

## Belgium

### *Description of available information*

A comprehensive report on dioxin emissions in Belgium was published in 1995 <1>. Besides emissions into the atmosphere dioxin fluxes into other compartments (waste water, residues) were considered, too. Generally, data reported are based on estimations derived from statistical information and emission factors that had been chosen from the literature. Results of emission measurements <2> were used as additional basis for the calculation of emissions in the case of waste incineration. Statistical information is displayed - as far as possible - for the years 1985 1990 and 1995, the latter being estimated or extrapolated if necessary.

The emission factors used in the Belgian study were often taken from the Dutch inventory, other references were used to a minor extent. Because all calculations were made using only one emission factor particularly defined for each reference year, no estimations for minimum and maximum emissions are given. In view of the fact that dioxin emissions were underestimated in the past, the reported data may be considered as describing the lower boundary.

With respect to data precision (activity rates and emission factors) a system of indexes ranging from “0” to “3” was introduced. The indexes relate to the order of magnitude of the uncertainty. Thus, “0” means that the data may vary within a range of  $10^0 = 1$ , hence being almost exact. The largest uncertainty is marked with index “3” that means that the range of uncertainty covers three orders of magnitude.

In the Belgian survey, data are often split to show the contribution of the three Belgian regions Flanders, Wallonie and Brussels. However, for the summary given in this report only national scale data are considered.

### *Discussion of results*

From the data shown in Table 1 and 2 it is obvious that even in 1995 waste incineration dominates the total output of dioxins in Belgium. On a short time scale a reduction to about 20% of the current emissions is expected by improvement of flue gas cleaning at municipal waste incinerators. Assuming compliance to a concentration limit of 0.1 ng I-TEQ/m<sup>3</sup> by all plants an air emission of only 2.5 g I-TEQ/a would result from this source type.

The decreasing emissions from waste incineration are contrasted by increasing outputs from other sources, particularly from installations of the heavy industry. This trend may be partly due to underestimation in the past. Furthermore, current data are quite uncertain, because no measurements have been performed so far at the relevant installations (sintering plants, electric arc steel oven, non ferrous metal works and smelters). In view of the increasing importance of this industrial sector more precise estimations based on emission measurements appear to be necessary.

Domestic combustion is predicted to become the most important source in Belgium assuming constant emissions on the current level. According to the statistical data used in the Belgian inventory a change from solid fuels (coal, coke, lignite) to oil and gas has been observed since 1985; while the total energy consumption remained nearly constant. This was accompanied by a decrease of dioxin emissions resulting from lower emission factors to be applied. Because the potential for further reduction of solid fuel consumption is limited, the future dioxin emission from domestic combustion is expected to be the same as the present. However, it should be noted, that the estimated emission of 122 g I-TEQ/a is based on the high emission factors reported by the PARCOM-ATMOS manual (3). This choice is based on the assumption that considerable amounts of treated (contaminated) woods are used as input material in domestic furnaces that generally show bad burn-out due to operation in stop-and-go modes. Clearly. This estimate has a very high degree of uncertainty because no data on average composition

of wooden fuels exist. Accordingly, the precision of the estimate is indexed by “2-3” in Table 1.

The authors conclude from the variability of emission factors applied in the report, that the total emission as well as the relative contribution of sectors and source types would be subject to changes if better estimations were available. They state the necessity of investigations and measurement campaigns at the most relevant sectors and/or source types in order to get more information of operating conditions and actual emissions <1, page 116>

CORINAIR SNAP	ITEM	Emission estimates g I-TEQ/a		
		typ	min	max
	<b>SUM</b>	<b>726.8</b>	<b>268.6</b>	<b>9525.6</b>
<b>01</b>	Combustion in Energy Production and Energy Transformation	2.3	0.7	7.3
<b>02</b>	Combustion in Commercial, Residential...	122.2	6.3	3076.8
<b>03</b>	Combustion in Industry	221.8	33.6	4298.2
<b>04</b>	Production Processes	8.0	0.3	90.9
<b>05</b>	Extraction and Distribution of Fossil Fuels	nd	nd	nd
<b>06</b>	Solvent and Other Product USE	25.0	25.0	25.0
<b>07</b>	Road Transport	1.7	0.5	5.4
<b>08</b>	Other Mobile Sources and Machinery	nd	nd	nd
<b>09</b>	Waste Treatment and Disposal	343.9	202.0	1974.9
<b>10</b>	Agriculture, Forestry, Land use change	0.1	0.0	1.8
<b>11</b>	Nature	nd	nd	nd
<b>12</b>	Fires	1.9	0.1	60.1

**B: Annual PCDD/F AIR emissions (nd: no data available)**

*Detailed data sorted out by CORINAIR '94 codes*

Belgium

01 01

Public power

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## **01 01**

### **Public power**

*General remark:*

For co-combustion of sewage sludge see 09 10 02

*Considered pathways or media:*

Atmosphere.

*Measurements:*

Measurements are available for only one fluidized bed pilot plant in which a mixture of anthracite and recuperator coal is burned. An emission factor of 10 µg I-TEQ/t C was obtained, which was not included in the estimate of the total annual emissions in Belgium.

*Plant data:*

The Belgian report does not contain any information on the number, capacity and technical details of the plants covered. It only states that coal-fired power plants in Belgium do not desulphurize the flue gases nor do they reduce the emissions of the oxides of nitrogen. Gas turbines or engines are not covered specifically.

*National activity rates:*

Data on the annual fuel consumption by electric power generation plants and industrial furnaces are supplied for Belgium for the period 1985 to 1993. Distinctions are made among 10 different types of fuel and between regions. The majority (approx. 60%) of electric power generation plants use anthracite coal as fuel. Natural gas ranks second with about 26% of the power plants using this type of fuel. To obtain an estimate of the emissions the fuel consumption data are combined into 2 groups: the group "anthracite coal" (which includes other types of coal) and the group "oil" (which includes also gaseous fuels). However, natural gas has not been taken into account.

Year	1985	1990	1995
“Oil”	14597	7855	8405
“Coal”	116072	161264	176577

**B: Public power; fuel consumption [TJ/a]**

*Emission factors:*

The emission factors applied to power are based on Danish values (no reference given) or on values published in the literature [4]. These emission factors are used to calculate the emissions by power plants.

	“Coal”	“Oil”
Power plants	13	0.89

**B: Public power; emission factors [ $\mu\text{g I-TEQ/TJ}$ ]**

*Estimation of uncertainty:*

In accordance with the evaluation method that was applied in the case of the Belgian Dioxin inventory an uncertainty margin of one decade (index 1) is obtained. However, the activity rates are found to be precise (index: 0).

Activity rates	0
emission factors	1
<b>total uncertainty</b>	<b>1</b>

**B: Public power; estimates of data precision**

*Estimation of annual emission:*

In the Belgian dioxin inventory the emissions into the atmosphere caused by the use of the various fuels taken into consideration are being estimated with the emission factors and activity rates above. No information is provided with regard to other compartments and paths of entry.

In the present report an estimate of the uncertainty margin using the above mentioned indices was added:

fuel	1985	1990	1995
“Coal”	1.51	2.10	2.30
“Oil”	0.025	0.007	0.007
<b>total</b>	<b>1.535</b>	<b>2.11</b>	<b>2.31</b>
<b>margin of uncertainty</b>	<b>0.48-4.8</b>	<b>0.66-6.6</b>	<b>0.92-9.2</b>

**B: Public power; annual PCDD/PCDF emissions [g I-TEQ/a]**

## 02 02

### Residential plants

#### *Considered pathways or media:*

Atmosphere.

#### *Measurements:*

Belgium did not supply results of own measurements; studies performed in other countries are quoted:(Schatowitz <5>, NL-inventory <6>, Parcom-Atmos <3>, US EPA <7>).

#### *Plant data:*

No information on the number or type of heating systems or fireplaces is provided.

#### *National activity rates:*

Extensive statistics divided according to regions are supplied for the consumption of fossil fuels in the years 1985 to 1993. An estimate of the consumption in 1995 is obtained by extrapolation. For wood consumption a coarse estimate is given which was obtained from data contained in the inventory for the Netherlands by comparing population numbers. Because of the higher fuel prices in 1985, 50% are added to the amount of burned wood obtained by this method for the period past 1990 to obtain the amount for 1985. For obtaining an estimate of the emissions the various types of fuels are combined into 3 groups:

1. "Oil": gasoline, light fuel, residual fuel
2. "Coal": coke, brown coal briquettes, coal agglomerates,  
"kwaliteitskolen", "langwaardige stenkool"
3. wood

Gaseous fuels, kerosene for lamps and petroleum coke are not being taken into consideration.

For above groups following consumption data are given:

<b>fuel</b>	<b>1985</b>	<b>1990</b>	<b>1995</b>
<b>oil</b>	4820	4669	4081
<b>coal</b>	1784	917	565
<b>wood</b>	990	660	660

**B: Residential plants; consumption of fuels [kt/a]**

*Emission factors:*

The emission factors for the 3 groups of fuels stem from available studies. For oil and coal the values mentioned in the Parcom-Atmos-Manual of 2 and 50 µg TEQ/t were taken. With regard to wood the emission factors provided by the various studies are being discussed. It is assumed that a high amount of "contaminated" wood is being burned. Because of the frequent start-up and shut-down of domestic firing systems the relatively high emission factor of the Parcom-Atmos Manual of 130 µg/t has been taken.

*Estimation of uncertainty:*

The emission factors are considered to be very imprecise (index 2 to 3), while the activity rates are termed precise. This assessment is correct with regard to the fossil fuels. In the case of wood burning both the activity rates and the emission factors are uncertain and should receive following indices:

	"Oil"	"Coal"	Wood
Activity rates	0	0	1
emission factors	2	2	2
<b>total uncertainty</b>	<b>2</b>	<b>2</b>	<b>3</b>

**B: Residential plants; indices of uncertainty**

The following overall uncertainty indices are obtained for the years under consideration, if the uncertainty indices are weighted by the contributions of the various fuel classes to the total emissions (that is for 1995: ratio of "oil" : "coal" : wood = 1:3, 5:10, 5):

<b>Year</b>	<b>1985</b>	<b>1990</b>	<b>1995</b>
<b>Index</b>	2.2	2.6	2.7

**B: Residential plants; uncertainty indices weighted for fuel contribution**

*Estimation of annual emission:*

With the mentioned data the following annual emissions are obtained. Application of the indices derived above result in the margins:

Belgium

02 02

Residential plants

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<b>Fuel</b>	<b>1985</b>	<b>1990</b>	<b>1995</b>
<b>oil</b>	9.64	9.34	8.16
<b>coal</b>	89.2	43	28.2
<b>wood</b>	128.7	85.5	85.8
<b>total</b>	228	138	122
<b>Margin of uncertainty</b>	14-5058	8-3227	6.1-3077

**B: Residential plants; annual PCDD/PCDF emissions [g I-TEQ]**

**03 01 01-05****Combustion in boilers, gas turbines and stationary engines***Considered pathways or media:*

Atmosphere.

*Measurements:*

No results of measurements are presented from Belgium.

*Plant data:*

The number of wood-fired furnaces is assumed to amount to between 200 and 300.

*National activity rates:*

The fossil energy consumption by industrial furnaces comprises natural gas and coke (about one third each) while the remaining third mainly comprises liquid fuels (all data based on the fuel consumption in TJ/a). The detailed data are summarised in the categories „oil“ (gasoline, residue fuel) and „coal“ (diverse types of coal products).

The total amount of wood burned in the industrial sector amounts to about 650 kt/a; the fibreboard industry accounts for about 500 kt of this amount; the remaining amount is consumed by the furniture industry. As in the case of wood combustion for domestic heating (02 02 05) 50% are added to the total consumption in 1985. This was done due to the generally high energy costs in that year thus arriving at a total amount of 975 kt.

Year	1985	1990	1995
“Oil”	74251	63426	54989
“Coal”	196414	205828	138936

**B: Combustion in boilers, gas turbines and stationary engines;  
fossil fuel consumption [TJ/a]**

Year	1985	1990	1993
[kt/a]	975	650	650

**B: Combustion in boilers, gas turbines and stationary engines;  
wood fuel consumption [kt/a]**

*Emission factors:*

Following emission factors are used:

fuel	Emission factor	Dim.
„oil“	5.1	µg I-TEQ/TJ
„coal“	25	µg I-TEQ/TJ
wood	5	µg I-TEQ/t

**B: Combustion in boilers, gas turbines and stationary engines; emission factors**

The value for wood combustion is taken from the "EPA-Dioxin-Reassessment" document. According to the Belgian inventory the other emission factors used for industrial furnaces are obtained by logarithmic interpolation from estimated values that apply to electric power generation plants and domestic firing systems. Because of a lack of more detailed information the calculation cannot be reproduced in that case. were estimated by interpolation between those applied for small (domestic) and large (power plants) installations???

*Estimation of uncertainty:*

In the Belgian dioxin inventory the accuracy evaluation of the data is based on all industrial combustion processes that include the fossil fuels. It arrives at the conclusion that the data for the national activity rates are precise (index 0). However, this assessment does not apply in the case of wood-fired furnaces for which only a rough estimate could be obtained. The uncertainty index is therefore increased to "1". With regard to the emission factors there is agreement with the Belgian dioxin inventory that also considers them uncertain (index 2); maintaining this index the following assessment is obtained:

	„coal“	„oil“	wood
Activity rates	0	0	1
emission factors	2	2	2
<b>total uncertainty</b>	<b>2</b>	<b>2</b>	<b>3</b>

**B: Combustion in boilers, gas turbines and stationary engines; indices of uncertainty**

*Estimation of annual emission:*

Following the reported emission estimates and the calculated ranges are shown:

## Combustion in boilers, gas turbines and stationary engines

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	<b>1985</b>	<b>1990</b>	<b>1995</b>
<b>“Coal”</b>	0.38	0.32	0.28
<b>“Oil”</b>	4.9	5.07	3.47
<b>wood</b>	4.88	3.25	3.25
<b>Total</b>	10.16	8.64	7.0
<b>Margin of uncertainty</b>	0.68-209	0.64-158	0.48-141

**B: Industrial wood combustion; annual PCDD/PCDF emission**

Belgium

03 01 06

Other stationary equipments

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## **03 01 06**

### **Other stationary equipments**

*General remark:*

Subject addressed: combustion of gases emitted from landfills

*Considered pathways or media:*

Air.

*Measurements:*

None.

*Plant data:*

Belgium has 4 such plants (capacities 100 / 500 / 250 / 500 m<sup>3</sup>/h), one of which is equipped with heat recovery. All plants went into operation after 1990. In addition, sewage treatment plants have installations for biogas combustion. No additional information is provided on these facilities.

*National activity rates:*

Assuming that all plants operate continuously throughout the year an amount of 11.826.000 m<sup>3</sup> of landfill gases burned in 1995 is obtained.

*Emission factors:*

An emission factor of 1 ng/m<sup>3</sup> is assumed without explanation how it was obtained and without quoting any literature sources.

*Estimation of uncertainty:*

The emission factor is termed uncertain (index “2”); the activity rates are said to have been estimated (index “1”). A total uncertainty index of “3” is therefore obtained.

Activity rates	1
emission factors	2
<b>total uncertainty</b>	<b>3</b>

**B: Other stationary equipments; indices of uncertainty**

*Estimation of annual emission:*

	<b>g I-TEQ/a</b>
<b>annual emission</b>	0.012
<b>margin of uncertainty</b>	0.0004-0.4

**B: Other stationary equipments;  
annual PCDD/F emissions from combustion of landfill gases in 1995**

Belgium

03 03 01

Sinter plants

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### **03 03 01**

#### **Sinter plants**

*General remark:*

This group does not contain the scattered emissions of dust-containing indoor air; for this turn to 04 02 09

*Considered pathways or media:*

Atmosphere, water.

*Measurements:*

No measurements have been taken in and around Belgian sintering plants up to the time the national inventory went into print.

*Plant data:*

No information is provided on the existing plants. According to the database of the German Association of Ore Sintering Plants, Belgium has 6 plants in operation with a total capacity of 14164 kt/a.

*National activity rates:*

The annual production of iron ore sinters is taken from a report on emission reducing measures in the Belgian iron and steel industry as follows:

<b>Year</b>	<b>1985</b>	<b>1990</b>	<b>1995</b>
<b>Prod. [kt]</b>	12508	13500	10630

**B: Sinter plants; annual production in kt**

*Emission factors:*

a) **Air**

The Belgian report quotes results from Sweden, the Netherlands and Germany; a typical emission factor of

5 µg/t with an uncertainty range of 1.5 to 50 µg/t

is given.

b) **Water**

B 14

The emissions caused by waste water are stated to amount to 0.3 µg/t.

*Estimation of uncertainty:*

**Atmosphere:**

While the emission factors are termed uncertain (index 2), the activity rates are considered precise ("0"), so that a total index of "2" is obtained. However, in order to obtain an estimate of the emissions the mentioned lowest and highest emission factors were used.

Activity rates	0
emission factors	2
<b>total uncertainty</b>	<b>2</b>

**B: Sinter plants; indices of uncertainty**

**Water:**

Because no mention is made of the applied emission factor it is to be considered uncertain and an index of "1" is to be assigned.

*Estimation of annual emission:*

	<b>1985</b>	<b>1990</b>	<b>1995</b>
<b>AIR</b>	62.6	67.5	53.2
<b>Margin of Uncertainty</b>	18.8-626	20.3-675	15.9-532
<b>WATER</b>	3.75	4.05	3.19
<b>Margin of Uncertainty</b>	1.2-12	1.3-13	1-10

**B: Sinter plants; annual PCDD/PCDF emissions [g I-TEQ/a]**

*Comment:*

The report states the emissions into the atmosphere solely for the mentioned typical emission factor. Calculations performed in retrospect for the stated lowest and highest values in Belgium yield in the worst case a doubling of the total dioxin emissions (from all sources!) from sintering plants, in the best case a reduction by only approx. 10 %. A more accurate knowledge of the actual emissions appears to be urgently needed.

Belgium

03 03 04

Primary lead production

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## 03 03 04

### Primary lead production

*Considered pathways or media:*

Air.

*Measurements:*

No results of measurements in Belgium supplied.

*Plant data:*

No informations on the plants existing in Belgium provided.

*National activity rates:*

The activity rates are obtained from 3 different groups of statistical data. To the amount of lead produced by the first and second melt one third of the semi-finished products is added and the amount of secondary lead imported by Belgium is subtracted:

Product	1985	1990	1995
1st/2nd melt	114.2	106.8	131
+1/3 semi-finished products	9.1	10.6	10.6
- imported secondary material	11.6	73.6	124
Sum	111.7	43.8	17.6

#### **B: Primary lead production; annual production estimates**

*Emission factors:*

An emission factor of 3 µg/t is assumed for the period until 1990, for 1995 one of only 1 µg/t is assumed.

*Estimation of uncertainty:*

The activity rates are termed as partly known (index "1"), the emission factors are considered uncertain (index "2"). These estimates are considered valid for the entire non-ferrous metal industry. They yield a total uncertainty of 3 orders of magnitude with the corresponding index "3".

Activity rates	1
emission factors	2
<b>total uncertainty</b>	<b>3</b>

**B: Primary lead production; Indices of uncertainty**

*Estimation of annual emission:*

With the mentioned data following annual emissions are obtained:

	<b>1985</b>	<b>1990</b>	<b>1995</b>
<b>Annual emission [g I-TEQ/a]</b>	0.34	0.13	0.02
<b>Margin of Uncertainty</b>	0.01-10	0.004-4	0.0006-0.6

**B: Primary lead production; annual PCDD/PCDF emission**

*Comment:*

No reasons for the selection of the emission factors are given.

Belgium

03 03 05

Primary zinc production

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### 03 03 05

#### Primary zinc production

*Considered pathways or media:*

Air.

*Measurements:*

None

*Plant data:*

None; in the survey of industries in the European Union one Belgian producer is listed who applies the electrolytic process and achieves an annual output of 190 kt.

*National activity rates:*

Applying the same procedure as in the case of the primary production of lead (03 03 04) following production data are obtained:

Product	1985	1990	1995
1st/2nd melt	320.8	358.8	267.7
+1/3 semi-finished products	9.6	7.1	6.7
- imported secondary material	10.1	101.6	157
Sum	320.3	264.3	117.4

**B: Primary zinc production; annual production rates [kt/a]**

*Emission factors:*

The same emission factors as given in 03 03 04 are used:

Years	Emission factor [µg I-TEQ/t]
1985-90	3
1995	1

**B: Primary zinc production; emission factors**

*Estimation of uncertainty:*

See 03 03 04.

Activity rates	1
emission factors	2
<b>total uncertainty</b>	<b>3</b>

**B: Primary zinc production; indices of uncertainty**

*Estimation of annual emission:*

	<b>1985</b>	<b>1990</b>	<b>1995</b>
<b>Annual emission [g I-TEQ/a]</b>	0.96	0.79	0.12
<b>Margin of uncertainty</b>	0.03-30	0.025-25	0.004-4

**B: Primary zinc production; annual PCDD/F emissions**

*Comment:*

See 03 03 04.

Belgium

03 03 06

Primary copper production

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## 03 03 06

### Primary copper production

*General remark:*

The ore roasting furnaces (for sulphide removal with subsequent sulphuric acid production) as well as the primary smelting plants are being taken into consideration

*Considered pathways or media:*

Air.

*Measurements:*

No results of measurements in Belgium are presented. Results from a German ore roasting furnace for ore desulphurization are mentioned (Norddeutsche Affinerie; concentration in the waste gas of 0,005 - 0,015 ng I-TEQ/m<sup>3</sup>, volume of waste gas produced 5000 standard m<sup>3</sup>/t copper). In addition, the results of a Swedish primary smelters are mentioned. The Swedish smelting plant produces a waste gas volume of 2000 standard m<sup>3</sup>/t with a concentration of 11 ng I-TEQ/m<sup>3</sup>.

*Plant data:*

No information is furnished by the Belgian report; According to the survey of industries in the European Union 2 copper refineries with a (theoretical) total capacity of 368t/a are in operation.

*National activity rates:*

Following activity rates are obtained by the procedure described above(see 03 03 04):

Product	1985	1990	1995
1st/2nd melt	455.7	542.5	452
+ 1/3 % semi-finished products	107.3	130.4	107
- imported secondary material	152.5	211.5	305
<b>Sum</b>	<b>410.5</b>	<b>461.4</b>	<b>254</b>

**B: Primary copper production; annual production rates [kt/a]**

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 Primary copper production
 

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*Emission factors:*

From the results of measurements given above emission factors of 0.25 µg I-TEQ/t (from German results) and 22 µg I-TEQ/t (from Swedish results) are derived. An emission factor of 10 µg I-TEQ/t that lies between these 2 values is used.

*Estimation of uncertainty:*

See 03 03 04.

Activity rates	1
emission factors	2
<b>total uncertainty</b>	<b>3</b>

**B: Primary copper production; indices of uncertainty***Estimation of annual emission:*

Following PCDD/PCDF emissions and uncertainty margins are obtained:

	1985	1990	1995
<b>Annual emission [g I-TEQ/a]</b>	4.11	4.61	2.54
<b>Margin of uncertainty</b>	0.128-128	0.144-144	0.080-80

**B: Primary copper production; annual PCDD/F emissions into the air***Comment:*

No attempt has been made to estimate the amounts of copper produced by the two considered methods whose emission factors differ by almost two orders of magnitude.

Belgium

03 03 07

Secondary lead production

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### **03 03 07**

#### **Secondary lead production**

*Considered pathways or media:*

Air.

*Measurements:*

Results of measurements are presented for a blast furnace (division Hoboken of the company Union Minière). Residues from lead, zinc and copper refineries as well as scrapped electrical equipment are processed at this location. This plant is equipped with a wet flue gas cleaning system, a “bag filter” (??) and a thermal afterburner. In the cleaned gas 0.07 ng/m<sup>3</sup> were measured corresponding to an emission factor of 0.2 µg/t.

*Plant data:*

Apart from the previously mentioned plant no other plants are covered; the survey of industries in the European Union mentions one other plant (Fonderie-et-Manufacture des Metaux).

*National activity rates:*

The amounts of secondary lead are estimated by adding half of the semi-finished products to the imported amount of secondary lead:

	<b>1985</b>	<b>1990</b>	<b>1995</b>
<b>Import of sec. lead</b>	11.6	73.6	124
<b>+ 1/3 of semi-finished products</b>	9.1	10.6	10.6
<b>SUM</b>	20.7	84.2	134.6

**B: Secondary lead production; activity rates [kt/a]**

*Emission factors:*

An emission factor of 5 µg/t is assumed.

*Estimation of uncertainty:*

See 03 03 04.

Activity rates	1
emission factors	2
<b>total uncertainty</b>	<b>3</b>

**B: Secondary lead production; indices of uncertainty**

*Estimation of annual emission:*

	1985	1990	1995
<b>Annual emission</b>	0.1	0.42	0.67
<b>Margin of uncertainty</b>	0.003-3	0.013-13	0.021-21

**B: Secondary lead production;  
annual PCDD/PCDF emissions [g I-TEQ/a]**

*Comment:*

No information is provided on how the emission factor was obtained; although the emission is rather low the growing imports reveal the increasing importance of Belgium as a centre of metal recycling in Europe.

Belgium

03 03 08

Secondary zinc production

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### 03 03 08

#### Secondary zinc production

*Considered pathways or media:*

Air.

*Measurements:*

See 03 03 07.

*Plant data:*

See 03 03 07.

*National activity rates:*

According to the procedure explained in Paragraph 03 03 07 following activity rates are obtained:

	1985	1990	1995
<b>Import of secondary. zinc</b>	10.1	101.6	157
<b>+ 1/3 of semi-finished-products</b>	9.6	7.1	6.7
<b>SUM</b>	19.7	108.7	163,7

**B: Secondary zinc production; activity rates [kt/a]**

*Emission factors:*

As in Paragraph 03 03 07 a value of 5 µg/t is assumed.

*Estimation of uncertainty:*

See 03 03 04.

Activity rates	1
emission factors	2
<b>total uncertainty</b>	<b>3</b>

**B: Secondary zinc production; indices of uncertainty**

Secondary zinc production

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*Estimation of annual emission:*

	<b>1985</b>	<b>1990</b>	<b>1995</b>
<b>Annual emission [g I-TEQ/a]</b>	0.10	0.54	0.82
<b>Margin of uncertainty</b>	0.003-3	0.017-17	0.026-26

**B:** Secondary zinc production; annual PCDD/PCDF emissions

*Comment:*

See 03 03 07

Belgium

03 03 09

Secondary copper production

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**03 03 09**

## **Secondary copper production**

*General remark:*

Baths of molten scrap metal are being considered.

*Considered pathways or media:*

Air.

*Measurements:*

No, Belgian measurements have become known; the report refers to data from the USA, Germany and Sweden.

*Plant data:*

None.

*National activity rates:*

According to the procedure described in 03 03 07 following activity rates are obtained:

	<b>1985</b>	<b>1990</b>	<b>1995</b>
<b>Import of secondary copper</b>	152.5	211.6	305
<b>+ 1/3 of semi-finished-products</b>	107.3	130.4	107
<b>SUM</b>	259.8	342	412

**B: Secondary copper production; activity rates [kt/a]**

*Emission factors:*

From a survey of emission factors, which were obtained by studies in Germany (160 µg I-TEQ/t), Sweden (22 µg I-TEQ/t) and the USA (2340 µg I-TEQ/t) (the sources of the data are not given), an estimated geometric mean emission factor for Belgium of 200 µg/t is obtained.

*Estimation of uncertainty:*

See 03 03 04.

## Secondary copper production

Activity rates	1
emission factors	2
<b>total uncertainty</b>	<b>3</b>

**B: Secondary copper production; indices of uncertainty**

*Estimation of annual emission:*

	<b>1985</b>	<b>1990</b>	<b>1995</b>
<b>Annual emission</b>	52	68.4	82.3
<b>Margin of uncertainty</b>	1.625-1625	2.138-2138	2.6-2603

**B: Secondary copper production;  
annual PCDD/PCDF emissions [g I-TEQ/a]**

Belgium

03 03 10

Secondary aluminium production

---

### 03 03 10

#### Secondary aluminium production

*Considered pathways or media:*

Air.

*Measurements:*

None.

*Plant data:*

None.

*National activity rates:*

It is estimated that approximately 350 kt/a of secondary aluminium are produced.

*Emission factors:*

For the years 1985 and 1990 the value of 130 µg/t mentioned in the Parcom-Atmos-Manual is used. Referring to the NL-inventory and taking into account the declining use of chlorinated solvents over the past years in the secondary aluminium production, a lower emission factor of 60 µg/t is assumed for 1995.

year	Emission factor [µg I-TEQ/t]
1985/1990	130
1995	60

**B: Secondary aluminium production; emission factors**

*Estimation of uncertainty:*

See 03 03 04.

Activity rates	1
emission factors	2
<b>total uncertainty</b>	<b>3</b>

**B: Secondary aluminium production; indices of uncertainty**

Secondary aluminium production

---

*Estimation of annual emission:*

	<b>1985</b>	<b>1990</b>	<b>1995</b>
<b>Annual emission</b>	21.4	32.5	19.8
<b>Margin of uncertainty</b>	0.669-669	1.016-1016	0.6-629

**B: Secondary aluminium production;  
annual PCDD/PCDF emissions [g I-TEQ/a]**

*Comment:*

The uncertainty assessments for the entire non-ferrous metal industries definitely need to be narrowed. Both production data as well as emission factors are highly uncertain.

Belgium

03 03 11

Cement

---

## 03 03 11

### Cement

*Considered pathways or media:*

Air

*Measurements:*

There are no Belgian data but references to results from Sweden, the Netherlands and the USA. One result obtained at a not specified plant in the Benelux is cited; with an emission factor 20 µg I-TEQ/ton cement this plant was estimated to emit 15 g I-TEQ/a.

*Plant data:*

The amounts of waste added to the fuel of the kilns are reported for two installations (Ciments d'Obourg and CBR). Four cement kilns in Wallonie are said to have incinerated a total of 272 kt industrial waste in 1993. In Flanders, 32.5 kt were burned. These amounts represent an increase by 300% over 1989. Except for one, all installations are located in Wallonie.. The primary fuel is mainly coal. The World Cement Dictionary 1991 lists 8 existing installations with a capacity of 8400 kt per year.

*National activity rates:*

The Belgian cement production is reported as follows:

Year	1985	1990	1995
production rate [kt/a]	5688	6963	7336

#### **B: Cement; production rates**

A breakdown per region is not given, but it provides the basis for the estimate of the emissions. It is assumed that for one half of the cement production in Wallonie industrial waste is burned as additional fuel.

*Emission factors:*

For cement that is produced without industrial waste as added fuel an emission factor of 1 µg/t is assumed with its uncertainty ranging from 0.03 to 20 µg/t. If industrial waste is

added to the fuel, a factor of 5 µg/t cement is used considering US results that led to an emission factor of 50 µg/ton burned waste.

*Estimation of uncertainty:*

While the activity rates are considered to be precise, the emission factors are characterised by the uncertainty index 2.

Activity rates	0
emission factors	2
<b>total uncertainty</b>	<b>2</b>

**B: Cement; indices of uncertainty**

*Estimation of annual emission:*

Observing the boundary conditions of the estimate described above the following values are obtained:

	1985	1990	1995
<b>Annual emission</b>	16.1	19.7	20.8
<b>Margin of uncertainty</b>	1.6-161	2-200	2.1-208

**B: Cement; annual PCDD/PCDF emissions [g I-TEQ/a]**

*Comment:*

The characterisation of the uncertainty of the annual emission appears to be somewhat too optimistic in view of the broad range of the emission factors over four orders of magnitude.

Belgium

03 03 12

Lime (including iron and steel and paper pulp industries)

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**03 03 12**

**Lime (including iron and steel and paper pulp industries)**

*Considered pathways or media:*

Air

*Measurements:*

No Belgian measurements are reported.

*Plant data:*

In Belgium there are 8 installations with various production processes. No information is given about the fuel used; the addition of industrial waste is considered to be likely.

*National activity rates:*

Year	1985	1990	1995 (=1991)
production rate [kt/a]	1689	1932	1853

**B: Lime (including iron and steel and paper pulp industries); activity rates**

*Emission factors:*

The emission factors are taken from a Swedish study. The average value is 18 µg/t with a range from 6.2 to 29.4 µg/t. N-TEQ is equated with I-TEQ.

*Estimation of uncertainty:*

Activity rates	0
emission factors	2
<b>total uncertainty</b>	<b>2</b>

**B: Lime (including iron and steel and paper pulp industries); indices of uncertainty**

*Estimation of annual emission:*

	1985	1990	1995
Annual emission	30.4	34.6	33.4
Margin of uncertainty	10.5-49.7	11,9-56,5	11.5-54.4

**B: Lime (including iron and steel and paper pulp industries); annual PCDD/PCDF emissions [g I-TEQ/a]; range calculated with range of emission factors**

B 32

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Lime (including iron and steel and paper pulp industries)

---

*Comment:*

The emission factors used were obtained by personal communication from C. de Wit (ITM Solna, Stockholm). In the meantime, the factors were apparently recomputed for the “Swedish Dioxin Survey”. Now they cover the range from 0.01 to 11.6 µg/t (see part „Sweden“).

Belgium

03 03 13

Asphalt concrete plants

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**03 03 13**

**Asphalt concrete plants**

*General remark:*

No data are presented in the Belgian report; reference is made of the Dutch inventory.

**03 03 14/15/17****Flat, container and other glass***General remark:*

The emissions of this industrial branch are not included in the total emissions of Belgium!

*Considered pathways or media:*

Air

*Measurements:*

None.

*Plant data:*

In Belgium, glass is produced in 10 plants

*National activity rates:*

The following production rates of various glass products are reported:

<b>Year</b>	<b>1985</b>	<b>1990</b>	<b>1995</b>
<b>Flat glass</b>	910	1044	917
<b>Container glass</b>	350	336	339
<b>Other</b>	106	115	134

**B: Flat, container and other glass; activity rates [kt/a]**

*Emission factors:*

The factor 0.21 µg/t of the Dutch inventory is used.

*Estimation of uncertainty:*

No estimate is given in the survey. For the present study the following estimates are used:

Activity rates	0
emission factors	1
<b>total uncertainty</b>	<b>1</b>

**B: Flat, container and other glass; indices of uncertainty**

Belgium

03 03 14/15/17

Flat, container and other glass

---

*Estimation of annual emission:*

<b>Year</b>	<b>1985</b>	<b>1990</b>	<b>1995</b>
<b>Flat glass</b>	0.189	0.217	0.190
<b>Container glass</b>	0.073	0.07	0.07
<b>Other</b>	0.022	0.024	0.028
<b>Sum</b>	0.284	0.311	0.288
<b>Margin of uncertainty</b>	0.09-0.9	0.1-1	0.09-0.9

**B: Flat, container and other glass; annual PCDD/F emissions [g I-TEQ/a]**

**03 03 20****Fine ceramic materials***General remark:*

The emissions of this industrial branch are not included in the total emissions of Belgium!

*Considered pathways or media:*

Air

*Measurements:*

None.

*Plant data:*

None.

*National activity rates:*

Production figures are quoted for each type of product for the years 1989 to 1993. Because of the small fluctuations from year to year, the value of 1989 is used for 1985 and the value of 1993 for 1995.

Year	1985	1990	1995
production rate [kt/a]	3736	3913	3960

**B: Fine ceramic materials; production rates***Emission factors:*

Same as for the glass production (see 03 03 14/15/17). The factor 0.21 µg/t of the Dutch inventory is used.

*Estimation of uncertainty:*

No estimate is given in the survey. For the present study the following estimates are used:

Activity rates	0
emission factors	1
<b>total uncertainty</b>	<b>1</b>

**B: Fine ceramic materials; indices of uncertainty**

Belgium

03 03 20

Fine ceramic materials

---

*Estimation of annual emission:*

	<b>1985</b>	<b>1990</b>	<b>1995</b>
<b>Annual emission [g I-TEQ/a]</b>	0.78	0.82	0.83
<b>Margin of uncertainty</b>	0.24-2.4	0.25-2.5	0.26-2.6

**B: Fine ceramic materials; annual PCDD/PCDF emissions**

**04 02 01****Coke oven (door leakage and extinction)***Considered pathways or media:*

Air, water

*Measurements:*

None

*Plant data:*

None

*National activity rates:*

Year	1985	1990	1995
<b>production rate [kt/a]</b>	5845	5304	3580

**B: Coke oven (door leakage and extinction); production rates***Emission factors:*

The emission factors were taken from the Dutch inventory:

Medium	Emission factor [µg - TEQ/t]
<b>Air:</b>	0.3
<b>Water:</b>	0.063

**B: Coke oven (door leakage and extinction); emission factors***Estimation of uncertainty:*

The following indices are given:

Activity rates	0
emission factors	2
<b>total uncertainty</b>	<b>2</b>

**B: Coke oven (door leakage and extinction); indices of uncertainty**

Belgium

04 02 01

Coke oven (door leakage and extinction)

---

*Estimation of annual emission:*

	<b>1985</b>	<b>1990</b>	<b>1995</b>
<b>AIR</b>	1.75	1.59	1.07
<b>Margin of uncertainty</b>	0.18-18	0.16-16	0.1-10.7
<b>WATER</b>	0.37	0.33	0.23
<b>Margin of uncertainty</b>	0.04-4	0.03-3.3	0.02-2.3

**B: Coke oven (door leakage and extinction);  
annual PCDD/PCDF emissions [g I-TEQ/a]**

**04 02 07****Electric furnace steel plant***Considered pathways or media:*

Air

*Measurements:*

None taken in Belgium; reference is made of the Dutch inventory <8> and Swedish data <9,10> and.

*Plant data:*

The Belgian plants process mostly scrap iron; there are 5 companies. A reduction of the production and closure of plants are expected for the future.

*National activity rates:*

Year	1985	1990	1995
production rate [kt/a]	518	977	1284

**B: Electric furnace steel plant; production rates***Emission factors:*

According to data from Sweden and the Netherlands the emission factor is estimated to amount to

5 µg/t with a range of 0.1 to 50 µg/t.

*Estimation of uncertainty:*

Activity: precise (index "0"), emission factor: very uncertain (index "2" to "3"):

Activity rates	0
emission factors	3
<b>total uncertainty</b>	<b>2-3</b>

**B: Electric furnace steel plant; indices of uncertainty**

Belgium

04 02 07

Electric furnace steel plant

---

*Estimation of annual emission:*

	<b>1985</b>	<b>1990</b>	<b>1995</b>
<b>Annual emission</b>	2.59	4.89	6.42
<b>Margin of uncertainty</b>	0.052-25.9*	0.098-48.9*	0.13-64.2*

**B: Electric furnace steel plant;  
annual PCDD/PCDF emissions [g I-TEQ/a].**

**\* Range calculated using range of emission factors**

*Comment:*

The emissions related to the indicated highest and lowest emission factors are not contained in the Belgian report (and are neither taken into account), but were calculated for the present report.

**04 03 01****Aluminium production (electrolysis)**

*Considered pathways or media:*

Air

*Measurements:*

*Plant data:*

*National activity rates:*

Because of the high proportion of in-plant recycling the amount of aluminium produced is difficult to estimate; reported are the production figures of semi-finished products. From the listed emissions and emission factors, the activity rates used can be derived. Apparently, the calculation was based on one third of the quantity of semi-finished products without explaining this assumption.

Year	1985	1990	1995
semi-finished products	305.4	380.7	293.3
used for emission estimation	102	127	100

**B: Aluminium production (electrolysis); production rates [kt/a]**

*Emission factors:*

For the years 1985 and 1990, an emission factor of 10 µg/t was used which was halved to 5 µg/t for 1995.

*Estimation of uncertainty:*

As it is the case with the entire non-ferrous-metal industry, the emission factor is considered to be uncertain (index "2"). Because some of the activity rates were estimated, they are characterised by the index "1":

Activity rates	1
emission factors	2
<b>total uncertainty</b>	<b>3</b>

**B: Aluminium production (electrolysis); indices of uncertainty**

Belgium

04 03 01

Aluminium production (electrolysis)

---

*Estimation of annual emission:*

The following annual emissions are obtained:

	<b>1985</b>	<b>1990</b>	<b>1995</b>
<b>Annual emission [g I-TEQ/a]</b>	1.02	1.27	0.50
<b>Margin of uncertainty</b>	0.1-10	0.13-13	0.02- 16

**B: Aluminium production (electrolysis); annual PCDD/PCDF emissions**

**04 03 09**

**Other - cable burning**

*General remark:*

This section is not contained in the catalogue Corinair 94 SNAP.

While a few old contaminated sites are known, no information is available on operating plants. Therefore no estimates of emissions are possible.

Belgium

04 04 13

Chlorine production

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## 04 04 13

### Chlorine production

*General remark:*

The Belgian report addresses the electrolysis of alkali chlorides.

*Considered pathways or media:*

Air/water/residues

*Measurements:*

No data from Belgium; data from Sweden are used.

*Plant data:*

There are three plants in Belgium all of them use the amalgam process.

*National activity rates:*

No production figures are given.

*Emission factors:*

Because of the lack of production figures, only the emissions per plant and year can be quoted:

Medium	Emission per plant and year [I-TEQ]
<b>WATER:</b>	10 mg
<b>RESIDUES</b>	100 mg
<b>AIR</b>	negligible

**B: Chlorine production; „emission factors“**

*Estimation of uncertainty:*

The activity rates for the entire chemical industry are judged to be precise (“0”), the emission factors to be sufficiently accurate (“1”):

Activity rates	0
emission factors	1
<b>total uncertainty</b>	<b>1</b>

**B: Chlorine production; indices of uncertainty**

B 46

*Estimation of annual emission:*

For the years 1985, 1990 and 1995, the same emissions are estimated as follows:

	<b>Water</b>	<b>Residues</b>	<b>Air</b>
<b>annual emission</b>	0.03	0.3	negligible
<b>margin of uncertainty</b>	0.003-0.3	0.1-1	-

**B: Chlorine production; annual PCDD/F emissions [g I-TEQ/a]**

Belgium

04 05 05

1,2-dichloroethane + vinylchloride (balanced process)

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## 04 05 05

### 1,2-dichloroethane + vinylchloride (balanced process)

*Considered pathways or media:*

Air/water/residues

*Measurements:*

Measurements exist for two Belgian plants. Concentrations are not reported, but emission factors and/or resulting annual emissions are listed.

plant 1: air: < 40 pg/t VC corresponding to < 6.8 µg/a  
water: < 6.3 mg/a  
plant 2: water: 7 to 100 g/a

*Plant data:*

In Belgium, vinyl chloride is produced in three plants.

*National activity rates:*

The annual production is estimated to amount to about 1 million tons (1993: 970,000 t).

*Emission factors:*

The estimates are based on the following assumed factors:

water: 0.5 µg/t VC

residues: 0.4-8 g per plant and year

air: it is assumed that until 1990 the waste gas concentration was about 1 ng/m<sup>3</sup> (corresponding to an emission factor of 0.6 µg/t VC); for 1995 the estimates are based on 0.1 ng/m<sup>3</sup> (corresponding to 0.06 µg/t).

Medium	before 1990	after 1990
water [µg I-TEQ/t VC]	0.5	0.5
residues [g I-TEQ per plant and year]	0.4 - 8	0.4 - 8
air [µg I-TEQ/t VC]	0.6	0.06

**B: 1,2-dichloroethane + vinylchloride (balanced process); emission factors**

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 1,2-dichloroethane + vinylchloride (balanced process)
 

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*Estimation of uncertainty:*

The activity rates for the entire chemical industry are judged to be precise (“0”), the emission factors to be sufficiently accurate (“1”).

Activity rates	0
emission factors	1
<b>total uncertainty</b>	<b>1</b>

**B: 1,2-dichloroethane + vinylchloride (balanced process);  
indices of uncertainty**

*Estimation of annual emission:*

	<b>1985</b>	<b>1990</b>	<b>1995</b>
<b>AIR</b>	0.447	0.455	0.050
<b>Margin of uncertainty</b>	0.14-1.4	0.15-1.5	0.02-0.16
<b>WATER</b>	0.201	0.205	0.222
<b>Margin of uncertainty</b>	0.06-0.63	0.06-0.65	0.07-0.69
<b>RESIDUES</b>	1.2-24	1.2-24	1.2-24

**B: 1,2-dichloroethane + vinylchloride (balanced process);  
annual PCDD/PCDF emissions [g I-TEQ/a]**

Belgium

04 05 24/25

Halogenated hydrocarbons and pesticide production

---

**04 05 24/25**

## **Halogenated hydrocarbons and pesticide production**

*Considered pathways or media:*

Air/water/residues

*Plant data:*

In Belgium there are no significant production plants for PCP, PCB or pesticides. The production of chlorinated hydrocarbons is estimated to be less than or equal to the production of vinyl chloride. The production of dioxin is considered to be low.

*National activity rates:*

no data reported

*Emission factors:*

Reference of the literature <11> is made for possible emissions and it is assumed that the annual emissions (per plant) mentioned in this publication roughly apply to Belgium as well:

<b>Medium</b>	<b>emission per plant and year [mg I-TEQ/a]</b>
<b>air</b>	360
<b>water</b>	80
<b>residues</b>	2200

**B: Halogenated hydrocarbons and pesticide production;  
"emission factors"**

*Estimation of uncertainty:*

The uncertainty of the following emission estimates must be considered as being high; however, due to the lack of base data it cannot be quantified.

*Estimation of annual emission:*

Evaluation was impossible since no base data are available.

**04 06 02****Paper pulp (kraft process)***General remark:*

The only plant in Belgium was converted to the ClO<sub>2</sub>-bleaching process in 1993. Therefore, the present PCDD/PCDF emissions are assumed to be negligible. The emissions into the atmosphere that may arise from the treatment of bleaching solutions in the so-called “black liquor boiler” are estimated.

*Considered pathways or media:*

Air/water

*Measurements:*

Records of measurements of PCDD/PCDF concentrations, for example in the waste water, are available. The measurements were conducted prior to 1993 by the plant operators. All values were below the detection threshold.

*Plant data:*

See. General Remark

*National activity rates:*

Production figures for the years 1985 through 1993 are reported, the rates for 1985 and 1990 are:

Year	1985	1990	1995
production rate [kt/a]	180.9	217.5	-

**B: Paper pulp (kraft process); production rates***Emission factors:*

From the literature <12> a value of 10 µg/t for WATER is taken; for AIR a value of 0.17 µg/t (“black liquor”) is assumed, based on a production of 1.43 t “black liquor” per ton of cellulose <13>.

Belgium

04 06 02

Paper pulp (kraft process)

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*Estimation of uncertainty:*

Activity rates	0
emission factors	1
<b>total uncertainty</b>	<b>1</b>

**B: Paper pulp (kraft process); indices of uncertainty**

*Estimation of annual emission:*

From the data mentioned above the following emissions are estimated:

	<b>1985</b>	<b>1990</b>	<b>1995</b>
<b>AIR</b>	0.04	0.05	-
<b>Margin of uncertainty</b>	0.01-0.1	0.01-0.1	-
<b>WATER</b>	1.18	2.18	-
<b>Margin of uncertainty</b>	0.37-3.7	0.68-6.8	-

**B: Paper pulp (kraft process); annual PCDD/PCDF emissions [g I-TEQ/a]**

**06 04 06****Preservation of wood***General remark:*

As for the PCDD/PCDF emissions that arise at the application of wood preservatives, particularly PCP, only the general knowledge is summarised and reference is made of the results of the Dutch study. It is assumed that the situation in Belgium is similar and that therefore also in Belgium an emission of about 25 g I-TEQ/a into the atmosphere can be presumed. This estimate, however, is not included in the quoted total national emission.

**07****Road transport***Considered pathways or media:*

Air

*Measurements:*

In Belgium, concentration measurements were conducted in a road tunnel.. The PCDD/PCDF concentrations obtained were correlated with the simultaneously determined total-C-concentrations in air in order to derive an emission factor.

*Plant data:*

Not applicable.

*National activity rates:*

The report contains detailed tables of the fuel consumption and the size of the fleet of catalyst-equipped vehicles.

	1985	1990	1995
<b>leaded fuel</b>	2717	2064	643
<b>unleaded fuel</b>	0	663	2246
<b>diesel fuel</b>	2375	3504	4100
<b>total</b>	5092	6231	6989

**B: Road transport; annual fuel consumption [kt/a]***Emission factors:*

For estimating the emissions, emission factors are taken from a summary of the tunnel measurements and from the literature <4>. In a first step, the total national emission (2.64 g/a) is computed from the fuel consumption in 1991 and the emission factors found in the literature (for example, 23.6 pg I-TEQ/l diesel fuel <4>). Because the tunnel report cited a national emission rate of about 4 g/a, the emission factors were multiplied by the factor  $4/2.64 = 1.5$ . Further taking into account the fuel density, this procedure yields the following factors:

Type of fuel	Emission factor[ng/t]
leaded fuel	2200
unleaded fuel	104
unleaded fuel, with catalyst	14.3
diesel fuel	43

**B: Road transport; emission factors***Estimation of uncertainty:*

The activity rates are termed precise while the emission factors are considered to be sufficiently accurate:

Activity rates	0
emission factors	1
<b>total uncertainty</b>	<b>1</b>

**B: Road transport; indices of uncertainty***Estimation of annual emission:*

Type of fuel	1985	1990	1995
leaded fuel	5.98	4.54	1.41
unleaded fuel	0	0.06	0.1
unleaded fuel, with catalyst	0	0.001	0.019
diesel fuel	0.151	0.151	0.176
<b>TOTAL</b>	<b>6.08</b>	<b>4.755</b>	<b>1.705</b>
<b>Margin of uncertainty</b>	<b>1.9-19</b>	<b>1.5-15</b>	<b>0.54-5.4</b>

**B: Road transport; annual PCDD/PCDF emissions [g I-TEQ/a]**

Belgium

09 02 01

Incineration of domestic or municipal wastes (illegal)

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## **09 02 01**

### **Incineration of domestic or municipal wastes (illegal)**

#### *General remark:*

Subject covered: Illegal domestic burning of municipal waste

The estimated emissions are not contained in the total national emission as given in the Belgian survey!

#### *Considered pathways or media:*

Air

#### *Measurements:*

No data reported from Belgium.

#### *Plant data:*

Not applicable.

#### *National activity rates:*

Following the procedure employed in a study conducted in the USA, the assumption is made that about 1% of the total domestic waste is burned "illegally". This amounts to 30,000 tons per year.

#### *Emission factors:*

According to the USA-study: 1000 µg/t.

#### *Estimation of uncertainty:*

The data are not characterised by an index of precision. Because of the very different population densities and the degree of urbanisation the estimated quantity of illegally burned domestic waste is considered to be probably too high. Thus, the following emission estimate would mark an upper limit.

Incineration of domestic or municipal wastes (illegal)

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*Estimation of annual emission:*

With the assumptions mentioned, the emission is 30 g I-TEQ/a.

*Comment:*

Ignoring this potential source impairs the quality of the national inventory significantly.

Belgium

09 02 01

Incineration of domestic or municipal wastes (legal)

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## **09 02 01**

### **Incineration of domestic or municipal wastes (legal)**

*General remark:*

Subject considered: Legal commercial incineration.

*Considered pathways or media:*

Air, water, residues

*Measurements:*

Results from earlier measurements (1985, 2 installations), concentration in the waste gas: 2200 ng/m<sup>3</sup> total dioxins (not converted into I-TEQ).

In 1991 and 1993 four measurements were carried out at one installation and nine measurements at another facility. The mean concentrations in the waste gas were found to be 6.9 ng I-TEQ/m<sup>3</sup> (or 41 µg/t) and 3.2 ng I-TEQ/m<sup>3</sup> (or 17 µg/t). Combining these results an average concentration of 4 ng I-TEQ/m<sup>3</sup> and an emission factor of 22 µg/t are obtained.

A study of all Flemish incinerators yielded an estimate of the total emissions from these sources of 122.7 g I-TEQ; individual results may be gathered from a special report..

In the waste water of three incinerators with wet flue gas scrubbers an average concentration of 167 pg I-TEQ/l was found.

*Plant data:*

In November 1994 Belgium had a total of 22 waste incinerators. Most of these were taken into operation before 1980 and are equipped only with electrostatic filters. Between 1993 and 1995 some of these installations were retrofitted with wet flue gas scrubbers. There are plans for the near future to furnish some incinerators with activated carbon filters.

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 Incineration of domestic or municipal wastes (legal)
 

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*National activity rates:*

For every waste incinerator plant the annual amounts of waste are listed for the years 1985, 1990 and 1995; the total amounts of waste for these years are:

Year	1985	1990	1995
consumption rate [kt/a]	1334	1737	1887

**B: Incineration of domestic or municipal wastes (legal);  
annually burned municipal waste**

For estimating the emissions from fly ash landfills it is assumed that the amount of fly ash is 1% of the total mass of the domestic waste before incineration.

*Emission factors:***Air:**

The emission factors are quoted separately for each flue gas cleaning method. For the years 1985 and 1990 a distinction is made only between dry and wet scrubbing. It is assumed that the dry methods have technically improved so that by 1995 the emission factors were only one half of the earlier ones.

	1985	1990	1995
<b>dry scrubber</b>	240	240	120
<b>wet scrubber</b>	22	22	22
<b>dry/wet scrubber combined</b>			50
<b>activated carbon (Sorbalit)</b>			2.5

**B: Incineration of domestic or municipal wastes (legal);  
emission factors for MSW incineration [ $\mu\text{g I-TEQ/t}$ ] (AIR)**

**Water:**

The emissions via the waste water are calculated to be

0.09  $\mu\text{g I-TEQ/l}$ .

This value is derived from the measured concentration of 167  $\text{pg/l}$  while taking into account the quantity of water required per ton of solid waste (not stated).

**Residues:**

In 18 fly ash samples a concentration of 26.4  $\text{ng I-TEQ/g}$  was determined. After rounding this value to 25  $\text{ng I-TEQ/g}$  the emission rates below are obtained.

*Estimation of uncertainty:*

Both the activity rates and the emission factors are considered to be precise:

## Incineration of domestic or municipal wastes (legal)

Activity rates	0
emission factors	0
<b>total uncertainty</b>	<b>0</b>

**B: Incineration of domestic or municipal wastes (legal); indices of uncertainty**

*Estimation of annual emission:*

By multiplying the mass of waste incinerated per year with the respective emission factors the following PCDD/PCDF emissions are obtained:

AIR	1985	1990	1995
Annual emission [g I-TEQ/a]	297	385	187

**B: Incineration of domestic or municipal wastes (legal); annual PCDD/PCDF emissions into the AIR [g I-TEQ/a]**

Due to planned abatement measures, the emissions are expected to be reduced by 2/3 to 63.2 g I-TEQ/a by 1996. Provided that all installations complied with the limit value of 0.1 ng/m<sup>3</sup> the resulting emission would amount to 0.95 g I-TEQ/m<sup>3</sup>.

WATER	1985	1990	1995
Annual emission [g I-TEQ/a]	0.0305	0.0471	0.0575

**B: Incineration of domestic or municipal wastes (legal); annual PCDD/PCDF emissions into waste water [g I-TEQ/a]**

The emissions of dioxins by fly ash into landfills are shown in the next table.

	1985	1990	1995
Annual emission [g I-TEQ/a]	334	434	472

**B: Incineration of domestic or municipal wastes (legal); annual PCDD/PCDF emissions into landfills**

*Comment:*

No other considerations are given to the fate of the dioxins contained in the fly ash in the landfills. Hence it is not at all clear how much dioxin actually escapes into the environment.

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 Incineration of industrial wastes (open burning of demolition waste)
 

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**09 02 02****Incineration of industrial wastes (open burning of demolition waste)***General remark:*

Subject covered: Open waste burning in the construction industry. The emissions estimated in this section are not included in the total national emission estimate!

*Considered pathways or media:*

Air

*Measurements:*

None.

*Plant data:*

Not applicable.

*National activity rates:*

The construction industry produces about 10 kt waste per year. The waste consists of paper, carton and wood that may partially be mixed with PVC and other plastics.

Sector	Activity [kt of burned waste /a]
construction	10

**B: Incineration of industrial wastes (open burning of demolition waste); estimates of total open waste burned**

*Emission factors:*

For the construction industry an amount of 500 µg/t is used without stating any reasons:

Sector	emission factor [µg I-TEQ/t]
construction	500

**B: Incineration of industrial wastes (open burning of demolition waste); emission factors related to open burning of waste**

Belgium

09 02 02

Incineration of industrial wastes (open burning of demolition waste)

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*Estimation of uncertainty:*

No data are given in the Belgian survey. The reliability of the emission data must certainly be considered to be quite low. This may explain why they were not used in the calculation of the total emission estimate.

Activity rates	1
emission factors	2
<b>total uncertainty</b>	<b>3</b>

**B: Incineration of industrial wastes (open burning of demolition waste); indices of uncertainty**

*Estimation of annual emission:*

Sector	Annual emission [g I-TEQ/a]
construction	5
<b>Margin of uncertainty</b>	0.16-160

**B: Incineration of industrial wastes (open burning of demolition waste); annual PCDD/F emissions [g I-TEQ/a]**

**09 02 02****Incineration of industrial wastes (except flaring)***General remark:*

The Belgian report contains a detailed overview over the present situation of industrial waste incineration. Only excerpts of it can be summarised here.

*Considered pathways or media:*

Air/water/residues

*Measurements:*

PCDD/PCDF emissions of installations for the incineration of industrial waste were thoroughly studied (20 installations); the original report does not mention any results of measurements but only refers to the pertinent report <2>.

*Plant data:*

Installations for the incineration of waste stemming from the production of chemicals are operated by the companies Solvay, BASF, Tessenderlo, Monsanto and Indaver. It is pointed out that there are numerous smaller incinerators, but figures are not given. Except for 3 plants burning chemical wastes the 20 examined installations in Flanders burn wood residues, fibreboards, sawdust, paper, cartons and garden wastes. Industrial waste, particularly solvents, are also used as additional fuel in cement kilns (see 03 03 11). In this context the plants in d'Obourg, Abtoing, Harmignies and Lixhe are mentioned.

*National activity rates:***Air:**

The industrial waste incinerated in the Belgian regions Flanders, Wallonie and Brussels are classified according to origin and treatment. For estimating the emissions the following values are taken into account:

## Incineration of industrial wastes (except flaring)

Year	1985	1990	1995
incineration rate [kt/a]	159.4	233.1	436.0

**B: Incineration of industrial wastes (except flaring);  
amount of burned waste**

Residues incinerated in cement kilns are not contained in these figures. The ensuing emissions are incorporated into the emissions of the cement industry (03 03 11). It should be noted that the figures shown above contain 1.9 kt hospital waste per year that are incinerated in a plant in Wallonie. No explanation is given why this waste is included in this chapter and not in the chapter on the incinerators for hospital waste.

**Water:**

For computing the emissions into waste water and sludge only those wastes are considered which are incinerated in installations with wet flue gas scrubbers. Because the incinerators for chlorinated hydrocarbons had not yet been taken into operation in 1985, the emission is considerably lower in this year than in the years 1990 and 1995.

Year	1985	1990	1995
incinerated waste [kt/a]	0.754	56.4	131.5

**B: Incineration of industrial wastes (except flaring);  
amount of industrial waste burned in installations with wet scrubber**

*Emission factors:*

**Air:**

At the incineration of highly chlorinated hydrocarbons, a concentration in the flue gas of less than 0.1 ng/m<sup>3</sup> translates into an emission factor of 1 to 10 µg/t. For 1985 and 1990 an emission factor of 99 µg/t is assumed, corresponding to a flue gas concentration of 6 ng/m<sup>3</sup> and a specific flue gas volume of 16,500 standard m<sup>3</sup>/t.

The measurements performed in 1993 in 20 installations yielded a total emission of 4.04 g I-TEQ/a. Relating this figure to the amount of waste incinerated in these incinerators, the emission factors listed in the following table are obtained.

**Water/residues:**

The emission factors for water and for emissions via (sewage) sludge are listed in the following table:

## Incineration of industrial wastes (except flaring)

Medium	Emission factor [ $\mu\text{g I-TEQ/t}$ ]
<b>AIR</b>	48
<b>WATER</b>	0.15
<b>SLUDGE, chlorinated hydrocarbons</b>	0.02
<b>SLUDGE, other waste</b>	9

**B: Incineration of industrial wastes (except flaring); emission factors**

*Estimation of uncertainty:*

Both the activity rates and the emission factors are characterised as sufficiently accurate:

Activity rates	1
emission factors	1
<b>total uncertainty</b>	<b>2</b>

**B: Incineration of industrial wastes (except flaring); indices of uncertainty**

*Estimation of annual emission:*

The emissions listed hereafter are estimates based on the previously mentioned activity rates and emission factors.

	1985	1990	1995
<b>AIR</b>	7.65	11.19	20.9
<b>Margin of uncertainty</b>	0.8-80	1.1-112	2-200
<b>WATER</b>	0.0024	0.01	0.021
<b>Margin of uncertainty</b>	0.0002-0.025	0.001-0.1	0.002-0.2
<b>RESIDUES</b>	0.142	0.164	0.298
<b>Margin of uncertainty</b>	0.015-1.4	0.016-1.6	0.03-30

**B: Incineration of industrial wastes (except flaring); annual emissions [g I-TEQ/a]**

*Comment:*

It is not quite clear how the concentrations in water and residues were computed. They cannot be reproduced from the existing collection of data; for example, the given data for water result in values of 0.0001, 0.0085 and 0.012 g I-TEQ/a. In view of these very small emissions, however, these discrepancies are immaterial.

Belgium

09 02 05

Incineration of sludges from waste water treatment

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## 09 02 05

### Incineration of sludges from waste water treatment

*Considered pathways or media:*

Air

*Measurements:*

The only available measurement results from Belgium were obtained at the installation in Brugge in 1985. Considering these results that are expressed as total PCDD/PCDF contents, a concentration of 4 ng I-TEQ/m<sup>3</sup> is derived. The specific flue gas volume is quantified to be 12,500 standard m<sup>3</sup>/t.

*Plant data:*

Two installations existed until 1987, one in Brugge, the other in Antwerp. The latter has been shut down in the mean time. In 1990, the throughput of the incinerator in Brugge was about 14 kt dry matter. For the future a significant increase of the amounts of sewage sludge is forecast with an accompanying enlargement of the plant capacity.

*National activity rates:*

Considering the data mentioned the following amounts of sewage sludge are estimated:

Year	1985	1990	1995
combustion rate [kt/a]	29	14	15

**B: Incineration of sludges from waste water treatment;  
amount of annually burned sewage sludge**

*Emission factors:*

The emissions were calculated with the factor

50 µg/t

that was derived from one measurement result.

*Estimation of uncertainty:*

Both estimation parameters are characterised as sufficiently accurate:

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 Incineration of sludges from waste water treatment
 

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Activity rates	1
emission factors	1
<b>total uncertainty</b>	<b>2</b>

**B: Incineration of sludges from waste water treatment;  
indices of uncertainty**

*Estimation of annual emission:*

	<b>1985</b>	<b>1990</b>	<b>1995</b>
<b>Annual emission [g I-TEQ/a]</b>	1.45	0.70	0.75
<b>Margin of uncertainty</b>	0.15-15	0.07-7	0.08-7.5

**B: Incineration of sludges from waste water treatment;  
annual PCDD/PCDF emissions into the air [g I-TEQ/a]**

*Comment:*

The reliability of the data cannot be considered to be satisfactory.

Belgium

09 02 07

Incineration of hospital wastes

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**09 02 07**

## **Incineration of hospital wastes**

*Considered pathways or media:*

Air

*Measurements:*

In Belgium, measurements were conducted in four installations in 1993 <14>. An average flue gas concentration of 150 ng/m<sup>3</sup> was obtained.

*Plant data:*

In Belgium, some of the hospital waste is burned in incinerators for domestic waste. This fact is disregarded here.

*National activity rates:*

The waste is classified in great detail according to year, region and partially also according to type. For the whole of Belgium the following values are quoted:

Year	1985	1990	1995
hospital waste [kt/a]	44.5	44.5	42.3

### **B: Incineration of hospital wastes; amount of annually incinerated hospital waste**

Results of a survey conducted in Flanders in 1994 could not be included in the present national inventory. This survey showed that only seven hospitals incinerate their waste in-house that reduced the amount of waste in the year 1995 by about 26 kt.

*Emission factors:*

The measurement results mentioned above together with a specific flue gas volume of 15,000 standard m<sup>3</sup>/t yield an emission factor of 2250 µg/t.

*Estimation of uncertainty:*

The estimation parameters are characterised as being rather accurate:

Activity rates	1
emission factors	1
<b>total uncertainty</b>	<b>2</b>

**B: Incineration of hospital wastes; indices of uncertainty**

*Estimation of annual emission:*

The estimated PCDD/PCDF emissions are listed in the following table.

	<b>1985</b>	<b>1990</b>	<b>1995</b>
<b>Annual emission [g I-TEQ/a]</b>	100	100	95
<b>Margin of uncertainty</b>	10-1000	10-1000	9.5-950

**B: Incineration of hospital wastes;  
annual PCDD/PCDF emissions [g I-TEQ/a]**

*Comment:*

No predictions are made concerning the future development but the need for urgent actions is emphasised. The corrections of the amounts of waste in Flanders induced by specific surveys of hospitals show that even quite detailed statistics are not necessarily trustworthy.

Belgium

09 07

Open burning of agricultural wastes (except 10 03)

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**09 07**

**Open burning of agricultural wastes (except 10 03)**

*General remark:*

Subject covered: Open waste burning in agriculture. The emissions estimated in this section are not included in the total national emission estimate!

*Considered pathways or media:*

Air

*Measurements:*

None.

*Plant data:*

Not applicable.

*National activity rates:*

The estimate of the mass of the incinerated waste was based on the number of farms and the assumed amount of 500 kg per farm and year.

Sector	Activity [kt of burned waste /a]
agriculture	38.5

**B: Open burning of agricultural wastes (except 10 03); estimates of total open waste burned**

*Emission factors:*

The incineration of waste in agriculture is characterised by an emission factor of 130 µg/t that is quoted in the Parcom-Atmos-Manual for burning wood under unfavourable conditions.

Sector	emission factor [µg I-TEQ/t]
agriculture	130

**B: Open burning of agricultural wastes (except 10 03); emission factors related to open burning of waste**

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 Open burning of agricultural wastes (except 10 03)
 

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*Estimation of uncertainty:*

No data are given in the Belgian survey. The reliability of the emission data must certainly be considered to be quite low. This may explain why they were not used in the calculation of the total emission estimate.

Activity rates	1
emission factors	2
<b>total uncertainty</b>	<b>3</b>

**B: Open burning of agricultural wastes (except 10 03);  
indices of uncertainty**

*Estimation of annual emission:*

Sector	Annual emission [g I-TEQ/a]
agriculture	5
<b>Margin of uncertainty</b>	0.16-160

**B: Open burning of agricultural wastes (except 10 03);  
annual PCDD/F emissions [g I-TEQ/a]**

Belgium

09 09

Cremation

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**09 09**

## **Cremation**

*Considered pathways or media:*

Air

*Measurements:*

No measurement results are reported from Belgium.

*Plant data:*

In 1994 there were 10 crematoria in operation in Belgium. These installations use afterburning as the sole means of flue gas cleaning.

*National activity rates:*

The numbers of annual cremations are given as:

Year	1985	1990	1995
Annual cremations	13271	20818	32035

**B: Cremation; number of cremations per year**

*Emission factors:*

From data determined in other countries a range of the emission factors from the smallest value found in the UK) to the largest value reported from Germany is taken for calculation of an average value:

Parameter	Emission factor [ $\mu\text{g I-TEQ/Crem}$ ]
Minimal	2
Maximal	28
applied mean	6

**B: Cremation; emission factors**

*Estimation of uncertainty:*

No indices are applied in the Belgian report. The number of cremations per year is known accurately and the uncertainty is calculated using the range of emission factors taken from foreign results.

*Estimation of annual emission:*

The mentioned data yield the following emission rates:

	1985	1990	1995
<b>Annual emission</b>	<b>0.08</b>	<b>0.13</b>	<b>0.19</b>
Margin of uncertainty	0.03-0.37	0.04-0.58	0.06-0.9

**B: Cremation; annual PCDD/PCDF emissions [g I-TEQ/a]***Comment:*

A strong increase of the number of cremations may lead to a local problem situation.

Belgium

09 10 02

Waste water treatment in residential and commercial sectors

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## 09 10 02

### Waste water treatment in residential and commercial sectors

*Considered pathways or media:*

Water

*Measurements:*

None.

*Plant data:*

None.

*National activity rates:*

It is assumed that in the waste water of sewage treatment plants PCDD/PCDF is adsorbed to suspended material. The estimate of the annually produced amount of suspended material as shown in the following table rests on a number of assumptions that cannot be explained here in detail.

Year	1985	1990	1995
suspended material [kt/a]	467	438	406

**B: Waste water treatment in residential and commercial sectors ;  
suspended material leaving waste water treatment plants**

*Emission factors:*

The following values were taken from a rather comprehensive German report <15>:

Year	1985	1990	1995
Concentration [ng I-TEQ/kg d.s.]	0.039	0.039	0.024

**B: Waste water treatment in residential and commercial sectors ;  
emission factors for effluent of waste water treatment plants**

In view of the fact that in Belgium, too, measures have been introduced to reduce PCDD/PCDF in the environment the emission factor for 1995 is assumed to be smaller than for the other two years.

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 Waste water treatment in residential and commercial sectors
 

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*Estimation of uncertainty:*

No data are given in the Belgian survey. Taking into account that the quantities of released materials are calculated using certain model assumptions, the following indices are used for the present study:

Activity rates	1
emission factors	1
<b>total uncertainty</b>	<b>2</b>

**B: Waste water treatment in residential and commercial sectors ; indices of uncertainty**

*Estimation of annual emission:*

With the data mentioned the following emission rates are obtained:

	1985	1990	1995
<b>Annual emission]</b>	18.2	17.1	9.74
<b>Margin of uncertainty</b>	1.8-180	1.7-170	1.0-100

**B: Waste water treatment in residential and commercial sectors ; annual PCDD/PCDF emissions into the water [g I-TEQ/a]**

Belgium

09 10 09

Other - regeneration processes

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**09 10 09**

**Other - regeneration processes**

*General remark:*

This type of installation is not contained in the catalogue CORINAIR 94.

Plants for regenerating activated carbon and catalysts of industrial chemical processes are mentioned as potential sources of dioxin. There is a plant in Belgium in which activated carbon is regenerated, but figures on its throughput are not reported. Therefore its emission cannot be estimated. In a report from the USA an emission factor of 1 µg/t is given.

**12 01 -12 03\*****Fires***General remark:*

This source is not listed in the catalogue CORINAIR 94. The Belgian inventory covers fires of buildings, straw, grass, chimneys and vehicles.

*Considered pathways or media:*

Air/water

*Measurements:*

None.

*Plant data:*

Not applicable.

*National activity rates:*

The fires of chimneys, straw, grass and vehicles are quantified by their numbers and estimated averages of the amount of burned mass per event.

Fires of buildings are characterised by the burned mass. This mass is estimated by using data from fire statistics and fire insurance statistics:

$$M = Z * F * M_F$$

where M: burned mass, in kt/a;

Z: number of fires per year;

F: fractional contribution by each loss class; the definitions of the classes may

vary from year to year;

$M_F$ : average mass burned in each loss class, in kt.

The resulting masses are not explicitly given in the Belgian report; for producing the following table the factors F and  $M_F$  have been combined to form a characteristic number K:

	1985	1990	1995
<b>Buildings fire [events/a]</b>	12330	10962	9228
<b>Mass factor K [t/fire]</b>	1.5635	1.204	1.1722
<b>Burned mass [t/a]</b>	19278	13198	10817
<b>Straw/grass fires[events/a]</b>	2074	7437	6611
<b>Burned mass [t/event]</b>	0.5	0.5	0.5
<b>total burned mass [t/a]</b>	1037	3718.5	3305.5
<b>Vehicle fires [events/a]</b>	2287	1994	1819
<b>Burned mass [t/event]</b>	0.1	0.1	0.1
<b>total burned mass [t/a]</b>	228.7	199.4	181.9
<b>Chimney fires [events/a]</b>	7800	4144	2664
<b>Burned mass [t/event]</b>	0.02	0.02	0.02
<b>total burned mass [t/a]</b>	156	82.88	53.28

**B: Fires; activity rates***Emission factors:***Air:****Building, vehicle and chimney fires**

The emission factor is determined from the specific smoke volume, the soot content of the smoke and the measured PCDD/PCDF concentration in the soot. Using data from a German publication <16> a factor of

170 µg/t is obtained ranging from 113 to 223 µg/t.

**Straw and grass fires**

Reference is made of a report from Austria <17>.

An emission factor of 17 µg/t is used.

**Water:**

Emissions by way of the water used in fire fighting are estimated to amount to

1 µg/t, at straw and grass fires to 0.1 µg/t.

*Estimation of uncertainty:*

Both estimated parameters are considered to be very uncertain; however, no indices are presented. Quantification of the emission range is based solely on the range of the emission factors applied.

*Estimation of annual emission:*

Considering the data mentioned above, the following emissions are presented:

	<b>1985</b>	<b>1990</b>	<b>1995</b>
AIR	3.36	3.22	2.56
Margin of uncertainty	2.23 - 4.45	2.19 - 4.22	1.69 - 3.41
WATER	0.02	0.02	0.015

**B: Fires; annual PCDD/PCDF emissions [g I-TEQ/a]***Comment:*

For this study, the missing masses were calculated as a control. Emission values slightly different from those reported in the Belgian survey but well within the calculation uncertainty were obtained.

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