REDUCTION OF (DIOXIN) EMISSIONS BY MUNICIPAL SOLID WASTE INCINERATION IN THE NETHERLANDS

Jan G.P. Born

Waste Processing Association, P.O. Box 19300, 3501 DH Utrecht, The Netherlands

ABSTRACT

An short overview is given of the reduction of flue gas emissions by Dutch Municipal Solid Waste Incinerators during the last five years. The emission of polychlorodibenzodioxins and -furans (PCDD/Fs) is related to the total emission of this group of compounds in The Netherlands.

INTRODUCTION

In 1989 in the Netherlands elevated dioxin concentrations were found in cow milk originating from areas a.o. located near Municipal Solid Waste Incinerators (MSWIs). These findings initiated huge efforts to reduce dioxin emissions from all possible sources[1,2].

For MSWIs this has been the starting point for strict emission regulations and an extensive modernization programme. Since 1990 several MSWIs were closed down. Others have been retro-fitted with flue gas cleaning devices. Finally new MSWIs have been built or are under construction at the moment. The developments in the flue gas cleaning technology and the resulting emission levels by MSWI are presented in this paper.

MSWI FLUE GAS EMISSIONS IN 1990

In 1990 the flue gas cleaning equipment of MSWIs in the Netherlands consisted of Electrostatic Precipitators (ESP), sometimes combined with single staged wet scrubbers and/or calcium hydroxide injection in the furnace. Given this limited air pollution control devices the flue gas emissions from MSWI per tonne waste and in tonnes/year were as high as listed in Table 1. Furthermore, Table 1 contains an estimate of the contribution of MSWI to the total emissions in the Netherlands.

Component	Emissions by MSWI		Contribution of MSWI to the total Dutch emission [%]
	[tonne/yr]	[g/tonne waste]	
particulates	772	240	0.7
HCl	8047	2500	91
HF	46	14	3
CO	3216	900	0.3
C_xH_y (as CH_4)	148	50	< 0.1
SO_2	3004	940	1.5
NO_x (as NO_2)	5737	1800	1.0
HM [1]	43	13	5 [2]
Cd	0.845	0.26	44
Hg	1.733	0.54	53
PCDD/F (I-TEQ)	0.000611	0.00019	79

[1] HM: sum heavy metals Pb, Zn, As

[2] sum of the following heavy metals: Sb, As, Cd, Cr, Cu, Pb, Ni, Zn

Tab. 1 Flue gas emissions from MSWI, 1990[3]

DEVELOPMENTS IN THE YEARS 1990-1995

In 1989 the Dutch emission guideline "Richtlijn Verbranden '89" was formulated. Subsequently, this guideline has been changed into the MSWI Directive "Besluit Luchtemissies Afvalverbranding (BLA)". The Directive directly came into force for new MSWI facilities on February 21, 1993. Existing plants had until January 1st 1995, to comply with the emission limits in this Directive, except for CO, C_xH_y, PCDD/F and NO_x. Emissions of PCDD/F up to 0.4 ng I-TEQ/Nm3 are temporarily tolerated for some MSWIs, but the majority of the MSWIs has to meet the 0.1 ng I-TEQ/Nm^3 value.

MSWIs that could not be modernized for practical, economical or political reasons have been closed down (Leiden, Leeuwarden, Zaanstad, Den Haag) or replaced by totally new installations (Amsterdam-Noord, Alkmaar). The other existing plants have been modernized and extensive flue gas cleaning equipment has been retrofitted. Several newly built MSWIs have been put (Amsterdam-West, Alkmaar) in service or will be (Wijster, Twente, Moerdijk) in the near future.

The result of this extensive modernization programme is that the amount of combusted waste has not changed much during the past 5 years; in 1990 2.8 million tonnes of MSW were combusted, in 1995 this figure was essentially the same. Due to the planned start-up of new MSWI that are already under construction, this figure is expected to increase to about 4.5 million tonnes in 1998.

In order to meet the above mentioned regulations, currently a flue gas cleaning system of a typical Dutch MSWI facility contains:

- one or more dust removal systems (usually ESP, sometimes fabric filters),
- a 2-stage wet scrubbing system,
- an activated cokes or activated carbon system to adsorb and remove (mainly) PCDD/F and gaseous heavy metals. (In one new plant an oxidative catalytic process is installed to

destroy PCDD/F)
- either a catalytic or a non-catalytic DeNOx-process.

In Figure 1 a schematic overview of a newly built MSWI is given as an example of the flue gas cleaning measures that are taken by Dutch MSWIs.

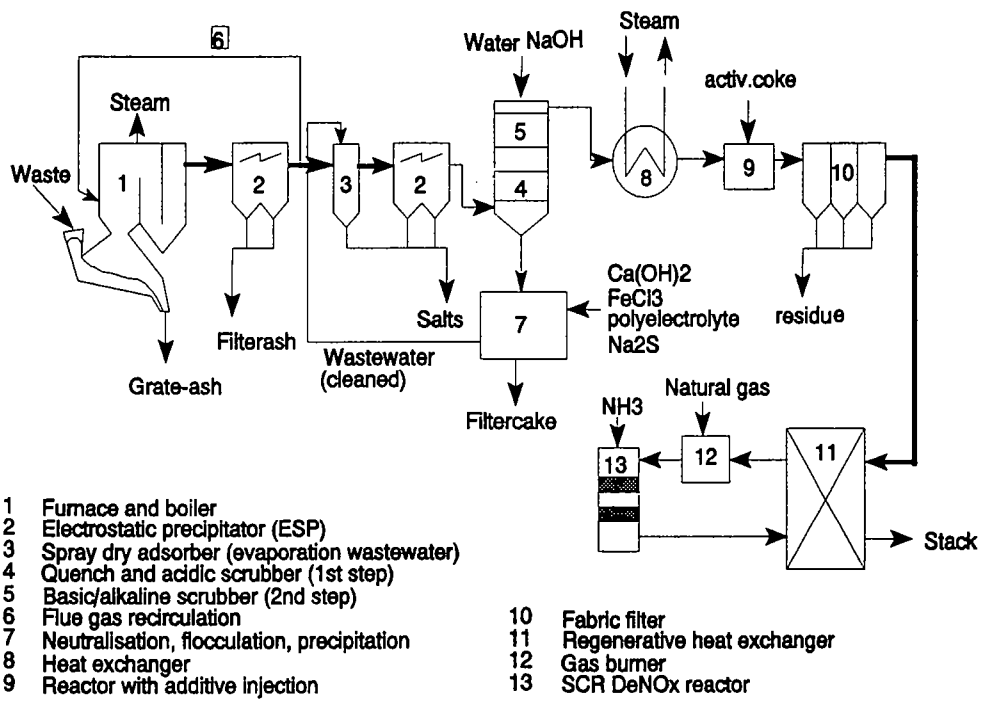

Fig. 1 Typical flue gas cleaning system of a modern MSWC facility (Alkmaar)

MSWI FLUE GAS EMISSIONS IN 1995

Under assignment of the Waste Processing Association, TNO has made a survey of the flue gas emissions from MSWI in the Netherlands in 1995. The results have been reported in June 1995[3]. After that date, the greatest MSW facility of the Netherlands - AVR - changed the start-up and cool-down procedures in order to further decrease the PCDD/F-emissions. These changes are taken into account in the survey given in Table 2. Because a clear picture of the total emissions in the Netherlands in 1995 was not yet available at the time the survey was made, the contribution of MSWI to these emissions, as given in Table 2, should be considered as a rough estimate.

From the comparison of Table 1 and Table 2, it can be concluded that of all the components considered, the total emissions from MSWI as well as the emissions per tonne waste are strongly reduced. The comparison of the tables also leads to the conclusion that the contribution of MSWI to the total Dutch emissions has strongly been reduced.

Component	Emissions by MSWI		Contribution of MSWI to the total Dutch emission [%]
	[tonne/yr]	[g/tonne waste]	
particulates	44	15	0.1
HCl	73	25	8
HF	4	1	0.3
CO	428	145	< 0.1
C_xH_y (as CH_4)	40	14	< 0.1
SO_2	230	78	0.1
NO_x (as NO_2)	2037	690	0.4
HM [1)]	5	2	0.6 [2)]
Cd	0.154	0.05	13
Hg	0.193	0.07	11
PCDD/F (I-TEQ)	0.0000041	0.000001	4 - 7

1) HM : sum heavy metals Sb, Pb, Cr, Cu, Mn, V, Sn, As, Co, Ni, Se, Te.

2) Rough estimates for 1995, based on total Dutch emission in 1993.

Tab. 2 Flue gas emissions from MSWI, 1995[4]

The largest reduction of the emissions per year was realised for PCDD/F *i.e.* 99.3%. Also, the total PCDD/F emissions in The Netherlands have been related to the PCDD/F emissions by MSWIs only. The share of MSWIs in 1990 was as high as 79%. Note that the contribution of MSWI has been reduced remarkably since to some 4 - 7%.

CONCLUSIONS

Over the last 5 years the flue gas emission of PCDDs and PCDFs by Dutch MSWIs has been reduced by more than 99%. This achievement is a direct result of an investment of several billions of Dutch Guilders, used for retrofitting existing MSWIs and the construction of new MSWIs.

REFERENCES

1) Slob, W., L.M. Troost, M. Kijgsman, J. de koning and A.A. Sein (1992): Combustion of Municipal Solid Waste in the Netherlands. RIVM/TNO report no. 730501052.

2) Koning, J. de, A.A. Sein, L.M. Troost and H.J. Bremmer (1993): Sources of dioxin emissions in the Netherlands. Proc. Dioxin 1993, Vienna.

3) Hesseling, W.F.M. and J. de Koning (1995): Emission Reduction Municipal Solid Waste Combustion 1990-1995. TNO report no. R95-184 (in Dutch)

4) Hesseling, W.F.M., G. Kuipers and J.W. Wormgoor (1995): Reduction of emissions by MSW incineration in The Netherlands, specified for all individual MSWIs. TNO report no. R95-206 (in Dutch)