested(Table 2). Especially content of DEHP in the residual soil was greater than DBP. This may be resulted from that biodegradation of DEHP under anaerobic condition makes slow progress.

Batch studies were performed to determine the adsorption behavior of DEHP on the residual soils under landfill conditions(35℃, 200rpm, 48hr) using pure water and leachate. Freundlich isotherm was fitted to the data(Figs. 4 and 5).

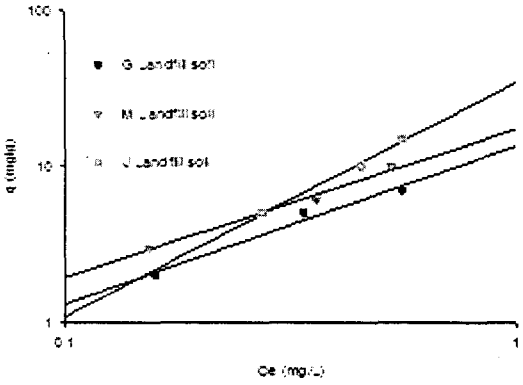

Fig. 4. Freundlich isotherm of DEHP in pure water.

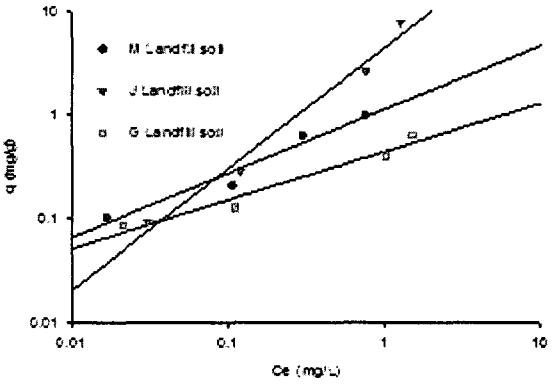

Fig. 5. Freundlich isotherm of DEHP in leachate

Table 3. The Freundlich isotherm parameters for the adsorption of DEHP in pure water and leachate.

Soil	Pure water			Leachate		
	K	n	R^2	K	n	R^2
J landfill	34.76	0.666	0.994	5.10	0.487	0.956
M landfill	17.35	1.052	0.983	0.77	0.646	0.957
G landfill	13.53	0.988	0.980	0.28	1.196	0.980

Based on Table 3, sorption coefficient(K) of DEHP in leachate was investigated lower than that in pure water, suggesting that the fate of phthalate esters in landfill should be studied using leachate for batch reactors.

The residual soil from J-landfill seems to have high probability to keep great organic matter content, CEC, and #200 sieve passing ratio. In addition, Freundlich isotherm sorption coefficient(K) and constant(1/n) were higher than others (Table 3). However, content of phthalate esters in residual soil from M landfill was greater than others. In residual soil from M landfill, content of waste material relating leaching of phthalate esters was the highest among three residual soils.

Overall, this study suggests that residual amount of phthalate esters in landfill can be affected by waste materials remaining.