AIR QUALITY IMPACT ASSESSMENT RELATED TO SOME TECHNOLOGICAL IMPROVEMENTS IN A ROMANIAN IRON AND STEEL PLANT

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INTRODUCTION

Romanian iron and steel industry use, handle, store or undertake important amounts of raw materials, fuels, energy, gases, wastewaters and different types of wastes. In iron and steel plants, raw materials under high temperature and pressure are processed, therefore being used big amounts of fuels and energy. These activities have a significant environmental impact, important amounts of pollutant gases, wastewaters and wastes being produced therefore.

Currently, many Romanian iron and steel plants needs technological improvements imposed both by the necessity to raise the final products quality, and to fulfill the environmental requirements. This should be in line with European environmental standards, taking into account that Romania is now in the EU accesion process.

In 2002, based on environmental balance, a Romanian Iron and Steel Plant, namely Special Alloy Steel Plant (COS) Targoviste, requested to the Agency for Environmental Protection Targoviste, to release them the Environmental Permit. Environmental Balance was accompanied by the Conformity Program for the period 2005 – 2007, which foreseen the actions for modernization, in order to fulfill the environmental requirements, according to the national legislation.

One of these is referred to the gas cleaning modernization of the equipments of the Electric Arc Furnace (EAF) no. 3 for 10 t and of the Ladle Furnace (LF) for 12 t, from Melting Shop no.1 (OE1), having a deadline to be set working the forth trimester of 2004. Another action foreseen in the above mentioned Program, was the modernization of the gas cleaning equipments of the Electric Arc Furnace no.7 and of the Ladle Furnace no.2 (LF2) from Melting Shop no.2 (OE2), with deadline fourth trimester of 2006. The completion of dust retaining equipment from EBT Furnace with an filtering – cleaning installation, deadline fourth trimester of 2007, is another target as well.

These modernizations, together with some others, foreseen in the Conformity Plan should ensure the reduction of emissions from COS Targoviste and their setting into the limits imposed by Romanian legislation.

Taking into account the trend of the thresholds (in the sense of their reduction) for the PM_{10} in the period 2005 – 2007, according to the Romanian Governmental Ordinance no. 592 / 2002, this Program has to be reanalyzed.

In this respect, within this paper are analyzed four working scenarios for various types of modernization of the equipments mentioned from OE1 and OE2 and the imissions produced in each case.

First scenario analyzed, corresponds to the current situation, in which the cleaning – retaining equipments cannot ensure the conformity with BAT (IPPC) limits.

The second scenario, is that one corresponding to the Conformity Program. This foreseen that until the end of forth trimester 2004, the EAF no. 3 and the LF from OE1 will be upgrated. In this case, EAF no. 7 and LF2 and EBT Furnace and LF no. 1 remain in the current status.

Third scenario corresponds to the existence of filtering – cleaning installation for EBT & LF1, in order to achieve the BAT requirements, till the end of 2004. In this case, EAF no. 7 and LF2 remain unused, and EAF no. 3 and LF from OE1 remain in the current status.

The fourth scenario analyzed takes into account the upgrading until 2007 of the both furnaces (EAF no. 3 & LF, EBT & LF) with equipments, which has to ensure the complete fulfillment of BAT requirements (but in 2004 the both furnaces remain in the current status).

METHODOLOGY APPROACH

The methodology to assess the environmental impact in each of the four scenarios consists in the calculation and the visualization of the imissions resulted from these sources, in the nearly area of the plant, through mathematical modeling of the pollutant dispersion.

Dispersion modelling of the pollutants released has been realized based on ISC3 model (Industrial Source Complex – 3), using ISC – AERMOD Software.

For the atmospheric dispersion modelling of the TSP has been considered three point sources and two volume sources, distributed as following:

- a point source (S_1) corresponding to the no. 3 furnace and the LF from OE1;
- a point source (S_2) corresponding to the EBT furnace and the LF1 from OE2;
- a point source (S_3) corresponding to the no. 7 furnace from OE2;
- a volume source (S_4) corresponding to the emissions from OE2;
- a volume source (S_5) corresponding to the emissions from OE1.

In the tables 1 and 2 are showed sources parameters in all four scenarios.

Table 1. Point sources parameters

Scenario	Source	Emission rate[1] (g/s)	Variable emission rate	Stack height (m)	Stack inside diameter (m)	Stack gas exit velocity (m/s)	Stack gas exit temp. (K)
I	S1	0.740	Yes	33	1.30	6.80	338
	S2	3.310	Yes	30	3.79	7.60	338
	S3	21.160	Yes	50	4.00	4.00	343
II	S1	0.148	No	33	1.30	6.80	338
	S2	3.310	Yes	30	3.79	7.60	338
	S3	21.160	Yes	50	4.00	4.00	343
III	S1	0.740	Yes	33	1.30	6.80	338
	S2	2.580	No	30	3.79	7.60	338
	-	-		-	-	-	-
IV	S1	0.148	No	33	1.30	6.80	338
	S2	2.580	No	30	3.79	7.60	338
	-			-	-	-	-

1) The reference parameter for variable emissions rate value

Table 2. Volume sources parameters

Scenario	Source	Emission rate (g/s)	Source center height (m)	Equivalent lenght of side (m)
I	S4	40.13	19.00	187
	S5	0.87	12.50	134
	S4	40.13	19.00	187

II	S5	-	-	-
III	S4	-	-	-
	S5	0.87	12.50	134
IV	S4	-	-	-
	S5	-	-	-

The surface used for dispersion modeling is 70 km^2 (7 km on Ox axis and 10 km on Oy axis), the plant is being situated in the center of this. A non-uniform cartesian receptors grid was set up in. The grid is constituted by 134 receptors placed on the two directions (X, Y) of the surface, including Targoviste city.

RESULTS ACHIEVED

The results obtained from the dispersion modelling ISC3, consist in maps, in which are presented the iso-concentration curves and in reports with imission concentrations values in the network points receptors established before.

The TSP concentration has been calculated for a period of time of 24 hours (*daily*) and *annual*, according to the Governmental Ordinance no. 592/2002.

The program calculates *the hourly concentrations of TSP* in the network points receptors, and then a mediation for the established period (*daily* and *annual*) are obtained.

Then, the results obtained by the dispersion modelling of the TSP, for the four scenarios, have been analyzed

In the first scenario, the maximum concentration amount is 2121 μg/Nm^3 around the sources, and decrease until the 2 – 5 μg/Nm^3 in the extreme area of the receptors network in N - NW direction. A detailed analysis, imposed by the large number of the concentration values, is presented bellow (table 3).

Table 3. Frequencies distribution for each bin, on the whole area

Bin μg/Nm^3	Frequency	Percentage %
< 40	123	86.01
40 - 60	10	7.00
60 - 120	8	5.59
120 - 180	0	0.00
180 - 240	0	0.00
> 240	2	1.40

It can be observed that the values under 60 μg/Nm^3 (set in the limits foreseen for PM_{10} in Ordinance 592/2002) appear in 93.01 % from the total network points. The limit values are exceeded only in 10 network points, the majority inside the plant.

For the second scenario, the maximum concentration value is 2100 μg/Nm^3 around the sources, and decrease until the 2 – 5 μg/Nm^3 in the extreme area of the receptors network in N - NW direction.A detailed analyze, imposed by the large number of the concentration values, is presented bellow (table 4).

Table 4. Frequencies distribution for each bin, on the whole area

Bin, µg/Nm^3	Frequency	Percentage %
< 40	126	88.11
40 - 60	7	4.90
60 - 120	8	5.59
120 - 180	0	0.00
180 - 240	0	0.00
> 240	2	1.40

It can be observed that the value under 60 µg/Nm^3 (set in the limits foreseen for PM_{10} in Ordinance 592/2002) appears in 93.01 % from the total network points.
The figure 1.a shows the imissions map for the *daily concentrations*. The limit values are exceeded only in 10 network points, the majority inside the plant.

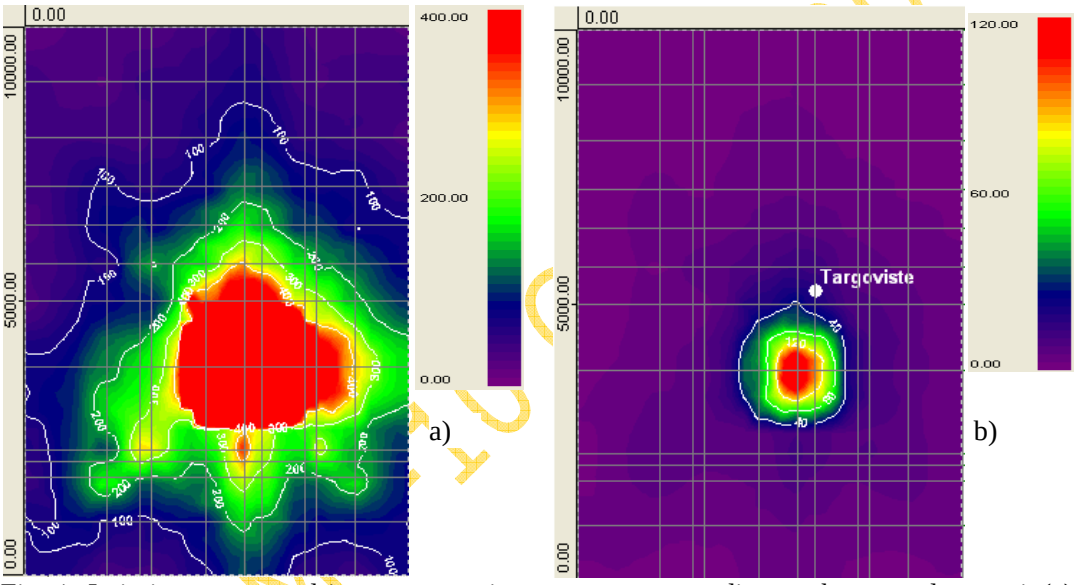

Fig. 1; Imissions maps and iso-concentration curves coresponding to the second scenario(a) and third scenario (b)

Even for the daily fluctuation, the maximum concentrations of TSP have very big amounts, according with above explanations, for the annual fluctuation the limit values exceeds only in a few points, showing that daily big amounts have rarely been achieved, only in extreme meteorological conditions (like in 23 of January 2003).
There is no exceedings of the limit values for Targoviste town area and for other sites arround the plant.

In the third scenario, the maximum amount of the concentration is 38.87 µg/Nm^3 around the sources, and decreases until 0.1 – 0.3 µg/Nm^3 in the extreme area of the receptors network in the N - NW direction. In the figure 1.b is presented the imissions map for the daily concentrations in this case. These values are settled in the limits for PM_{10} in Ordinance 592/2002 in the all receptors network points.
There is no exceedings of the limit values for Targoviste town area and for other sites around the plant.

For the fourth scenario, the maximum amount of the concentration is 22.16 μg/Nm^3 around the sources, and decreases until 0.04 – 0.05 μg/Nm^3 in the extreme area of the receptors network in the N - NW direction. These values are settled in the limits for PM_{10} in Ordinance 592/2002 in the all receptors network points.
There is no excedeengs of the limit values for Targoviste town area and for other sites around the plant after 2007.

CONCLUSIONS

To quantify the differences between the four scenarios, percentage comparisons has been produced in each receptors network point for daily and annual concentrations.
The results of these comparisons are presented in the table no. 5.

Table 5. The comparasons results between the imission concentrations amounts in the case of the four scenarious

Scenario	Maximum daily concentration (μg/Nm^3)		Daily limit value (μg/m^3)	Maximum annual concentration (μg/Nm^3)		Annual limit value (μg/m^3)	Daily imissions reduction comparing with first scenario, (%)
	Network	Targoviste		Network	Targoviste		
I	12407	642.22	75	2121.00	49.86	60	-
II	12372	627.71	75	2100.00	48.36	60	2.32
III	241	27.64	75	38.87	2.44	60	95.71
IV	155	10.75	60	22.16	0.78	40	98.19

It can be observed that the imission values obtained in the second scenario cannot ensure the seting of COS Targoviste in the limits imposed by the European and national legislation, including the Governmental Ordinance 592/2002. *In the third scenario the seting in limits, in whole the period after 2005 (2007 including) will be ensured*, while in the fourth scenario as only after 2007 the environmental requirements will be accomplished.

Taking into account the specific meteorological conditions for the Targoviste area (low wind speed, low mixing high and a very stable atmospheric conditions, in many days of the year), it has been proposed the increasing of the height of the stack from OE1 and OE2.

Based on the results of this analisys, it has been proposed by COS Targoviste and approved by the Environmental Agency of Targoviste, to apply the modernization option coresponding to the third scenario and the changing of the Conformity Plan accordingly.

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