

REDUCING THE PCDD/F EMISSIONS FROM WASTE INCINERATORS FOR WOOD WASTE AND BIOMASS WASTE IN THE FLEMISH REGION (BELGIUM)

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Introduction

The Environmental Inspectorate Division (EID) is responsible for the enforcement of the environmental health legislation in Flanders (Belgium). The EID aims at constant improvement of the quality of the enforcement by focusing on efficient, professional, consistent and integrated action in Flanders. In the field of air pollution, PCDD/F emissions have received particular attention during the past decade, due to high public concern for their possible health effects and the high population density in the Flemish Region. The EID has focused on reduction of PCDD/F emissions from municipal solid and industrial waste incineration plants¹, iron sintering plants², non-ferrous metal plants³ and crematories⁴. The largest point sources of PCDD/F emissions have been monitored and tackled in the recent past. This led already to a very significant emission reduction. More recently, the focus is shifted towards diffuse emissions⁵ of PCDD/F and towards PCDD/F emissions of incinerators for wood waste and biomass waste⁶ as they are gaining importance in the field of climate change abatement. This paper comments on the results of 136 enforcement actions at 93 incinerators for wood waste and biomass waste during 5 years in the period 2006-2010.

Materials and Methods

Legislation

The environmental health legislation has been integrated in the Environmental License Decree (1985) which became operational through its implementing orders Vlarem I (1991) and Vlarem II (1995). The main objective of the EID is to enforce the environmental health legislation for the potentially most environmentally damaging establishments, the so called “class 1” establishments. Vlarem I defines all types of activities and establishments considered to generate nuisance and that are subjected to general and sector-related provisions, specified in Vlarem II.

In the period 2006-2010, the Flemish environmental health legislation had provisions for wood and biomass incinerators that were in accordance with the Directive 2000/76/EC of the European Parliament and of the Council of 4 December 2000 on the incineration of waste. The emission limit values (ELV) for wood waste and biomass waste incinerators and the self-monitoring program for stack emissions (SMP-stack) depend on the capacity of the incinerator and the quality of the incinerated wood as there are three categories of wood waste defined in Vlarem II. The table below (table 1) gives an overview of the different categories of installations depending on the capacity and the quality of the incinerated wood waste.

Table 1: Classification of the wood waste and biomass waste incinerators

	≤ 5MW	> 5 MW	Definitions
Incineration of biomass waste → untreated wood waste → non-contaminated treated wood waste	Class 2 Class 2	Class 1 Class 1	natural wood, bark included, that has only been subjected to mechanical treatment treated wood waste that meets the composition requirements mentioned in Vlarem II
Incineration of contaminated treated wood waste	Class 1	Class 1	wood that as a result of treatment can contain halogenated organic compounds, or heavy metals, including particular wood waste that originates from construction and demolition work, where one or more of the composition requirements are exceeded

The definitions of non-contaminated treated and contaminated treated wood waste are linked with composition requirements. The classification of the wood waste uses the following guide values (table 2).

Table 2: Composition requirements of treated non-contaminated wood waste (in mg/kgDM)

	arsenic (As)	copper (Cu)	lead(Pb)	chromium (Cr)	fluorine (F)	chlorine (Cl)	pentachlorophenol	benzo-a-pyrene
A	2	20	90	30	30	600	3	0.5
B	4	40	180	60	60	1200	6	1

To classify the incinerated wood waste, it should be analysed on the initiative and at the expense of the operator, as part of the self monitoring program to define the quality of the wood waste (SMP-wood). The frequency of the wood analysis depends on the nominal thermal capacity of the incinerator and on the origin of the wood waste. The wood waste is identified as non-contaminated treated wood waste if:

- out of the annual and six-monthly samples, none of the parameter concentrations mentioned in row B are exceeded.
- out of quarterly samples none of the parameter concentrations in row B are exceeded and per calendar year at least three of the four measurements meet the parameter concentration guide values in row A.

Both the ELV and the SMP depend on nominal thermal capacity of the incinerator and the quality of the wood waste. The table below (table 3) gives an overview of the ELV and the SMP for two categories of installations as this paper only includes measurements on incinerators of untreated or non-contaminated treated wood waste.

Table 3: Overview of the ELV and the self monitoring program related to the wood waste quality and the nominal thermal capacity of the incinerator.

	capacity	dust	CO	TOC	HCl	HF	SO ₂	NO _x	Cd+Tl	Hg	metals	PCDD/F
Untreated wood waste:												
ELV	≤ 5 MW	150	250				300	400				
SMP stack		1/y	1/y				1/y	1/y				
ELV	5-50 MW	30	200				300	400				0.1
SMP stack		4/y	4/y				4/y	4/y				1/y
ELV	>50 MW	10	100				50	200				0.1
SMP stack		Cont.	Cont.				Cont.	Cont.				1/y + Cont.
Non-contaminated treated wood waste:												
ELV	≤ 5 MW	150	250		50		300	400				0.4
SMP stack		2/y	2/y		2/y		2/y	2/y				1/2y
SMP wood		Annual analysis of treated wood waste, originating from the establishment its-self Six-monthly analysis of treated wood waste originating from third parties										
ELV	5-50 MW	30	200	20	50	2	300	400	0.1	0.1	1.5	0.1
SMP stack		Cont.	Cont.	2/y	2/y	2/y	2/y	2/y	2/y	2/y	2/y	1/y
SMP wood		Six-monthly analysis of treated wood waste, originating from the establishment its-self Quarterly analysis of treated wood waste originating from third parties										
ELV	> 50 MW	10	100	10	10	1	50	200	0.05	0.05	0.5	0.1
SMP stack		Cont.	Cont.	2/y	2/y	2/y	Cont.	Cont.	2/y	2/y	2/y	1/y + Cont.
SMP wood		Six-monthly analysis of treated wood waste, originating from the establishment its-self Quarterly analysis of treated wood waste originating from third parties										

ELV in mg/Nm³ depending on the nominal thermal capacity of the incinerator

ELV for PCDD/F in ng TEQ/Nm³

SMP-stack in times a year or continuous (Cont.)

Set-up of the coordinated inspection campaign

To check up on the fulfilment of the new provisions, EID organised an inspection campaign on wood waste and biomass waste incinerators into the Environmental Inspection Plan (EIP) of 2006-2010⁷. It contained three important points of interest:

- stack emission measurement performed by officially recognised labs.
- sampling and chemical analysis of the wood waste as to determine the appropriate provisions.
- follow up of the obligatory SMP by the plant operators.

If necessary, the inspectors of the EID took measures to obtain the necessary clean-up in compliance with the environmental health legislation.

As part of the inspection campaign the EID performed emission measurements on 93 wood waste or biomass waste incinerators. The incinerators are either functional as heating installation to produce process heat either as an incinerator where the heat of the fume is used for the drying process.

Results and discussion

Evaluation of all the results of the 2006-2010 campaign, showed that only 17 out of 93 investigated installations were fully in line with the existing provisions of the environmental health legislation. Measured stack emission concentrations exceeded ELV at 60 incinerators. Concentrations of contaminants in wood waste exceeded the guide values at 29 installations. Besides there were 23 incinerators which did not fully comply with SMP requirements.

An overview of the stack emission concentrations for the 93 measured incinerators is given in the figures 2a en 2b. The most frequently exceeded parameters were CO, total dust, dioxins/furans and NO_x. In general, 65 % of the installations do not comply with at least one ELV. From figure 2b it is shown that the three categories of incinerators, investigated in the campaign caused elevated CO, total dust and HCl concentrations exceeding ELV. From the data of figure 2b one could think that only the incinerators on treated wood had high concentrations of PCDD/F, heavy metals and HCl, exceeding ELV. This is not the fact. Incinerators burning untreated wood waste do not have ELV for these parameters (see table 3), although at least some stack emission measurements revealed emission concentrations of PCDD/F of the same range as the ones of figure 2b. Probably, the reason was that treated wood had been illegally burned in these installations, while they had a permission to use untreated wood only. When this happened in the days prior to the EID measurement, the incinerator was still under the memory effect. The same consideration applies to heavy metals from the category below 5 MW burning treated wood waste.

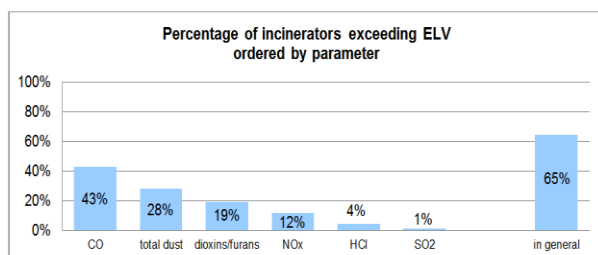


Figure 2a: Overview of the stack emission measurement results of the enforcement campaign

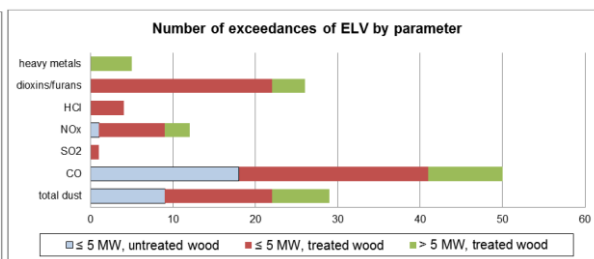


Figure 2b: Overview of the stack emission measurement results of the enforcement campaign

As the implementation of the Order of 12 December 2003 states that the ELV and the SMP depend on the quality of the incinerated wood waste, the EID sampled and analyzed the incinerated wood, simultaneously with the emission measurements performed (except for 6 cases). The results are shown in figure 3. It appeared that in 41 out of 130 samples (31,5%) one or more parameters of the compounding elements in row B (table 2) were exceeded. The most common exceeded parameters were lead, chlorine and copper. The contamination might originate from treatment with wood preservatives or application of a coating.

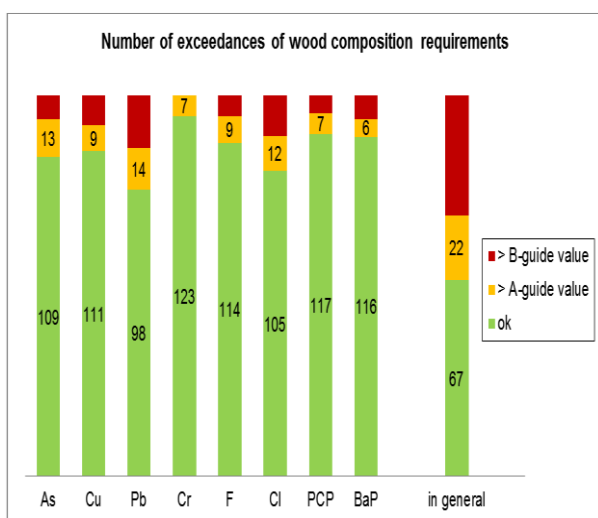


Figure 3: Overview of the results of the wood sample analysis during the enforcement campaign

It is obvious that the incineration of contaminated wood waste might cause elevated PCDD/F emissions. As to prevent PCDD/F emissions as much as possible, it is forbidden to incinerate wood waste that doesn't meet the composition requirements in installations for non-contaminated wood waste. After all, these installations lack the necessary end of pipe sanitation techniques and measurement devices for the continuous measurements. The cost to install sanitation techniques and measurement devices, adjusted with maintenance costs, is substantially and economically not profitable for small capacity incinerators. Therefore the incinerated wood waste must be checked rigorously and selected with consideration and constant vigilance.

When the EID concluded the ELV for one or more parameters was exceeded, the inspectors of the EID sent a report of the infringements to the Public Prosecutor and exhorted the operator to take measures so the emission level will comply with the ELV. Also when the SMP wasn't fulfilled, an official report was made, to the Public Prosecutor. In these cases the operator was exhorted to perform the necessary measurements. When the EID recorded that contaminated wood waste was incinerated in incinerators for non-contaminated treated or untreated wood waste, the operator was exhorted to be more selective or to install end-of-pipe sanitation techniques and measurement devices. During the period 2006-2010 the EID sent 21 exhortations, 63 public reports accompanied by exhortations en 7 administrative sanctions.

From literature, it is known ELV exceedances are, in most of the cases, related to five important factors:

- type of incinerator, age of it, maintenance of the installation
- quality of incineration process
- presence and type of end-of-pipe sanitation technique and maintenance of it
- quality of the incinerated wood waste
- burning of wood waste of own production process or bought from others

The EID tried to find relations between these factors and the measured emission concentrations in the dataset of 2006-2010 but discovered all kind of combinations between them. The conclusion is that although there are some explanations for the appearance of high stack emission concentrations, there is no clear relationship between them. Following situations have been noticed for several installations:

- situation 1: results of wood analysis do not relate to results of emission measurements
- situation 2: although a new installation is used, the emission measurement results are above ELV
- situation 3: the pollutants exceeding the ELV are changing with every stack emission measurement

Considering also the results of the SMP stack emission measurements, which are carried out on behalf of the plant operator, in order to have a larger data set to be able to find more relationships, also between SMP and EID stack emission results, two more situations have been revealed:

- situation 4: results of SMP emission measurement exceeding ELV, but emission measurement on behalf of EID below ELV
- situation 5: results of emission measurement on behalf of EID exceeding ELV, but SMP emission measurements below ELV

However, the experience of the EID with these SMP measurements is that they are sometimes performed in optimal conditions (optimal wood quality, right after maintenance of the installation, in presence of a technical assistant adjusting burning process during emission measurement) and therefore the SMP stack emission concentrations often tend to be better than those resulting from unexpected measurements on behalf of the EID.

On the base of the results of this extensive enforcement campaign with 136 enforcement actions at 93 wood waste incinerators during four years, the EID concluded that:

- the concentrations of pollutants in the clean gasses of wood and biomass incinerators are very dependent on wood quality, the quality of the burning process and the presence and performant exploitation of clean gas abatement techniques, but there is no clear relationship between these factors.
- the often very heterogeneous character of the wood and a too selective or chosen sample by the plant operator, result in very different and every time changing analysis results. This way, enforcement tends to be the work of 'a cat chasing the mouse'.
- during stack emission measurements, it is not always clear whether the burning process and the production process are performed in optimal conditions. Because of lack of this information, it is difficult to make a thorough analysis on the relationship between the five factors mentioned and the measured stack emission concentration.
- the results of stack emission measurements at some installations vary from year to year. Always different pollutants seem to be emitted above ELV. As mentioned before, it is not easy to find out the cause of this.

As a result of these alarming results and given the proliferation of biomass waste incinerators in the Flemish Region, the EID decided to continue the inspection campaign for the following years and to elevate the number of measurements.

Acknowledgements

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References

1. François F., Bernaert P. and Baert R., *Organohalogen Compounds* 45, 352 – 355, 2000
2. François F., Bernaert P. and Baert R., *Organohalogen Compounds* 54, 115 – 118, 2001
3. François F., Bernaert P. and Baert R., *Organohalogen Compounds* 56, 421 – 424, 2002
4. François F., Bernaert P. and Baert R., *Organohalogen Compounds* 63, 252 – 255, 2003
5. François F., Blondeel M., Bernaert P., Baert R., *Organohalogen Compounds* 66, 921-927, 2004
6. Rommens L., Vanthienen M., Van Landschoot G., Blondeel M., Baert R., *Organohalogen Compounds* 68, 1693-1697, 2008
7. Baert R., Environmental Inspection Plan, 2006, 2007, 2008, 2009, 2010: www.milieu-inspectie.be