

7.6 Coke oven furnaces

7.6.1 Coverage

This section deals with emissions originating from coke oven furnaces in iron and steel production. The further use of coke or coke oven gases is not regarded here, for information see section "Iron and Steel Production".

7.6.2 Emission sources

Within the production of primary iron and steel, the blast furnace (cf. section "Iron and Steel Production") is the main operational unit. Coke is basically used as a reducing agent in a blast furnace due to its physical and chemical characteristics. It is produced from coal in a coke oven via dry distillation.

Coke oven plant: Coke is produced via heating of coal mixtures in absence of oxygen. The coke oven is a chamber made up of heat resistant bricks. A heating wall consists of heating flues with nozzles for fuel supply and with air intakes. In general, cleaned coke oven gas is used as a fuel as well as other gases such as blast furnace gas. The coke is afterwards used mainly as a reducing agent in blast furnaces.

Due to high costs of coke, replacement by pulverized coal, fuel oil, plastics etc. may replace it as reducing agents in the blast furnace route [2]. This reduction in coke consumption also helps to reduce total emissions from coke production. Several 'direct' and 'smelting reduction' processes have been developed for primary iron production without the use of coke (for example Corex).

7.6.3 BAT, Associated Emission Levels (AEL)

7.6.3.1 SO₂

In general emissions of SO₂ can be minimised by reducing the sulphur content of the coal.

During the coking process, this sulphur of the coal is fully converted into H₂S and captured with the coke oven gas, which is used usually after cleaning of the coke oven gas i.a. as fuel for coke oven underfiring. Hence, the emissions of SO₂ can be minimized by the use of coking coal with a lower sulphur content, as well as by adequate desulphurisation of the coke oven gas. For underfiring coke oven gas and blast furnace gas can be used.

The use of desulphurized coke oven gas is considered to be BAT. And the desulphurization of coke oven gas by absorption systems or the oxidative desulphurization is considered to be BAT.

The prevention of leakage between oven chamber and heating chamber by means of regular coke oven operation is considered to be BAT [2]. Table 1 shows selected BAT H₂S control measures with associated H₂S levels of the coke oven gas (to be later used as a fuel i.a. for coke oven underfiring).

Table 1 Selected BAT H₂S control measures with associated H₂S levels of coke oven gas

	Combination of control measures	H₂S level mg/Nm³ [2]
Coke oven gas	Desulphurisation by absorption systems	500 -1000
	Oxidative desulphurization	< 500
<p>The BAT associated emission levels may be expected to be achieved over a substantial period of time at standard conditions and represents a typical load situation.</p> <p>According to the German IPPC implementation report from 2006 the SO_x-emissions from coke oven plants in Germany - all applying COG desulphurisation - were in the magnitude of 110-250 mg/m³ when using solely COG (90% percentile values based on half-hourly average values from continuous measurements). When using mixed gas (a mix mainly consisting of COG and blast furnace gas), the reported emissions were in the range of 80-160 mg/m³.</p>		

7.6.3.2 NO_x

Coke oven gas

Nitrogen emissions arising from the coke oven firing result mainly from the thermal and the chemical NO_x mechanisms. Chemical NO_x is due to the residual content of nitrogen compounds in the COG after cleaning e.g. ammonia. Nevertheless, the type of fuel used is also of importance. [1].

The most effective way to reduce the formation of NO_x is achieved by reducing the flame temperature in the heating chamber.¹ Therefore, the NO_x emissions from the coke oven firing are preferably minimised by process-integrated measures, but end-of-pipe techniques may also be applied. However, due to the high cost, flue gas denitrification (e.g. SCR) is currently not applied except in a limited number of new plants under circumstances where environmental quality standards are not likely to be met. [2].

The use of combustion modification techniques such as, low-NO_x techniques, staged combustion are considered to be BAT in new batteries. Achievable NO_x emissions are 500-770 mg/Nm³.

Table 2 Emission sources and selected BAT NO_x control measures with associated emission levels in coke ovens

Emission source	Combination of control measures	NO_x emission level associated with BAT¹ mg/Nm³ [2]
Combustion of coke oven gas	Combustion modification (at new plants)	500-770 (5% O ₂) ²
<p>¹ The BAT associated emission levels may be expected to be achieved over a substantial period of time at standard conditions and represents a typical load situation. For peak load, start up and shut down periods, as well as for operational problems of the flue gas cleaning systems, short-term peak values, which could be higher, have to be regarded.</p> <p>²-German IPPC implementation report from 2006 the NO_x-emissions from coke oven: 322-414 mg as annual average values from different plants (using both solely COG or mixed gas).</p>		

7.6.3.3 Dust

Information on emissions from blast furnaces that use coke oven gas can be found in the section "Iron and steel production".

Emissions of dust in coke ovens arise mainly from diffuse dust emission sources at the coking plant, starting from coal handling and processing, diffuse emissions from charging holes, coke oven doors and coke pushing, until coke quenching.

Emissions of dust should be prevented by minimising charging emissions (cf. Table 3), by sealing the openings efficiently and good maintenance, by minimising leakage between coke oven chamber and heating chamber and especially by using de-dusting of coke pushing. Dust in the waste gas from coke oven underfiring can be removed by means of fabric filters or ESP [2] [3].

Table 3 Emission sources and selected BAT dust control measures with associated emission levels in coke ovens

Emission source	Combination of control measures	Dust emission level associated with BAT¹ mg/Nm³ or (kg/tonne) [2]
Charging	"smokeless" charging or sequential charging with double ascension pipes or jumper pipes are the preferred; efficient evacuation and subsequent combustion and fabric filtration	(< 5 g/t coke)
Pushing	Extraction with an (integrated) hood on coke transfer machine and land-based extraction gas treatment with fabric filter and usage of one point quenching car	(< 5 g/t coke (stack emissions))
Quenching	Wet quenching	(< 50 g/t Coke)
	Coke dry quenching (CDQ)	< 5 mg/m ³ (< 6-12 g/t Coke)
¹ The BAT associated emission levels may be expected to be achieved over a substantial period of time at standard conditions and represents a typical load situation. For peak load, start up and shut down periods, as well as for operational problems of the flue gas cleaning systems, short-term peak values, which could be higher, have to be regarded.		

7.6.4 Emerging techniques

Due to high costs and environmental impacts from coke use, 'direct' and 'smelting reduction' processes may replace the blast furnace route and hence make coke production unnecessary [2].

So-called super coke ovens aim at, amongst others, reduced NO_x and dust emissions.

7.6.5 References used in chapter 7.6

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- [1] Technical background documents for the actualisation and assessment of UN/ECE protocols related to the abatement of the Transboundary Transport of nitrogen oxides from stationary sources, DFIU, 1999
 - [2] European commission: Best Available Techniques Reference Document on the Production of Iron and Steel, December 2001
 - [3] European commission: Best Available Techniques Reference Document on the Production of Iron and Steel, Draft February 2008