

**090207****Incineration of hospital wastes***Process description*

Hospital waste can be distinguished into "specific hospital waste" and "other hospital waste". Specific hospital waste includes human anatomic remains and organ parts, waste contaminated with bacteria, viruses and fungi, and larger quantities of blood.

As a rule, the waste incinerators at hospitals consist of a pyrolysis furnace with an incineration chamber. In the pyrolysis furnace, the waste is degased and the remaining char is incinerated. Burn-out of the generated gases occurs in the after-burning chamber. In both parts of the process, the temperature is regulated by way of burners. The installations are operated batchwise.

The installations at the hospitals are operated only during the day. At start-up, the furnace is heated using the available support burners and, if required, the burning of domestic hospital waste. Every day, after the last charge of waste has been dosed, the furnaces are kept at temperature for another 1-2.5 hours using the burners. Subsequently, the furnace is cooled by leading ambient air through it for a number of hours.

*Abatement technologies:*

In general, there is no additional flue gas cleaning.

*Plant data/European situation*

Incineration of hospital wastes has been banned in some European countries; in other states even to date clinical waste is most probably combusted to a large extent in small facilities located on-site at the hospitals. No information could be collected about the number of these installations; it may be assumed that at least large hospitals will be

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equipped with such furnaces which usually have only basic abatement systems like dedusting facilities.

*Activity data*

The activity data for annually produced clinical waste (shown 090207—Table 4) were taken either from the national inventories or from publications of DG XI or OECD. However, inventory data were utilised for the dioxin emission estimations if they were provided by national inventory and by DG XI or OECD. The selected values were taken as base for calculating the annual dioxin emissions per capita from incineration of hospital wastes.

*Emission factors*

The emission factors for incineration of hospital wastes as reported by the national dioxin inventories are shown in 090207—Table 3. Most emission factors had been gained from measurement results; only the Belgian value was adopted from Swiss literature data. The very different incineration facilities with manifold abatement technologies and legal regulations in the 17 countries considered made it necessary to select three distinct emission factors instead of one typical as in the other chapters. Type 1 represents small on-site plants without any abatement technology; type 2 is related to larger on-site facilities equipped with dedusting systems and finally type 3 stands for incinerators complying to the hazardous waste directive.

The following default emission factors were derived to be used for the emission estimation:

type 1	type 2	type 3
2500	250	1

**090207—Table 1 Selected emission factors for incineration of hospital wastes [ $\mu\text{g I-TEQ/t}$ ]**

It should be noted that the type 1 emission factor was chosen to 50% of the value given in the Dutch inventory for small installations. This value, however, had purely been estimated assuming that small furnaces (< 2.5 t/year) might operate at worse conditions compared to medium-sized installations. For the latter emission factors of up to 3,300 µg I-TEQ/t had been found in NL.

#### *Emission estimation*

On the basis of the selected emission factors and the activity rates per capita the standardised annual PCDD/F emissions were derived (see 090207—Table 5). The values obtained were combined with those reported in some of the national inventories. For all 17 countries considered the following results are obtained (090207—Table 2):

	<b>TOTAL</b>
<b>national inventories</b>	151
<b>Re-evaluation, typical</b>	816

**090207—Table 2 Summary of re-evaluated typical PCDD/F air emissions [g I-TEQ/a] from incineration of hospital wastes**

If those countries are included into the total estimation which did not provide any data or emission inventories for the incineration of hospital wastes, the European total emission increases by a factor of more than 5.

#### *Conclusions/recommendations*

Incineration of hospital wastes is still of significant relevance for the total emission of PCDD/F in Europe. Especially small on-site facilities without any abatement systems and also larger on-site plants equipped with a dedusting system only can contribute significantly to the annual dioxin emissions of the considered countries. The high emission factors for these two types of incineration plants (090207—Table 4) result in substantial dioxin emissions even if average activity rates per capita are applied for the calculation (see 090207—Table 5).

Since activity rates per capita were used as base for the emission estimation all calculations in this chapter are associated with very high uncertainties. In addition the

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comparison of some values from the national inventories with corresponding values of DG XI or OECD shows considerable differences and the preference of the inventory data (if available) for the emission estimation may appear arbitrary. A review of the available activity data on hospital waste incineration would be helpful for a reliable estimation of the dioxin emissions.

Likewise, with regard to the few emission factors **emission measurements at hospital waste incinerators are recommended** especially in Spain, Greece, Italy, Ireland, Portugal and possibly in Belgium and France.

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	Flue gas conc. [ngI-TEQ/m <sup>3</sup> ]			Emission factors [µg/t]			Remark
	typ	min	max	typ	min	max	
<b>A</b>	0			0			
<b>B</b>	150			2250			mean concentrations measured: 150 ng/m <sup>3</sup>
<b>CH</b>				460			EF taken from literature [CH 135]
<b>D</b>	0.1			0.7			flue gas conc. according to legal limit value; spec. flow rate 7000 m <sup>3</sup> /t
<b>Dk</b>				824			
<b>E</b>							
<b>F</b>		7	9				
<b>Gr</b>							
<b>I</b>							
<b>Irl</b>							
<b>L</b>							
<b>N</b>							
<b>NL</b>	167	70	460	1169	490	3220	Efs correspond to medium facilities; activity given only for on-site incineration. Emission reported for 1993 situation
<b>P</b>							
<b>S</b>							Operating installations must comply with 0.1 ng Eadon-TEQ/m <sup>3</sup> limit
<b>Sf</b>		50	100				
<b>Uk</b>				240 63.25	120 20	480 200	EFs: 1) old plant, 2) new plant; measurements available only for time before 1990
Chosen values:	Type 1			2500			small on-site facilities without any abatement
	Type 2			250			large on-site facilities, dedusting
	Type 3			1			incinerators complying to hazardous waste directive

090207—Table 3 PCDD/F air emission factors for incineration of hospital wastes from national dioxin inventories

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	Activity rates [kt/a]	annual production [kt/a]					
	Dioxin Inventories	DG XI [1] healthcare risk waste	OECD [2] Clinical & pharmaceutical waste	OECD [3]	OECD [4] (fraction incinerated)	chosen value	kg/ a*capita
<b>A</b>	3.1		8	8		3	0.3915
<b>B</b>	42	14				42	4.1667
<b>CH</b>			3	3		3	0.4207
<b>D</b>		33				33	0.4057
<b>Dk</b>		10				10	1.8947
<b>E</b>		23				23	0.5813
<b>F</b>		105				105	1.8183
<b>Gr</b>		15	2	15		15	1.4591
<b>I</b>		50-60	1408	141	100 (100)	100	1.7619
<b>Irl</b>		9				9	2.5395
<b>L</b>			0.4	0.03		0	0.0748
<b>N</b>							0.0000
<b>NL</b>	0.675 *)	9	1	5		1	0.0438
<b>P</b>		15			50 (14)	14	1.4206
<b>S</b>	2					2	0.2289
<b>Sf</b>			0	4		4	0.7869
<b>Uk</b>	260	308	144	144		260	4.4829

\*) only on-site incineration considered; main amounts of waste is treated in incinerators for hazardous waste

[1] Analysis of priority waste streams - healthcare waste; information document summary, August 1994, EC-DGXI

[2] OECD Europe's Environment: Statistical Compendium

[3] OECD Environmental Data Compendium 1995;

[4] OECD Environmental Performance Reviews

**090207—Table 4 Activity rates related to incineration of hospital waste**

	Annual emission [g I-TEQ/a]		
	data from Inventories	re-evaluation	
		EF type used	Emission
<b>A</b>	0.001		0.001
<b>B</b>	95		95
<b>CH</b>	10		10
<b>D</b>		3	0.033
<b>Dk</b>	5.00		5
<b>E</b>		1	57.5
<b>F</b>		1	262.5
<b>Gr</b>		1	37.5
<b>I</b>		1	250
<b>Irl</b>		1	22.5
<b>L</b>		3	0.00003
<b>N</b>	0.09		0.09
<b>NL</b>	1		1
<b>P</b>		1	35
<b>S</b>	0.001	3	0.002
<b>Sf</b>		3	0.004
<b>Uk</b>	39.42		39.42
<b>TOTAL</b>	<b>151</b>		<b>816</b>

**090207—Table 5** Comparison of PCDD/F air emission estimates [g I-TEQ/a] for incineration of hospital wastes (reference period: 1993-1995)

European Dioxin Inventory - Results

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References to 090207

see national inventories for further information