

**030301****Sinter plants***Process description*

By sintering, the pelletisation of fine-grained, smeltable ores, iron ore in particular, to compact lumps by heating nearly to the melting or softening point is understood. Melting tendencies at the grain boundaries lead to a caking of the material.

Before the sintering, the various substances are first mixed and, if desired, granulated. The iron ores are agglomerated on conveyor sinter installations, the conveyor belts consist of a large number of waggons. These waggons that have been linked up as an endless conveyor belt which can be as big as 4 m in width and 100 m in length. The fine ore to be sintered is moistened and fed on to the circulating grid together with coke slack and additions such as limestone, quick lime, olivine or dolomite. Burners above a heat-resistant grate belt heat the material to the required temperature (1100-1200 °C). This causes the fuel in the mixture to be ignited. The carbon burns with the aid of the air sucked through the grid into the mixture, resulting in the flame front being moved through the sintering bed. The sintering processes are completed once the flame front has passed through the entire mixed layer and all fuel has been burnt.

Chlorine compounds can enter into the sinter installation by means of the additive cokes slack as well by the ore from its natural chloride contents. Furthermore, returned materials such as certain filter particles, scale and sludges from waste water treatment, which are added to the materials to be sintered, which can also increase the chlorine content of the substances used. This is reflected in the waste gases from sinter installations which contain inorganic gaseous chlorine compounds.

*Abatement technologies:*

Cleaning of the flue gases generated during the process is done in different ways: sometimes dedusting (cyclone or fabric filter) suffices; sometimes the flue gases are

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cleaned by a wet scrubber. The way of cleaning depends on the circumstances and the nature of the emissions (and on the substances to be sintered). With respect to the reduction of dioxin emissions special abatement techniques are currently being tested in Austria and Germany. The „Airfine“ technology used at the plant located in Linz, Austria consists of a high performance wet scrubbing system <sup>1</sup> leading to flue gas concentrations between 0.2 and 0.5 ng I-TEQ/m<sup>3</sup>. In Bremen, Germany the flue gas is split into parallel flows each being treated with adsorbent injection <sup>2</sup> as known from abatement measures installed at municipal waste incinerators. Concentrations below 0.1 ng I-TEQ/m<sup>3</sup> could be achieved occasionally.

#### *Plant data/European situation*

Most of the integrated steel works operated in Europe also have sinter plants (with a few exceptions that use pelletising plants or produce steel only from scrap material). A complete plant list could be obtained from the German Association of Steel Producers (VDEH) <sup>3</sup>; according to these data 47 sintering bands are operated at 33 different locations. Their total nominal capacity results to be nearly 125,000 kt/a (see 030301—Table 2) with the real production typically being about 60 - 80 % of this value.

A small sintering plant located in Duisburg, Germany is not mentioned in the list because it does use recycled materials from steel production (e.g. filter dust) or other iron containing waste materials instead of iron ores; however, the sinter produced mainly goes back into the iron and steel industry with a smaller fraction also being processed by non-ferrous metal industries.

The plants located in Luxemburg are to be closed in the near future (or already have been shut down).

#### *Activity data*

Activity data (shown in 030301—Table 2) were taken from the national inventories (Belgium, Germany and United Kingdom) and from annual production statistics. The

slight differences between the values reported for Belgium and UK are due to different basic years.

Five countries do not have any sinter plants (Switzerland, Denmark, Greece, Ireland and Norway) and subsequently were not regarded in this chapter.

#### *Emission factors*

Emission factors for sinter plants as reported by the national dioxin inventories are shown in 030301—Table 4. They had been gained either by special measurement programs or by adoption of literature data. The PCDD/F emissions of sinter plants were the subject of several scientific studies performed in the recent past. A broad range of flue gas concentrations and emission factors was found depending on the operation conditions of the sinter plants. In German publications two different emission factors are presented one referring to hot crushing and sieving of the sinter material and the other referring to stack emissions of the sintering process.

From these studies the following mean emission factors were derived to be used for emission estimations:

<b>Mean emission factors</b>	<b>[µg I-TEQ/t]</b>
arithm. mean of values for sintering process	7.01
estimate for hot sieving and crushing	1
overall estimate incl. fugitive emissions	10

**030301—Table 1 Mean emission factors for sinter plants [µg I-TEQ/t]**

It should be mentioned that a factor considerably above these values (nearly 100 µg I-TEQ/t) was found at one occasion in Germany <4 > .

#### *Emission estimation*

On the basis of the mean emission factors for the sintering process and hot sieving and crushing standardised annual PCDD/F emissions were derived (030301—Table 4). The sum of these two values gives the emissions of the overall process.

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*Conclusions/recommendations*

Obviously sinter plants belong to the most important dioxin sources in Europe. Due to measurement results from sinter plants the dioxin emissions are rather well known in some European countries, e. g. Germany, The Netherlands, United Kingdom. By contrast almost no information exists about the emissions from the facilities located in other countries, the main producers being located in Belgium, Spain, France and Italy.

The annual PCDD/F emissions have been calculated provided that the measurement results are valid for all plants in Europe. It should be stressed, that this assumption cannot be verified by consideration and comparison of process conditions since it had been shown that apparently similar processes may lead to very different emissions. Hence the estimate given here may be associated with considerable uncertainty; thus it is recommended to perform measurements on all or at least some additional plants in the countries mentioned before.

<b>Country</b>	<b>nominal capacity</b>	<b>national Inventory</b>	<b>annual production &lt;5&gt;</b>
<b>A</b>	3,400		2,720
<b>B</b>	14,146	10,630	9,828
<b>CH</b>			nr
<b>D</b>	29,940	25,451	25,451
<b>Dk</b>			nr
<b>E</b>	8,174		6,200
<b>F</b>	22,415		18,385
<b>GR</b>			nr
<b>I</b>	18,570		12,800
<b>IRL</b>			nr
<b>L</b>	5,700		4,600
<b>N</b>			nr
<b>NL</b>	4,000		4,143
<b>P</b>	480		400
<b>S</b>	1,200		960
<b>SF</b>	2,400		1,920
<b>UK</b>	14,010	15,096	13,602
<b>SUM</b>	124,435		98,289

**030301—Table 2 Activity rates related to annual sinter production [kt/a];  
nr: not relevant**

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	Flue gas conc. [ng I-TEQ/m <sup>3</sup> ]			Emission factors [µg/t]			Remark
	typ	min	max	typ	min	max	
<b>A</b>		0.20	2.50	2.35			lower EF corresponds to plant with high performance wet scrubber "Airfine"
<b>B</b>				5.00	1.50	50.00	EF refers to data from S, NL and D
<b>CH</b>							no sinter plant
<b>D</b>	0.08	0.11	0.62		0.88	0.89	refers to hot crushing and sieving
<b>D</b>	6.00	0.80	14.10	5.90	1.30	27.70	stack emission from sintering process; maximum concentration observed at one
<b>DK</b>							no sinter plant
<b>E</b>				6.00			acc. to information obtained from TNO
<b>F</b>				18.00	10.00	100.00	EFs estimated from German results
<b>GR</b>							no sinter plant
<b>I</b>							no data obtained
<b>IRL</b>							no sinter plant
<b>L</b>							sinter plant to be closed down; emissions inofficially reported to be in the "normal" range
<b>N</b>							no sinter plant
<b>NL</b>		4.50	6.80	13.86	11.30	17.00	
<b>P</b>							
<b>S</b>	0.86	0.46	1.30	1.67	1.00	2.80	NTEQ; sinter plant to be closed down in 1995
<b>SF</b>							
<b>UK</b>		0.60	3.40	3.29	1.20	9.00	Emission calculated from measured concentrations., spec. flew gas volumes and
				<b>7.01</b>			<b>chosen arithm. mean of values for sintering process</b>
				<b>1</b>			<b>estimated for hot sieving/crushing</b>
				<b>10</b>			<b>overall estimate incl. fugitive emissions</b>

030301—Table 3 PCDD/F air emission factors for sinter plants from the national dioxin inventories

<b>Country</b>	<b>sintering process</b>	<b>hot sieving/crushing</b>	<b>overall process</b>
<b>A</b>	19.1	2.7	27.2
<b>B</b>	68.9	9.8	98.3
<b>CH</b>			
<b>D</b>	178.4	25.5	254.5
<b>Dk</b>			
<b>E</b>	43.5	6.2	62.0
<b>F</b>	128.9	18.4	183.9
<b>GR</b>			
<b>I</b>	89.7	12.8	128.0
<b>IRL</b>			
<b>L</b>	32.2	4.6	46.0
<b>N</b>			
<b>NL</b>	29.0	4.1	41.4
<b>P</b>	2.8	0.4	4.0
<b>S</b>	6.7	1.0	9.6
<b>SF</b>	13.5	1.9	19.2
<b>UK</b>	95.3	13.6	136.0
<b>SUM</b>	<b>708</b>	<b>101</b>	<b>1010</b>

030301—Table 4 Comparison of PCDD/F air emission estimates [g I-TEQ/a] for sinter plants

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References to 030301

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- 3 Data bank "plantfacts".VDEH, Düsseldorf
- 4 Bröker G., Bruckmann P., Geueke K.-J., Hiester E., Hoffmann , Radermacher L., Gliwa H. (1995) : Abschlußbericht der Projektgruppe 'Dioxinmeßprogramm Nordrhein-Westfalen". Landesumweltamt Nordrhein-Westfalen (Ed.) 102 p.
- 5 Wirtschaftsvereinigung Stahl (Ed.): Statistisches Jahrbuch der Stahlindustrie 1995. Verlag Stahleisen GmbH, Düsseldorf, 360