

040309**Other - Installations for smelting and casting of non ferrous metals***Process description*

The following types of furnaces are mainly used in the secondary non-ferrous industry: the rotary kiln, the crucible furnace, the reverberatory furnace, and the multichamber furnace.

Rotary kiln

The rotary kiln is usually a discontinuously operating, device consisting of a horizontal cylinder that slowly rotates around its axis. Often, polluted aluminium is melted in it under a covering of melted salt. The fuel may be either natural gas or oil.

Crucible furnace

The crucible furnace consists of a crucible of refractory material in which the metal is melted by direct heating with a flame, or by an induction spiral. In order to tap the furnace, it is turned over manually or by using a hydraulic device. This type of furnace is used in the recycling industry to remelt thin-walled, clean types of scrap.

Reverberatory furnace

The reverberatory furnace is, in essence, a chamber-like room into which the scrap is fed. Above the scrap, a flame is fired with which the scrap is heated through direct contact and radiation. The fuel can be both oil and natural gas. This type of furnace is mostly found in industry and is used for melting a large variety of relatively clean types of scrap.

Multichamber furnace

This type of furnace consists of two rooms. The scrap is fed into one of the chambers. In the other room, the metal is heated using a flame, identical to the reverberatory furnace. Through a system with natural or forced convection, the warm metal is transported to the room with the scrap. By circulating the liquid metal through it, the

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scrap is melted. This type of furnace is mostly used for melting moderately polluted types of scrap.

Abatement technologies:

In the furnaces mentioned, flue gas cleaning is usually done by way of a fabric filter with lime injection. In addition to lime, activated carbon is injected at some installations.

Plant data/European situation

The foundry industry mainly consists of small and medium sized companies with fewer than 50 employees, many of which are family-owned <1>. Hence there exists a large number of installations in Europe; according to <1> a total of 871 non-ferrous metal foundries were surveyed in Germany (former western part), France and Spain in 1993. Thus several thousand facilities may be in operation in the 17 European countries considered here.

Activity data

Activity data (shown in 040309—Table 4) were taken from the national inventories and annual production statistics if available. The data used for the national dioxin inventories of Germany, The Netherlands, Sweden and the United Kingdom revealed considerable differences compared to the data from annual metal production statistics.

Information about the relative utilisation of different types of non ferrous metals such as aluminium, lead, copper and zinc was available from metal production statistics only. A national total for all non ferrous metals was used for each country to calculate the activity rates per capita.

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Emission factors

Emission factors for installations for smelting and casting of non ferrous metals as reported by the national dioxin inventories are shown 040309—Table 3. Apparently the Swiss and German, emission factors had been gained by measurements while for the whole British non ferrous metal industry a composite emission factor was calculated. As the Dutch and Swedish emission factors were not documented in the national inventories a verification through supplementary measurements may be necessary.

From the few emission factors presented in national inventories or publications the following default emission factors were selected to be used for the emission estimation:

typical	minimum	maximum
1.0	0.1	100.0

040309—Table 1 Selected emission factors for installations for smelting and casting of non ferrous metals [$\mu\text{g I-TEQ/t}$]

Emission estimation

The standardised annual PCDD/F emissions were derived on the basis of the selected emission factors and activity rates. For all 17 countries considered the following total results are obtained (040309—Table 2):

	TOTAL
national inventories	?
Re-evaluation, min	0.3
Re-evaluation, max	304.0
Re-evaluation, typical	3.0

040309—Table 2 Summary of re-evaluated typical PCDD/F air emissions [g I-TEQ/a] from installations for smelting and casting of non ferrous metals

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Conclusions/recommendations

The PCDD/F air emissions from installations for smelting and casting of non ferrous metals may be of significant relevance for the total emission of PCDD/F in Europe. The considerable uncertainties of dioxin emissions estimations for these plants are unavoidable due to the few data.

Emission measurements are strongly recommended to get a more comprehensive data base for estimations. Furthermore these measurements may reveal important and yet unknown dioxin sources in Europe.

	Flue gas conc. [ng I-TEQ/m ³]			Emission factors [µg/t]			Remark
	typ	min	max	typ	min	max	
CH				30			stack emissions, EF based on measurements and personal comm.
				87	3	365	diffuse emissions and drying of shavings;
D	0.110	0.00	1.2	0.030	0.001	0.840	copper and copper alloys
				0.4	0.2	2.4	diverse metals
NL				0			should be proved by measurements!
S							no results available for smoke stack gas emissions and other pathways; should be improved!
UK					5	35	Composite EFs for whole non ferrous metal industry; estimated total emission is 5 to 35 g I-TEQ/a
				1	0.1	100	Chosen values for stack emissions

040309—Table 3 PCDD/F air emission factors for installations of the non ferrous metal industries from national dioxin inventories

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	Activity rates [kt/a]		From metal statistics: Production of mould/die castings (kt/a):					combined [kt/a]	
	from Inv.		Al	Pb	Cu	Zn	All	per cap.	
A			46.6		58	13	118	0.0149	118
B			335.3	32.8	372.4	19.7	760	*)	760
CH									40 per capita est.
D	262	(excl. Al)	460.2	7.5	89.5	70.5	628	0.0077	628
Dk									30 per capita est.
E									223 per capita est.
F			235		21.6	33.6	290	0.0050	290
Gr									58 per capita est.
I			405.1		79.4	63.3	548	0.0097	548
Irl									20 per capita est.
L									2 per capita est.
N									24 per capita est.
NL	18.5					27	27	0.0018	27
P									56 per capita est.
S	37.2		17.3				17	0.0020	17
Sf			3.4				3	0.0007	3
Uk	1000		106		48.9	43.85	199	0.0034	199
Total	1318		1609	40	670	271	2590		3043

mean: 0.0056 std_dev.: 0.0045

B: incl. Semis; *) not regarded

Italy (Cu): prod. of alloyed ingots

Austria (cu): incl. semis

UK (Zn): Zn content given

NL (Zn): consumption by other uses incl. castings

040309—Table 4 Activity rates related to installations of the non ferrous metal industries

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	Annual emission		
	typ	min	max
A	0.12	0.01	11.76
B	0.76	0.08	76.02
CH	0.04	0.00	4.02
D	0.63	0.06	62.77
Dk	0.03	0.00	2.97
E	0.22	0.02	22.29
F	0.29	0.03	29.02
Gr	0.06	0.01	5.79
I	0.55	0.05	54.78
Irl	0.02	0.00	2.00
L	0.00	0.00	0.23
N	0.02	0.00	2.43
NL	0.03	0.00	2.70
P	0.06	0.01	5.55
S	0.02	0.00	1.73
Sf	0.00	0.00	0.34
Uk	0.20	0.02	19.88
Total	3.0	0.3	304

040309—Table 5 Comparison of PCDD/F air emission estimates [g I-TEQ/a] for installations of the non ferrous metal industries

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References to 040309

- 1 Panorama of EU Industry 95-96. Edited by Eurostat and European Commission, DG III