

ANALYSIS OF EMISSION CHARACTERISTIC OF PCDDs/DFs ON SOUTH KOREA INCINERATION WASTES

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Introduction

Dioxine is a toxic substance that is included in the defoliant (2,4,5-T). It is widely used during the Vietnam war, and today it is well known to the public as well as professionals. International society had agreed upon stockholmn treaty on May, 2004 to protect the environmnet and human helath from the remaning pullutitve organic toxic and Bioaccumulation , and South Korea officially joined on Jan, 25, 2007 and other 169 coutries joined by March, 2009. South Korea is announcing the baseline of dioxine once in every two years as an effort of graudal extermination of dioxine. According to the Ministry of Environment, the amount of emission of dioxine from the incineration facility in 2009 was 48g I-TEQ, and it was 94.5% reduced comparing to the amount in 2001(880g I-TEQ). Thus, this rapid decline of emission of PCDDs/DFs was the result of attempting diverse policies including fortified effluent quality standard, monitoring of PCDDs/DFs concentration through managing measurement net, and inducement of better facility through PCDDs/DFs measurement monitoring on incineration plant. However, there should be more research and data on PCDDs/DFs for its continuous decrease and extermination. On this research, the emission characteristic of PCDDs/DFs will be analyzed by classifying incineration to domestic waste, industrial waste, and specific waste.

Materials and methods

Sampling was proceeded from 2009 to 2010, and 84 facilities of domestic waste (more than 2ton/hr(DW-L)), 24 facilities (less than 2ton/hr (DW-MS)), 84 facilities of industrial waste (more than 2ton/hr (IW-L)), 34 facilities (less than 2ton/hr (IW-MS)), 30 facilities of specific waste (more than 2 ton/hr(SW-L)), and 14 facilities (less than 2ton/hr(SW-MS)) were participated to this study.

The measurement and analysis of PCDDs/DFs was performed based on the POPs official standard. Also, 12% of standard oxygen concentration was applied, and emission concentration was calculated with International Toxicity Equivalence Factor (I – TEF). The sample purification was done with HCl modification and Multilayer Silica gel column, and Alumina column. After reference standard substance was injected to final concentration solution, HRGC/HRMS (Aotospec Premier, Waters, USA) was used to analyzed with selected ion(isotope dilution ES 10330.1) flow mass spectrometry on the solution over 10,000.

Results and discussion

Like the result showing on Table 1. Fig 1, the concentration was represented higher in order as following; specific waste (less than 2ton/hr) average 1.935ng I-TEQ/Sm³(Sm³=Standard State of Gas, 0°C, 1atm), industrial waste (less than 2ton/hr) average 1.762ng I-TEQ/Sm³, specific waste (more than 2ton/hr) average 1.037ng I-TEQ/Sm³, industrial waste (more than 2ton/hr) average 0.715ng I-TEQ/Sm³, domestic waste (less than 2ton/hr) average 0.437ng I-TEQ/Sm³, domestic waste (more than 2ton/hr) average 0.012ng I-TEQ/Sm³.

Table 1. PCDDs/DFs Concentration ratio (Unit : ng I-TEQ/Sm³)

Item	DW-L		DW-MS		IW-L		IW-MS		SW-L		SW-MS	
	Conc.	%	Conc.	%	Conc.	%	Conc.	%	Conc.	%	Conc.	%
	AVE		AVE		AVE		AVE		AVE		AVE	
2,3,7,8-TCDD	0.000	3.9	0.032	7.2	0.032	4.5	0.099	5.6	0.028	2.7	0.057	2.9
1,2,3,7,8-PeCDD	0.001	9.2	0.046	10.6	0.051	7.1	0.136	7.7	0.065	6.3	0.107	5.5
1,2,3,4,7,8-HxCDD	0.000	1.9	0.006	1.4	0.009	1.3	0.022	1.3	0.017	1.6	0.024	1.2
1,2,3,6,7,8-HxCDD	0.001	4.9	0.013	2.9	0.020	2.8	0.044	2.5	0.037	3.5	0.057	2.9
1,2,3,7,8,9-HxCDD	0.000	3.2	0.009	2.0	0.011	1.6	0.035	2.0	0.021	2.1	0.035	1.8
1,2,3,4,6,7,8-HpCDD	0.000	3.0	0.006	1.5	0.013	1.8	0.025	1.4	0.029	2.8	0.043	2.2
OCDD	0.000	0.6	0.001	0.2	0.002	0.3	0.004	0.2	0.005	0.5	0.008	0.4
ΣPCDDs	0.003	26.8	0.112	25.7	0.139	19.4	0.365	20.7	0.201	19.4	0.331	17.1
2,3,7,8-TCDF	0.000	3.1	0.015	3.4	0.020	2.7	0.081	4.6	0.022	2.1	0.049	2.5
1,2,3,7,8-PeCDF	0.000	2.2	0.010	2.3	0.016	2.2	0.049	2.8	0.019	1.8	0.041	2.1
2,3,4,7,8-PeCDF	0.005	39.4	0.176	40.2	0.258	36.1	0.686	38.9	0.373	35.9	0.714	36.9
1,2,3,4,7,8-HxCDF	0.001	4.1	0.022	5.0	0.047	6.6	0.113	6.4	0.071	6.8	0.126	6.5
1,2,3,6,7,8-HxCDF	0.001	8.1	0.042	9.7	0.087	12.1	0.181	10.3	0.117	11.3	0.223	11.5
2,3,4,6,7,8-HxCDF	0.001	11.9	0.043	9.9	0.098	13.7	0.187	10.6	0.149	14.3	0.297	15.3
1,2,3,7,8,9-HxCDF	0.000	1.1	0.003	0.7	0.007	1.0	0.018	1.0	0.011	1.0	0.016	0.9
1,2,3,4,6,7,8-HpCDF	0.000	2.7	0.011	2.5	0.036	5.0	0.068	3.8	0.061	5.9	0.110	5.7
1,2,3,4,7,8,9-HpCDF	0.000	0.4	0.002	0.4	0.006	0.8	0.011	0.6	0.010	1.0	0.020	1.0
OCDF	0.000	0.1	0.000	0.1	0.002	0.3	0.003	0.2	0.003	0.3	0.008	0.4
ΣPCDFs	0.009	73.2	0.324	74.3	0.576	80.6	1.398	79.3	0.836	80.6	1.603	82.9
Σtotal	0.012	100.0	0.437	100.0	0.715	100.0	1.762	100.0	1.037	100.0	1.935	100.0

From comparing the type of isomer of one incineration facility on each research subjects, the PCDFs (of all the domestic waste, industrial waste, and specific waste) 2,3,4,7,8-PeCDF was the highest (35.9%~40.2%), and 2,3,4,6,7,8-HxCDF (9.9%~15.3%) and 1,2,3,6,7,8-HxCDF(8.1%~12.1%) were showing higher concentration rate in order.

PCDDs/DFs was showing higher concentration as following; 1,2,3,7,8-PeCDD 9.2%, 6.3%, 1,2,3,6,7,8-HxCDD 4.9%, 3.5%, 2,3,7,8-TCDD 3.9%, 2.7% on domestic and specific waste (more than 2ton/hr). For the wastes of domestic(less than 2ton/hr), industrial (more than 2ton/hr), and specific (less than 2ton/hr) were as following ; 1,2,3,7,8-PeCDD 10.6%, 7.1%, 7.7%, 5.5%, 2,3,7,8-TCDD 7.2%, 4.5%, 5.6%, 2.5%, 1,2,3,6,7,8-HxCDD 2.9%, 2.8%, 2.9%, 2.5%, and showing high concentration in order.

On each waste, PCDFs is showing higher concentration distribution than PCDDs, and also with the rate of domestic waste (7:2) and specific waste (8:2), PCDDs/DFs rate in incineration facility of domestic waste was slightly higher than the incineration facility of specific waste.

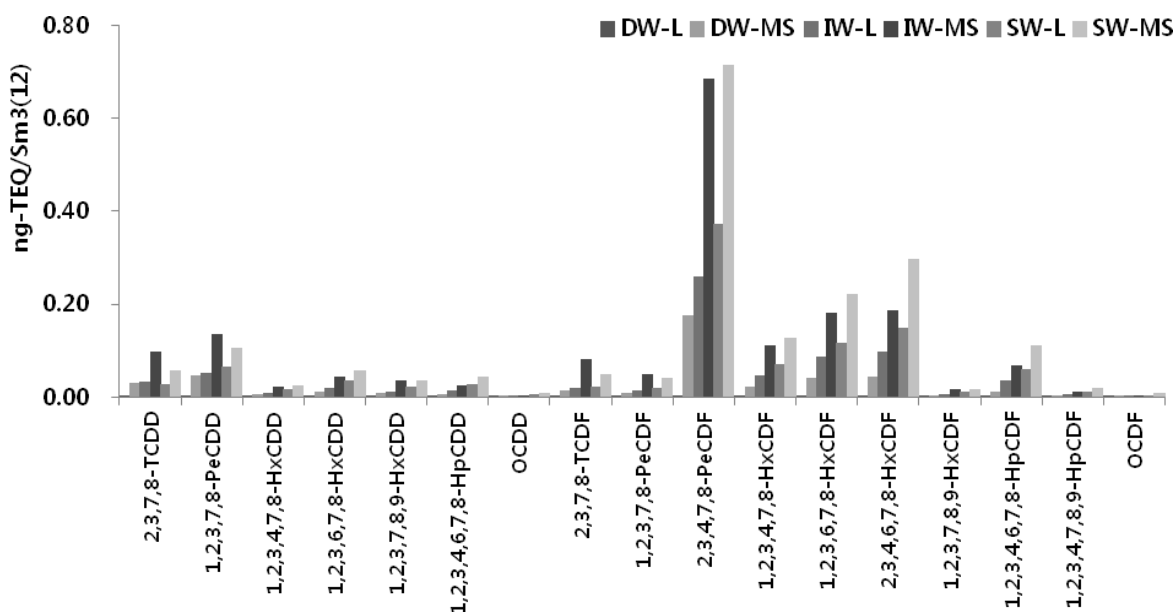


Fig 1. Distribution of PCDDs/DFs isomers in the incineration facility

Pearson correlation coefficient was used to check the correlation of PCDFs and PCDDs on incineration facility, and the result turned out as domestic waste PCDFs 0.999, 0.996, PCDDs 0.997, 0.957, industrial waste PCDFs 1.000, 0.994, PCDDs 0.988, 0.889, specific waste PCDFs 0.999, 0.999, PCDDs 0.989, 0.968, and therefore it is concluded that PCDFs has more influence on entire concentration rate than PCDDs with a small difference.

As the result of examining the excess of effluent quality standard, none of the exceeding domestic waste incineration facility was found, but there were two cases (2.4%) of industrial waste incineration facilities (more than 2ton/hr), 5 cases (13.9% / less than 2ton/hr) , 8 cases of specific waste (more than 2ton/hr), and 2 cases (15.4%/ less than 2ton/hr). Therefore the special and concentrated care for incineration facility (less than 2ton/hr) of industrial and specific waste, which has relatively higher concentration rate, should be considered and needed for continuous decline of PCDDs/DFs.