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SOURCES OF EMISSIONS IN THE SINTERING AND BLAST FURNACE PLANT

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ABSTRACT

The main technological operations for producing the sinter used for preparing the hot metal in the furnace are: preparation and transport of raw materials used for producing the sinter (transport, storage, crushing, sorting ore and coke); sintering the raw materials during the sintering tape preparation (cooling, smashing, sorting) and transport of the sinter.

KEYWORDS: blast furnace, sintering, pollutants emission

These operations are the sources of emission of pollutants into the atmosphere, and they appear like: dust, heavy metals in dust, CO emissions, CO_2, NOx, SO_2, COV.

Table 1. *Emission factors*

Emission type	Value
	gram/tone liquid steel
Dust	170-280[2]
Cd	0.002-0.04[3]
Cr	0.005-0.05[3]
Cu	0.007-0.16[3]
Hg	16-149.....
Mn	0.02-0.4[3]
Ni	0.002-0.04[3]
Pb	0.04-7[3]
Tl	0.005-0.03[3]
V	0.005-0.02
Zn	0.002-1.8[3]
HCl	17-65
HF	1.4-3.5
NOx	440-710
SO2	900-1850
CO	13-43

The emission level of the pollutants in the sintering plant varies as: fine dust (after purifying in electro filters): 100-150mg/m³; Heavy metals from dust emissions. Gas emissions: SO_2: 400-1000mg/Nm³ for coke between 5 – 6mm; 800mg/Nm³ for 1mm coke; 500mg/Nm³ for 6 mm coke; NO_x: 200-310mg/Nm³ (values up to 700mg/Nm³ depending of the nitrogen composites in the fuel; Fluoride: 0.6-1.5mg/Nm³; Hydrocarbons (methane, olefins, aliphatic compounds, phenols, aromatic compounds): 49-105mg C/Nm³ (for 11 determinations) and 20 – 90mg C/Nm³ (for 32 determinations); PCDD/F: 0.5 – 5ng I-TEQ/Nm³ (after purifying).

Gas emissions: Pb:≤70mg/Nm³; Hg: 15-54μg/Nm³ (Electro filter purifying system + wet purifying) depending on the content of Hg in ore; Zn: 50mg/Nm³, before the purifying, lower values after treatment. The specific technological operations in the blast furnace hot metal production are: Preheating the air used for blowing through the openings of the furnace with the cowpers; preparation, dispensing, transport and load of raw materials in the furnace; Removal of the hot metal from the furnace and its pouring into hot metal ladle; Blast furnace slag processing to be converted into granulated slag.

These operations are the source of emission of pollutants into the atmosphere, as shown in the diagram in Table 2.

Table 2. *Specific emission factors used for preparing hot metal*

Pollutant type	Value
	gram / tone liquid steel
Dust	10-50
Mn	< 0.01-0.13
Ni	< 0.01-0.02
Pb	< 0.01-0.12
SO2	20-230
Nox	30-120
H2S	0.2-20
CO	770-1750
CO2	280-500
PCDD/F	< 0.001-0.004

The emission level of pollutants in the hot metal making plant varies as follows:

- at the cowpers: dust: < de 10mg/Nm³; SO2: 160-400mg/Nm³ (for increased gas furnace); NOx: 70-400mg/Nm³; CO: up to 2500mg/Nm³ (internal combustors); 50mg/Nm³ for controlled burning (external combustors);
- at the hot metal casting sector; dust: < 10mg/Nm³;
- the burning blast furnace gas in coke ovens and cowpers: dates are presented in Table 3.

The particulate matter is the main pollutant with negative effects on human health and ecosystems that are released into the atmosphere by Arcelor Mittal S.A. The worst daily concentration can reach a maximum of 136µg/m in the South East Region of the plant and decreases to values of 30µg/m³ nearby Sendreni village, to 16µg/m³ values in the Vânători village and under 20µg/m³ in the Galati city.

Within the plant there are increases of the dust concentration, comparing with the daily concentration of 75µg/m³.

The average daily weight contamination of the atmosphere on the surface equipment in the Sintering and Blast Furnace Plant is 58.01%.

Table 3. *The emission levels of pollutants in making hot metal*

Pollutants	Emission levels	
	Before treatment	**After treatment**
Dust	3500 – 30 000 mg/Nm³	1 – 10 mg/Nm³
Hydrocarbons	67 – 250 mg/Nm³	There is no information
Cyanides	0.26 – 1 mg/Nm³	There is no information
Ammonia	10 – 40 mg/Nm³	There is no information
HAP: - benzopyren - fluoranten	0.08 – 0.28 mg/Nm³ 0.15 – 0.56 mg/Nm³	There is no information
CO	20 – 28%	20 – 28%
CO2	17 – 25%	17 – 25%
H2	1 – 5%	1 – 5%
H2S	There is no information	14 mg/Nm³
Mn	There is no information	0.10 – 0.29 mg/Nm³
Pb	There is no information	0.01 – 0.05 mg/Nm³
Zn	There is no information	0.03 – 0.17 mg/Nm³

The annual concentration in the worst situation reaches a maximum of 79.5 mg / m³ within the plant in a single point, and decreases to values of 15µg/m³ in the Sendreni village area and lower values of 3µg/m³ in the Vânători village and in Galati city.

The annual average concentration of 60µg/m³ is found in excess only within the plant.

These values are lower than those obtained by emission measurements made at points outside the plant, that show concentrations of particulate matter of 52µg/m³ in 2007 and 56µg/m³ in 2008.

The average annual weight contamination of the atmosphere on the surface equipment in the Sintering and Blast Furnace Plant is 77.25%.

The Sulfur dioxide (SO_2)

The hourly concentration in the worst situation reaches a maximum of 348µg/m³ within the plant, and decreases to values of 170µg/m³ in the Vanatori village and in Sendreni village and below 130µg/m³ in Galati city area. If we take into account the average annual concentration of 350µg/m³, we found that there are no exceeds neither within the plant nor in the plant neighboring areas.

The average hourly weight contamination of the atmosphere on the surface of the equipment in the Sintering and Blast Furnace Plant is 35.80%.

The daily concentration in the worst situation reaches a maximum of 103µg / m³ in the north west of the plant and decreases to values of 35µg/m³ in the Sendreni village and below 30µg / m³ in the Vânători village and in Galati city.

If we take into account the average daily concentration of 125µg/m³, provided by Order 592/2002 of MAPN, we found that there are no exceeds neither within the plant nor in the plant neighboring areas. The average daily weight contamination of the atmosphere on the surface of the equipment in the Sintering and Blast Furnace Plant is 32.36%. The annual concentration in the worst situation reaches a maximum of 34µg/m³ in the plant, and decreases to values of 6µg/m³ in the Sendreni village and below 2µg/m³ in the Vânători village and in Galati city.

The average annual weight contamination of the atmosphere on the surface of the equipment in the Sintering and Blast Furnace Plant is 27.18%.

The nitrogen dioxide (NO_2)

The hourly concentration in the worst situation reaches a maximum of 283µg/m³, within the plant, and decreases to values of 170µg/m³in the Sendreni village and at 130µg / m³ in the Vanatori village and less than 120µg/m³ in Galati city. If we take into account the average daily concentration of 300µg/m³ we found that there are no exceeds neither within the plant nor in the plant neighboring areas. The average hourly weight contamination of the atmosphere on the surface of the equipment in the Sintering and Blast Furnace Plant is 11.67%. The annual concentration reaches a maximum of 16.7 mg/m³ in the plant, and decreases to values of 2µg / m³ in the Sendreni village and lower values than 2µg / m³ in the Vanatori village and in Galati. If we take into account the average daily concentration of 60µg/m³ we found that there are no exceeds neither within the plant nor in the plant neighboring areas. The annual values obtained by modeling the dispersion of NO_2 emissions are comparable to those measured by DJSP Galati in 2007 and 2008 (average values of 4.3 and 4.0 mg / m³). Regarding the average annual values of NO_2 indicator determined by IPM Galati at Fileşti Railway in 2008 (24.97 mg / m³) the maximum annual value calculated using the dispersion program (16.7 mg / m³) is lower, because in the values measured by IPM Galati we found also NO_2 emissions from urban traffic. The average annual weight contamination of the atmosphere on the surface of the equipment in the Sintering and Blast Furnace Plant is 25.98%.

The Carbon monoxide (CO)

The carbon monoxide appears in the technological processes that occur at Arcelor Mittal from incomplete combustion processes in heating ovens and heat treatment at the sintering process and coke batteries. The hourly concentration reaches a maximum of 0.5mg/m³ within the plant, and decreases to values of 0.26 mg/m³ in the Sendreni village, at 0.24mg/ m³ in the Vanatori village and lower than 0.2mg/m³ in Galati city. It appears that these values are lower than those provided by the law, but by simulating at the various levels from the ground, significant variations in the concentrations have been found, so that at heights over 20m the calculated values are approaching the limit values. Thus employees that are working at heights greater than 20 m are more exposed to CO poisoning than those working at ground level. The average hourly weight contamination of the atmosphere on the surface of the equipment in the Sintering and Blast Furnace Plant is 37.79%.

Conclusions

The specific emission levels of pollutants in the sintering and blast furnace plant reported in tones of liquid steel are within the limits obtained by the EU countries, but towards the upper limit, which demonstrates the need for further concern for improving environmental performance through implementation of appropriate measures.

The prevention solutions - reduction and control / remedial analyzed and selected for testing / implementation in the Sintering and Blast Furnaces plant from Arcelor Mittal are grouped as follows:

- implemented solutions:
- tested solutions to implement:
- solutions that are not of interest at this stage:

The measurements of air pollutants took into consideration:

- characterization of a reference state in terms of environmental pollution and the contribution of manufacturing sinter sector and hot metal making at the pollution from Arcelor Mittal Galati platform, based on data reported in 2007
- the characterization of the current level of pollution of this sector compared to the previous stage.

The measurements results in October 2008 compared with the measurements from previous years at the controlled sources of the sintering machines and cowpers from furnaces in operation have shown the efficient measures assumed, they show the reducing of the contents of NO_x and CO from the sintering machines and the of maintaining same high values of CO at the furnaces cowpers 4 and 5. The contribution of the sinter manufacturing sector and hot metal making to pollution made by Arcelor Mittal Galati, expressed by weight average surface considered, on types of pollutants is:

Particulate matter: 58.01% (daily concentration) and 77.25% (annual concentration); SO_2: 35.80% (hourly concentration), 32.36% (daily concentration) and 27.18% (annual concentration); NO_2: 11.67% (hourly concentration), 25.98% (annual concentration); SO: 37.79% (hourly concentration).

This contribution is particularly important at the emission of particulate matter, when the gas emissions values are about one third of total emissions from the entire plant (for SO_2 and CO). However, the highly toxic pollutants were not monitored (VOC, PAH, benzopyrene, etc.) and therefore were not taken into consideration although they cause major environmental impact.

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