PCDD/PCDF - Emission From Moscow Municipal Solid Waste Incinerator.

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Introduction.

Official state support monitoring of dioxin hazardous industry is carried out since 1996 in Russia.. It is a part of the state program «The Environment and Population Protection From Dioxins and Dioxin-Like Compounds».

The objective of this investigation is the inventory of emissions of Moscow Municipal Solid Waste Incinerator (MMSWI), using thermal processes for waste products liquidation .

MMSWI is situated in Moscow, it has four incineration furnaces with the systems of the heat utilization and flue gases cleaning with the help of electrostatic and FFs. MMSWI works in the continuous regime. Maximum capacity of one incinerator is 12 ton/hour with emission of flue gases in the air about 6000 m^3 per 1 ton of solid waste. The emission of flue gases in the air is going through common flue stack 90 m high. Also, there are such solid waste products as bottom ash and fly ash.

To quantify MMSWI dioxins emission in the air flue gases were collected from one of the incinerators after cleaning by the Electrostatic Precipitator (EP) and Fabric Filter(FF). Besides, the probes of bottom ash and fly ash from heat exchanger, EP and FF were collected . Quantitative measurements of the dioxins in the air during MMSWI work with maximum productivity were performed from June to August 1997 for evaluation of gas emission effect on the ambient air in MMSWI vicinities.

Leeward air sampling was carried out in the zone of the maximal effect of emission gases, at the distance equal to three heights of stack (300m).Control sample was collected under the idle incinerator.

Experiment.

Flue gas samples were collected in isokinetic regime using sampling device. PCDD/F, carried by particles of fly ash, were trapped by membrane filter. Water-cooled XAD-2 resin was used for extraction of the dioxins from gaseous phase. Ambient air samples ($500m^3$) were collected on the filter using high volume air sampler ($60m^3$/hour). Quartz fibre filters impregnated with diethylene glycol sebacate [1)] were used for this purpose.

Quartz filter and XAD-2 resin were spiked with the mixture of labeled standards (Cambridge Isotope Laboratories, USA) prior to sampling. extraction. Fly ash and bottom ash were spiked with the same standard mixture prior to extraction.

PCDD/F from filter and XAD-2 resin were extracted in soxhlet for 5 hours by hexane and dichloromethane, respectively. Extraction from fly ash and bottom ash was carried out with toluene for 20 hours. Glass columns with acid and basic silica gel and basic alumina oxide were used for extracts cleaning.. The methods of cleaning and detection (HRGC/LRMS) were described in details earlier [2)]. Identification and quantitative analysis was performed on Hewlett-Packard GC/MS 5890/5971A using Ultra-2 capillary column by Hewlett-Packard.

Results and Discussion.

Table 1 tabulates the results of analyses in Toxic Equivalent Factor (TEF) of the flue gases, fly ashes, bottom ash and ambient air. Table 2 shows characteristic composition of the dioxin congeners in flue gases and fly ashes.

Results in Table 1 suggest that use of the FF decreases PCDD/F concentrations in flue gases two-, threefold. Quite significant dispersion of PCDD/F values presumably is caused by faulty performance of incinerator. It is confirmed by the downstream temperature profile measurements. It is well known that high dioxin concentrations are generated at the furnace start-up[3)].

Comparatively low efficiency of FF performance is related to high dioxin content in gas phase, but not in fly ash. However, FF absorbs fly ash with high PCDD/F concentration - 12 ug/kg in TEF. The PCDD/F concentrations in fly ash from the EP are somewhat lower (Table 1). The reason probably is the trapping of the bigger size fly ash particles with smaller surface areas.

Relatively high PCDD/F concentrations in bottom ash are apparently connected with its short time staying in the furnace high temperature zone.

Fig. 1 shows the profile of dioxin congeners concentrations in the flue gas.

Conclusions

1. The major hazards to environs from MMSWI operation represent flue gases and fly ash. Annual yield of dioxins from continuous work of four incinerators is 0,5 g - from flue gases, 10 g - from fly ash and 1,5 g - from bottom ash (in TEF).
2. The efficiency of the FF for PCDD/F trapping is insufficient because of high dioxins content in gas phase. It is advisable to use sorption systems.
3. Significant reduction of dioxin emission can be achieved by strict adherence to the technological regime.

Acknowledgments.

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References

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2. EPA. Method 8280: The Analyysis of Polychlorated dibenzo-p-dioxins and polychlorinated dibenzofurans.
3. H. Tejima, S. Shibakawa, K. Osumi, M. Kamashima. Organohalogen Compounds, Dioxin ' 96, Vol. 27, p. 215-219.

Table 1. Results of PCDDs and PCDFs in flue gas, bottom ash and fly ash from MSWI.

#	Flue gas, EP outlet, ugTEQ/Nm3	Flue gas (EP+FF) outlet, ngTEQ/Nm3	Bottom ash, ngTEQ/ kg	Fly ash from EP, ugTEQ/kg	Fly ash from FF, ugTEQ/kg	Heatex-changer fly ash ugTEQ/kg	Ambient air (300m from stack) pgTEQ/Nm3
1	1,14	2,09					
2	6,44	0,62	30	1,16	12,05		5,78
3	1,04	1,9					
4	0,97	0,36	55	5,89	8,59	0,95	0,03*

*-control probe under idle incinerator

Flue Gas (EP+FF) Outlet

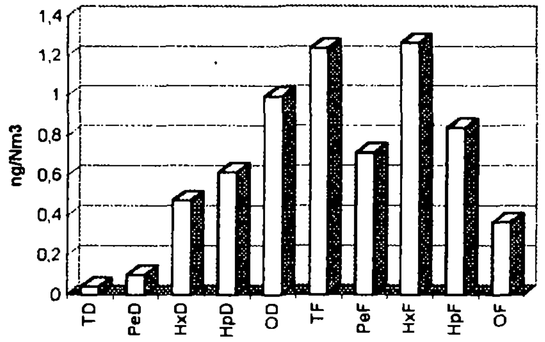

Fig. 1. Profile of PCDD/F Congerners Concentrations in Flue Gas

Table 2. Results of PCDDs and PCDFs in flue gas and fly ash

	flue gas, ng/Nm3				fly ash, ug/kg			
	EP	EP	EP+FF	EP+FF	EP	EP	FF	FF
2,3,7,8 -TCDD	0,207	0,737	0,038	0,073	0,035	0,065	0,255	0,077
1,2,3,7,8-PeCDD	0,225	1,962	0,098	0,315	0,289	3,324	2,213	6,934
1,2,3,4,7,8-HxCDD	0,621	3,328	0,185	0,425	0,322	2,897	2,338	5,042
1,2,3,6,7,8- HxCDD	0,253	1,651	0,15	0,538	0,977	1,631	4,948	1,294
1,2,3,7,8,9- HxCDD	0,2	1,178	0,136	0,406	0,936	4,491	5,912	2,705
1,2,3,4,6,7,8 -HpCDD	1,726	7,492	0,613	2,195	3,367	0,215	13,951	0,245
OCDD	5,439	15,3	0,993	9,463	8,93	0,978	35,67	0,772
2,3,7,8- TCDF	2,272	9,682	1,237	4,185	0,551	0,116	12,145	0,194
1,2,3,7,8- PeCDF	0,512	2,66	0,305	0,904	0,68	1,122	5,726	1,301
2,3,4,7,8-PeCDF	0,539	3,627	0,407	1,539	0,832	2,399	8,745	3,749
1,2,3,6,7,8-HxCDF	0,672	3,128	0,578	1,629	0,643	6,107	7,606	8,431
1,2,3,4,7,8-HxCDF	0,463	4,08	0,341	1,355	0,573	4,568	15,88	3,377
2,3,4,6,7,8- HxCDF	0,423	3,013	0,295	1,144	0,661	3,112	7,902	4,082
1,2,3,7,8,9 -HxCDF	0	0	0,048	0,203	0,059	3,475	0,436	4,242
1,2,3,4,6,7,8 -HpCDF	1,017	6,833	0,695	2,469	0,871	0,02	12,112	7,845
1,2,3,4,7,8,9- HpCDF	0,208	0,812	0,142	0,406	0,172	6,364	1,324	6,769
OCDF	4,817	0	0,993	2,881	1,046	0,04	6,983	0,02
Total TCDD	3,374	5,361	1,582	3,154	2,515	2,515	3,445	3,445
Total TCDF	14,49	49,34	96,01	19,58	20,58	0,02	52,78	0,05
Total PeCDD	2,318	13,7	1,663	5,334	54,43	0,05	34,66	0,03
Total PeCDF	8,923	43,64	5,311	21,04	34,65	0,03	90,38	0,09
Total HxCDD	2,358	17,52	3,306	7,856	18,5	0,02	19,7	0,02
Total HxCDF	3,164	22,73	2,441	9,51	378,7	0,04	64,18	0,06
Total HpCDD	1,553	6,912	0,675	1,975	13,34	0,01	11,94	0,01
Total HpCDF	0,52	3,006	0,334	1,035	3,283	3,283	5,153	5,153
TEQ	1,14	6,44	0,62	2,09	1,16	5,89	12,05	8,59