SNAP CODE: **040206**

SOURCE ACTIVITY TITLE: **PROCESSES IN IRON & STEEL INDUSTRIES & COLLERIES**
Basic Oxygen Furnace Steel Plant

NOSE CODE: **105.12.06**

NFR CODE: **2 C 1**

1 ACTIVITIES INCLUDED

The basic oxygen furnace is a part of the production process of primary iron and steel.

2 CONTRIBUTION TO TOTAL EMISSIONS

The emissions from the basic oxygen process are part of the primary iron and steel production.

Table 2.1 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
Basic Oxygen Furnace Steel Plant	040206	0.2	0	0	-	1.5	0	-	-

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

However, this chapter currently addresses only heavy metal emissions.

3 GENERAL

3.1 Description

Pig iron contains 4 - 4.5 weight % carbon. In its solid state pig iron is hard and brittle, and rolling or forging is impossible. This can only be done by lowering the carbon content to below 1.9 weight %. This is the steel production process.

The first step in the conversion of iron steel is the removal of carbon.

This is feasible thanks to the strong attraction between carbon and oxygen. In the blast furnace process, the carbon released from the coke breaks the iron/oxygen bond in the ore by binding itself to CO and CO_2.

In the steel making process, the opposite occurs, the oxygen causing the carbon to leave the iron. It disappears from the converter in the form of carbon monoxide gas.

The oxygen-blown steel making process takes place in a pear-shaped vessel called a converter. This has a refractory lining and is mounted in such a manner that it can be tilted. Inside iron is turned into steel by blowing almost pure oxygen on to the surface of the molten metal, causing undesirable substances to be combusted. The refining process can be enhanced, where necessary, by “bottom stirring” with argon gas by porous bricks in the bottom lining in certain phases of the process. This produces a more intensive circulation of the molten steel and an improved reaction between the gas and the molten metal. The oxidation (combustion) of the various elements which escape from the bath is accompanied by the release of a great deal of heat. In many cases steel scrap is added at a rate of 10% - 20% to cool the metal. The gas, which is rich in carbon monoxide, is removed and used as a fuel.

A complete cycle consists of the following phases: charging scrap and molten iron, blowing, sampling and temperature recording, and tapping. In a modern steelwork, 300 tonnes of steel are produced in a 30 minute cycle.

At the end of the refining process the ladle filled with molten steel is conveyed to the continuous casting machine. Continuous casting, in which billets or slabs are cast direct from molten metal, replaces the traditional method of pouring molten steel into moulds to produce ingots which, when solidified, are reheated and rolled into slabs or billets.

Continuous casting not only saves time and energy, but also improves the quality of the steel and increases the yield.

3.2 Definitions

Primary dust removal	Oxygen blowing with a vertical converter
Secondary dust removal	Oxygen blowing with a tilted converter during loading and tapping
Unabated emissions	Emissions from roof ventilation with a tilted converter with no secondary dust removal
Refractory lining	Fire-resistant coating of the converter. The coating contains tar.

3.3 Emissions

The primary dust abatement produces in addition to CO and CO_2 mainly dust emissions. When the converter is provided with a fire resistant coating, this coating has to be preheated, producing PAH containing aromatic hydrocarbons. The amount of PAH is usually below the detection limit of the measuring technique. The dust contains a small amount of heavy metals. The secondary dust abatement produces dust with a higher heavy metal content than the primary dust. The same applies to the unabated dust emissions from ventilation through the roof.

The main part of the dust emissions consists of particles with a size smaller then 10 micron. For the dust emitted through the roof this is more than 50 %.

3.4 Controls

Primary dust abatement consists of a vapour cooler for separation of coarse dust and a washer for fine dust abatement. The secondary dust abatement is usually a fabric filter.

4 SIMPLER METHODOLOGY

A simpler methodology would be the use of economic statistics in combination with emission factors. Default emission factors to facilitate this approach are provided in Section 8.1

5 DETAILED METHODOLOGY

For a local situation, the best approach would be to use extensive measurements, including the effects of abatement approaches. Reference emission factors for comparison with User's own estimates, are provided for selected pollutant releases, in Section 8.2

6 RELEVANT ACTIVITY STATISTICS

Plant specific, national and international production statistics could be used.

7 POINT SOURCE CRITERIA

Primary iron and steel industry with a capacity above 3 million tonnes per year should be considered as a point source.

8 EMISSION FACTORS

8.1 Default Emission Factors For Use With Simpler Methodology

Table 8.1 Default Emission Factors (abatement type unknown/not specified)

Compound	Emission factor (g/Mg)	Compound	Emission factor (g/Mg)
Arsenic	0.015	Lead	1.5
Cadmium	0.025	Selenium	0.003
Chromium	0.1	Zinc	4
Copper	0.1	Dust	-
Mercury	0.003		
Nickel	0.05		

8.2 Reference Emission Factors For Use With Detailed Methodology

The data provided in Table 8.2 are based on a combination of six sources with abatement and two without abatement. The combination of this information is related to total production.

Table 8.2 Emission factors for dust and heavy metals from basic oxygen furnace production as reported by several countries/authors (in g/Mg)

Compound	Germany [1]	Netherlands		France [4]	Pacyna [5]	Sweden [6,7]		Poland [8]	
abatement	partially abated	wet scrubbers fabric filters [2]	partially abated [3]	unknown	unknown	wet scrubbers fabric filters		abated	
Arsenic	0.0040	0.02	0.0001	0.02	-	-	-		
Cadmium	0.031	0.003	0.024	0.002-0.05	0.02	0.04	0.04		
Chromium	0.50	0.04	0.011	0.07	-	-	0.026	0.04-0.07	
Copper	0.13	0.04	0.010	0.25	-	-	0.066	0.01-0.04	
Mercury	-	0.004	0.002	-	-	0.001	0.00033		
Nickel	0.09	-	-	0.05	-	-	0.024		
Lead	1.30	2.3	1.08	0.9	1.6	4	4.6	0.08-0.14	
Selenium	-	-	-	-	-	-	-		
Zinc	3.3	4.1	2.7	4.1	3.9	6	6.4	0.4-0.8	
Dust	-	100	53	-	-	-	-		

- unknown

9 SPECIES PROFILES

Information about the profile of the used ores might provide extra information. Generalised ore profiles are not relevant.

10 UNCERTAINTY ESTIMATES

The uncertainty in the emission factors may be estimated at about 50 %

11 WEAKEST ASPECTS/PRIORITY AREAS FOR IMPROVEMENT IN CURRENT METHODOLOGY

The weakest aspect in the methodology is the lack of sufficient information in relation to details of the processes used.

12 SPATIAL DISAGGREGATION CRITERIA FOR AREA SOURCES

Not relevant if considered as point source.

13 TEMPORAL DISAGGREGATION CRITERIA

Although the different processes are discontinuous, steel production as such is a continuous process. Therefore for most purposes no temporal disaggregation is necessary.

14 ADDITIONAL COMMENTS

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15 SUPPLEMENTARY DOCUMENTS

Environmental Protection Agency. Compilation of air pollutant emission factors AP-42
PARCOM-ATMOS Emission Factors Manual

16 VERIFICATION PROCEDURES

Verification of the heavy metal emissions by comparing with the profile of the ore could be useful.

17 REFERENCES

1 Jockel, W., Hartje, J., Datenerhebung über die Emissionen Umweltgefärdenden Schwermetalle, Forschungsbericht 91-104 02 588, TüV Rheinland e.V. Köln; 1991

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3 Mulder, W., personnal communication, Delft, the Netherlands, 1994.

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7 10th Meeting Working Group Atm. Input of Poll. to Convention Waters, London, 9-12 Nov. 1992, Comments on Emission Factors Manual from Sweden (ATMOS 10/9/2).

8 Hlawiczka, S., Zeglin, M., Kosterska, Heavy metals emission to air in Poland for years 1980-1992, A., Inst. Ecol. Ind. Areas, Report 0-2.081, Katowice, 1995 (in Polish).

18 BIBLIOGRAPHY

No additional bibliography.

19 RELEASE VERSION, DATE AND SOURCE

Version : 3.1 (draft)

Date : April 2001

Source : J. J .M. Berdowski, P.F.J.van der Most, W. Mulder, J. PJ . Bloos
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20 POINT OF ENQUIRY

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