Concentrations of PCDD/PCDF in Leachates from disposal sites and their removal characteristics during Leachate Treatment

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ABSTRACT
Studied in this paper are the concentrations and the homologue profiles of dioxins in leachate from disposal sites, the correlation between years since commissioning of the landfill sites and the dioxins in the leachate, as well as the removal characteristics of dioxins in leachate treatment facilities.

INTRODUCTION
In Japan more than 70% of municipal solid waste is disposed of by incineration. Nowadays It is becoming more difficult to obtain sites for disposal, and accordingly the incineration is increasingly relied on as a treatment process of municipal solid waste. At the final disposal sites, the percentage of incineration residue found in the landfill is becoming higher; and there is apprehension of the amount of dioxins being discharged into the environment from incineration residue. However, there is not much information on the concentrations of dioxins in landfill leachate and the characteristics of removal at treatment facilities, nor on discharge of dioxins into the environment. In this study, the characteristics of the removal of dioxins from leachate at a leachate treatment facility are presented.

FORM

EXPERIMENTAL

The dioxins concentrations in the effluent were analyzed for leachates from thirteen final disposal sites and for four of those the dioxins were measured for the effluent from each unit process of the treatment facility. As the treatment process, biological treatment, coagulation and sedimentation, sand filtration, and activated carbon adsorption were used. These constitute a typical treatment process in Japan. The year of commissioning of the landfill site and the composition of the landfill materials for each of the four sites are listed in Table 1.

Finl Disposal Sites Investigated

Item \ Site No.		No-1	No-2	No-3	No-4
Landfill area(m^2)		16,000	18,700	42,000	15,751
Landfill volume(m^3)		149,000	250,000	156,000	68,000
First Landfill year		1985	1990	1991	1989
Total landfill weight(t)		38,699	18,000	96,107	75,000
Types of refuse and their ratios	Incombustibles	47%	71%	58%	8%
	Incineration Residue	38%	28%	30%	92%
	Others	15%			
Capacity of leachate treatment facility		50m^3/day	50m^3/day	135m^3/day	70m^3/day

Table-1

Biological processes employ biological denitrification. The No-1 facility uses a rotating biological disc and the other treatment facilities use contact aeration processes.

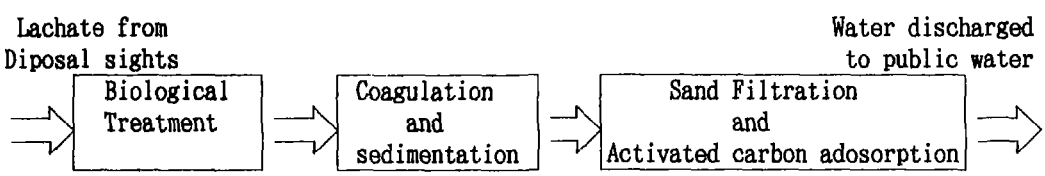


Figure.1 Typical Treatment Process in Japan

RESULTS AND DISCUSSION

The measured concentrations of dioxins in the leachate were in the range of 0.076 to 6.3 ng/l. The distribution of $PCDD_s$ and $PCDF_s$ concentrations is shown in Fig. 2.

2,3,7,8-T_4CDD was not detected at any of the sites and TEQ(International) was below 0.05 ng/l. If we look at the concentration of each homologue, those of H_7CDD_8 and OCDD, which have a low solubility in water, were high. On the other hand, OCDF was also high, for the furans. The homologue distribution of dioxins found in fly-ash transported to the final disposal site was about the same as that of dioxins found in leachate. The solubility in water of T_4CDD_8 and of OCDD in water differ by an order of 10^3 [1], but T_4CDD_8 and OCDD concentrations in fly-ash differ by an order of 10^2. From this fact it can be said that dioxins found in landfill leachate are governed more by the homologue distribution in the fly-ash than by their solubilities in water.

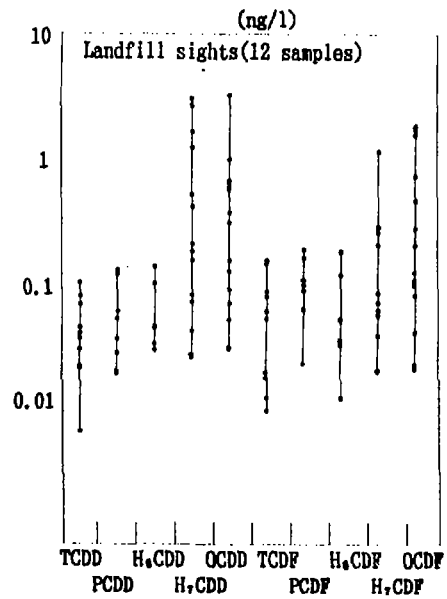


Fig. 2 Concentrations of PCDD/PCDF in Leachate from Disposal Sites

Fig. 3 shows a relationship between the years since commissioning of each final disposal site and dioxins concentoration of the leachate. Comparatively high concentrations were observed in the leachate from the new disposal sites. The dioxin level tends to decrease with the years of use of site. The reason is as follows: since the distribution ratio of dioxins to soil is much greater than that to water, the larger amount of dioxins is adsorbed by soil and the less amount is transferred to the environment as landfill sites are aged in final disposal areas in Japan, which have intermediate earth covers.

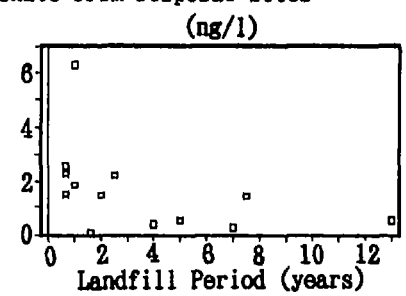
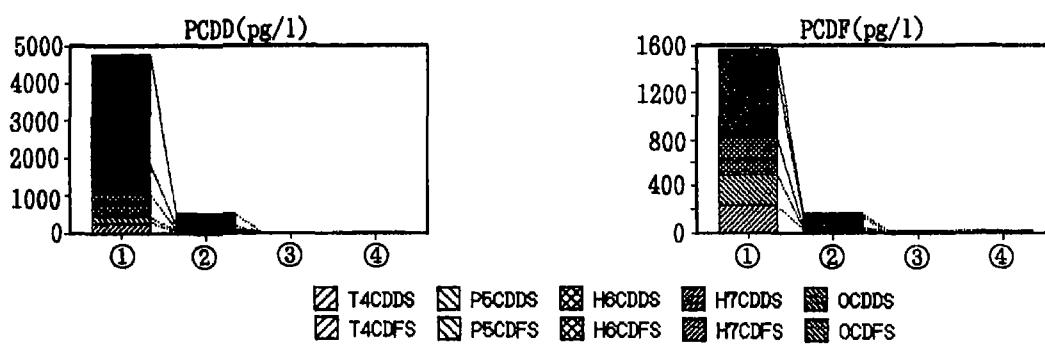


Fig. 3 Landfill Yers since Commissioning and Dxn Concentration

More than 80% of dioxins were removed by in each biological process. Looking at each homologue of dioxin separately, the removal efficiency is extremely high for lower concentrations of T_4CDD_8, P_5CDD_8, and H_6CDD_8 and thus the effluent levels become below the detectable limit; but when the concentration becomes higher, then the removal efficiency decreases. On the other hand, even when the concentrations of H_7CDD_8 and OCDD are high, the removal efficiency dose not fall, but rather displays

stabilized treatment characteristics. The same kind of tendency can be seen for the homologues of furan.
The mechanism of dioxins removal by a biological process is postulated as follows. The biological tank is tightly sealed and therefore, ultraviolet radiation would have no effect on the decomposition. Vaporization into the air by aeration could not be a mechanism of this removal. Since the similar result was obtained with a rotating biological disk process. From the above two points it is postulated that dioxins were removed by adsorption to the biological film.
There was no evident removal of dioxins by sand filtration and activated carbon adsorption possibly due to the fact that the influent concentrations to these processes were too low. However, the test results indicate that more than 80% removal of dioxins is possible for the leachate having the concentration levels as encountered in the experiments.
The concentration of dioxins actually measured in the effluent of activated carbon adsorption was below 0.15 ng/l and thus, the amount to be discharged into the environment could be minimized.



①Leachate
②Biological Treatment
③Coagulation Treatment
④Activated Carbon Treatment

Fig.4 Change in Concentration with Treatment Processes

References
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