SNAP CODE : **030302**

SOURCE ACTIVITY TITLE: **PROCESSES WITH CONTACT**
Reheating Furnaces Steel and Iron

NOSE CODE: **104.12.03**

NFR CODE: **1 A 2 a**

1 ACTIVITIES INCLUDED

The reheating furnaces are part of the production of primary iron and steel. A detailed description of non-combustion processes in iron and steel industries and collieries can be found in chapters B146 and B422 up to B428. However, in the following, if useful for description, also non-combustion process steps are mentioned.

2 CONTRIBUTION TO TOTAL EMISSION

The emissions of heavy metals from reheating furnaces at iron and steel production plants are relevant on a national level. Emissions of other substances only give a local contribution. For heavy metal emissions, specific figures on relative contributions for this source activity are not available. The average relative contribution from the total iron and steel production industry to the total emission of heavy metals has been presented for European countries in table 1. The data in table 1 is according to Baart *et al.* (1995) [1].

Table 1: Average relative contribution of the production of iron and steel to the total emission of heavy metals in European countries

Compound	Total iron & steel production (%)
Cadmium	22
Chromium	36
Copper	16
Nickel	14
Lead	12
Zinc	33

For emissions other than heavy metals, the contribution from reheating furnaces in steel and iron production to total emissions in countries of the CORINAIR90 inventory is given in table 2.

Table 2:Contribution to total emissions of the CORINAIR90 inventory (*28 countries*)

Source-activity	SNAP-code	Contribution to total emissions [%]							
		SO_2	NO_x	NMVOC	CH_4	CO	CO_2	N_2O	NH_3
Reheating Furnaces Steel and Iron	030302	0.3	0.3	0	0	0.2	0.6	0.1	-

0 = emissions are reported, but the exact value is below the rounding limit (0.1 per cent)
- = no emissions are reported

3 GENERAL

3.1 Description of activities

Reheating furnaces prepare cool iron material for further processing by an appropriate temperature increase. In soaking pits, ingots are heated until the temperature distribution over the cross section of the ingots is acceptable and the surface temperature is uniform for further rolling into semifinished products (blooms, billets and slabs). In slab furnaces, a slab is heated before being rolled into finished products (plates, sheets or strips). [2]

3.2 Definitions

3.3 Techniques

The type of reheating furnace depends on the site and nature of the intermediate product and the subsequent processing. Coal-fired furnaces are now comparatively rare. Reheating furnaces are normally fired by gas or oil. [3]

3.4 Emissions

Pollutants released are sulphur oxides (SO_x), nitrogen oxides (NO_x), volatile organic compounds (non-methane VOC and methane (CH_4)), carbon monoxide (CO), carbon dioxide (CO_2) and nitrous oxide (N_2O). According to CORINAIR90 the main relevant pollutants are SO_x, NO_x and CO_2 (see also table 2). The emissions are released through the stack.

Emissions of sulphur dioxides (SO_x) are directly related to the sulphur content of the fuel. Reheating furnaces are normally fed by low sulphur gas (blast furnace gas, desulphurised coke oven gas or natural gas) or by oil [3].

Nitrogen oxides (NO_x) are formed within the combustion process by conversion of fuel-nitrogen and nitrogen of the combustion air.

Carbon dioxide (CO_2) is a main product of the combustion process and is directly related to the carbon content of the fuel.

3.5 Controls

Emissions are reduced by preceding cleaning of the used blast furnace gas and coke oven gas. No information is available for treatment of exhaust gases from reheating furnaces. [2]

4 SIMPLER METHODOLOGY

The emissions. are inventoried using the default emission factors provided in Table 8.1. These emission factors represent the high end of typical emission factors, and assume limited control technology is in place.

5 DETAILED METHODOLOGY

If an extensive measuring programme is available the emission of heavy metals can be calculated on the basis of the measurements of the dust emission and the composition of compounds over the total process. Reference emission factors are provided for comparison with user's own data in Table 8.2.

6 ACTIVITY STATISTICS

Standard energy consumption statistics (IEA, UN, International Iron and Steel Institute etc.)

7 POINT SOURCE CRITERIA

The iron and steel plants from which the reheating furnaces are a part are connected to high chimneys (> 100 meter), and can be regarded as point sources . They can be considered to be point sources at a national as well as on a regional level.

8 EMISSION FACTORS, QUALITY CODES AND REFERENCES

8.1 Simpler Methodology

A summary of default emission factors using the simpler methodology for estimating emissions from ordinary steel and iron production are provided in Table 8.1.

8.2 Detailed Methodology

For emissions other than heavy metals, table 8.2 contains fuel use related reference emission factors for reheating furnaces in steel and iron production based on CORINAIR90 data in g/GJ. Technique related emission factors, mostly given in other units (e.g. g/Mg product), are listed in footnotes. In case of using production statistics the specific energy consumption (e.g. GJ/Mg product) has to be taken into account. The specific energy consumption is process and country specific; within CORINAIR 90 a value of 100 GJ/Mg product has been reported.

Table 8.1 Default emission factors - simpler methodology

Pollutant	Emission factor	Units
PM10	650	g/tonne steel
Arsenic	1.44	mg/tonne steel
Cadmium	0.48	mg/tonne steel
Chromium	24	mg/tonne steel
Copper	24	mg/tonne steel
Mercury	0.5	mg/tonne steel
Lead	38	mg/tonne steel
Zinc	84	mg/tonne steel
Dioxins and furans	0.2	µgTEQ/tonne cement
Hexachlorobenzene	11	µg/tonne cement
Polyaromatic hydrocarbons	24000	mg/tonne steel

Table 8.2 Emission factors for reheating furnaces in steel and iron production – detailed methodology

	Fuel			NAPFUE -code	Emission factors SO_2 [g/GJ]	NO_x [g/GJ]	NMVOC [g/GJ]	CH_4 [g/GJ]	CO [g/GJ]	CO_2 [kg/GJ]	N_2O [g/GJ]	NH_3 [g/GJ]
S	coal	hc	Coking	101			15[1)3)]	15[1)]	12[1)]	94[1)]	3[1)]	
S	coal	hc	Steam	102	992[3)]	150[3)]	15[1)]	15[1)3)]	120[1)], 70[3)]	94[1)], 98[3)]	14[3)]	
S	coal	hc	sub-bituminous	103	1,267[3)]	100[3)]	4[3)]	4[3)]	20[3)]	52[3)]	3[3)]	
S	coal	bc	brown coal/lignite	105	2,358[3)]	150[3)]	20[3)]	100[3)]	18[3)]	86[3)]	3[3)]	
S	coke	hc	coke oven	107	351[3)]	150[3)]	15[1)3)]	15[1)3)]	70[1)3)]	108[1)], 105[3)]	3[1)], 14[3)]	
S	coke	bc	coke oven	108	650[3)]	150[3)]	8[3)]	15[1)]	18[3)]	86[3)]	3[3)]	
S	coke		Petroleum	110	2,000[3)]	300	1.5[3)]	1.5[3)]	70[3)]	97[3)]	10[3)]	
L	oil		Residual	203	1,323[1)] 143-1,503[3)]	100-240[3)]	3-5[1)] 3[3)]	3-5[1)3)]	15[1)], 12-15[3)]	76-78[1)] 73-78[3)]	3-14[1)] 2-14[3)]	
L	oil		Gas	204	94-1,410[3)]	80-100[3)]	2.5[1)] 1.5[3)]	2.5[1)], 1.5[3)]	12[1)3)]	74[1)] 69-74[3)]	3[1)] 2-14[3)]	
L	oil		shale-oil	211	503[1)]	158[1)]			13[1)]			
G	gas		Natural	301	0.87-58[1)] 0.3-58[3)]	58-187[1)] 58-125[3)]	2.5-4[1)] 1-4[3)]	2.5-4[1)] 1-5[3)]	5.5-13[1)] 8-25[3)]	55-56[1)] 52-57[3)]	1.5-3[1)] 0.8-3[3)]	
G	gas		liquified petroleum gas	303	0.04[3)]	100[3)]	2.1[3)]	0.9[3)]	13[3)]	65[3)]	1-3[3)]	
G	gas		coke oven	304	23-715[1)] 60[3)]	84-207[1)] 85[3)]	2.5[1)3)]	2.5[1)3)]	12-17[1)] 15[3)]	42-46[1)] 45[3)]	3[1)], 1[3)]	
G	gas		blast furnace	305	57-831[1)] 18-830[3)]	145-831[1)] 25-830[3)]	0.25-2.5[3)]		12-69[1)] 10-14[3)]	192[1)3)] 290[3)]	3[1)], 1-2.4[3)]	
G	gas		coke oven and blast furnace gas	306	0.53[1)]	151[1)]		0.25-2.5[3)]	14[1)]	205[1)]		
-	not specified		-	-	400[2)]	400[2)]	5[2)]					

[1)] CORINAIR90, point sources (preliminary data)
[2)] EPA 1990 [4]
[3)] CORINAIR90 data, area sources, (preliminary data)

9 SPECIES PROFILES

The origin of the heavy metals emission is the dust production. The emission factors as presented are therefore related to the profile of the dust. This profile however is dependent on the ores used.

10 UNCERTAINTY ESTIMATES

Not available.

11 WEAKEST ASPECTS/PRIORITY AREAS FOR IMPROVEMENT IN CURRENT METHODOLOGY

The weakest aspects discussed here are related to emission factors and activities.

The fuel specific emission factors provided in table 3 are related to point sources and area sources without specification. CORINAIR90 data can only be used in order to give a range of emission factors with respect to point and area sources. Further work should be invested to develop emission factors, which include technical or fuel dependent explanations concerning emission factor ranges.

Uncertainties also occur concerning the activity covered due to the fact, that a single fuel (e.g. oil) or a mixture of blast furnace and coke oven gas can be used. Further work should be invested in a representative split of fuel gases used (activity data) and in providing corresponding emission factors e.g. for a blend of blast furnace and coke oven gas.

For heavy metals, knowledge on emission factors, abatement techniques, dust removal efficiencies and operating techniques is very limited; measurement data of composition of dust is poor.

12 SPATIAL DISAGGREGATION CRITERIA FOR AREA SOURCES

13 TEMPORAL DISAGGREGATION CRITERIA

Iron and steel production is a continuous process.

14 ADDITIONAL COMMENTS

15 SUPPLEMENTARY DOCUMENTS

Not available.

16 VERIFICATION PROCESSES

Verification of the emissions can be done for metal emissions by calculating the emissions using the factors from the PARCOM ATMOS manual and comparing the results with a mean profile of the ore used. A mass balance over the entire plant may also be a useful check.

17 REFERENCES

[1] A.C. Baart, J.J.M. Berdowski, J.A. van Jaarsveld; Calculation of atmospheric deposition of contaminants on the North Sea; IWAD; ref. TNO-MW-R 95/138; TNO MEP; Delft; The Netherlands; 1995

[2] US-EPA (ed.): AP 42 CD-Rom; 1994

[3] Parker, Albert (ed.): Industrial Air Pollution Handbook; Maidenhead, Berkshire (England); 1978

[4] EPA (ed.): AIRS Facility Subsystem, EPA-Doc: 450/4-90-003, Research Triangle Park, March 1990

18 BIBLIOGRAPHY

19 RELEASE VERSION, DATE, AND SOURCE

Version : 3

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20 POINT OF ENQUIRY

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