POLLUTION EMISSIONS RESULTING FROM COAL BURNING

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Abstract: *The paper presents a case study on the pollutant emissions from coal burning at the Mintia Thermal Power Plant. The Mintia Thermal Power Plant is a Romanian electric and thermal energy producer. The power plant consists of three large combustion plants that run on solid fuel (coal) natural gas or fuel oil. The emission of pollutants into the atmosphere is made by three chimneys with a height of 220 m. The plant has been included in the National Transition Plan on Industrial Emissions for the period 2016-2020.*

Keywords: **coal, SO_2, NOx, dust, desulphurization, electro filters**.

1. INTRODUCTION

The Mintia Thermal Power Plant produces electricity and thermal energy for urban consumers in Deva municipality.

The energy groups of the plant work with coal (pit coal), natural gas and fuel oil. The plant consists of three Large Combustion Plants (LCP).

Fig.1 Mintia Thermal Power Plant

LCP no 1 has a thermal power installed of 528 MWt and is designed to work with coal and natural gas or fuel oil;

LCP no 2 has a thermal power installed 1.056 MW_t and is designed to work with pit coal and natural gas or fuel oil;

LCP no 3 has a thermal power installed 1.056 MW_t and is designed to work with pit coal and natural gas or fuel oil;

In the National Transition Plan on Industrial Emissions for the period 01.01.2016 ÷ 30.06.2020, plan adopted by the European Commission, for the Large Combustion Plants, the following compliance deadlines are set:

- 31.12.2018, for LCP no 2 ;

- 30.06.2020, for LCP no 3 .

The emission limit values set out in Directive 2010/75 / EU starting from 1 July 2020 by implementing the necessary measures for the period 1 January 2016 to 30 June 2020 are:
- for the pollutant SO_2 – 200 mg/Nm^3;
- for the pollutant NO_X – 200 mg/Nm^3;
- for the pollutant dusts - 20 mg/Nm^3.

2. MEASURMENTS

The boilers of the energetic group CTE Mintia have a steam output of 660 t / h at live steam parameters of 140 bar at 540 ºC and 24,4 bar at 540 ºC for the intermediate overheated steam.

The solid fuel (base) is burned in a sprayed form. The preparation of coal dust is done with 8 mills for each energy group.

The gas burner and the pulverized coal burner form a unitary construction.

The coal deposit has a capacity of 552.000 tons.

The oil fuel is used to start the boilers and to ensure the stability of the fire.

The air required for combustion is provided by 2 fans for each energy group. Each energy group is provided with 2 air recirculation fans.

The flue gas circulation is carried out with 2 gas fans for each energy group. Evacuation of the slag from the boiler furnace is made in a solid state with the help of the slag conveyors. Fly ash is retained in electro filters. Each energy group consists of 2 electro filters.

The amount of slag and ash hydraulically evacuated in the plant during one year is 1,4 million tones.

Nominal operating parameters of the steam boiler

- Steam flow:	660 t/h;
- Primary steam pressure:	140 bar;
- Steam temperature:	540 ºC;
- Supply water temperature:	240 ºC;
- Minimum steam flow to combustion on mixed coal:	400 t/h;
- Boiler efficiency:	91 %;
- Temperature of the mixture air – dust:	110ºC;
- Depression in fire core:	- 4 ¸ - 6 mm CA;
- Flue gas temperature at the boiler exit:	150ºC;
- Lower calorific power of the coal:	3.740 kcal/kg.

The gases produced by the combustion of coal are discharged into the environment by means of three chimneys with a height of 220 m and a peak diameter of 6.4 m. The retention of ash dust in the combustion gases is carried out in electro filters.

The solid fuel used is the coal of the Jiu Valley (pit coal) with a lower calorific value of 3150 ÷ 3800 kcal / kg and the imported pit coal with a lower calorific value of 4500 ÷ 6000 kcal / kg.

Elemental analysis at the initial state of the pit coal:

Pit coal from Jiu Valley:

C^i = 33,0 %;
H^i = 2,5 %;
S^i_c = 0,67 %;
O^i = 14,8 %;
N^i = 0,62 %;
A^i = 44,1 %;
W^i_t = 5,41 %.

Imported pit coal:

C^i = 65 %;
H^i = 3,4 %;
S^i_c = 0,48 %;
O^i = 8,6 %;
N^i = 1,60 %;
A^i = 13,2 %;
W^i_t = 5,77 %.

Emissions monitoring system (SO_2, NO_x, CO, O_2) and of flows are made up of:

- gaseous oxygen and emissions analyzers
- the exhaust gas sampling probe from the chimney
- low rate probe
- temperature and absolute pressure measuring probes

The chemical composition of ash and slag in the deposit on the main constituents is the following:

SiO_2=51,5 %
TiO_2 = 0,9 %
Al_2O_3 =27,00 %
Na_2O = 0,76 %
Fe_2O_3 = 9,9 %
K_2O = 2,1 %
CaO= 6,4%
SO_3= 0,9%
MgO= 1,5%

In Table 1 are presented the quantities of pollutants discharged on the chimneys of the thermal plant during 2012 -2017

Table 1

Year	Emissions of pollutants (tons)		
	SO_2	NO_x	Dusts
2012	22200	8500	4300
2013	21200	8100	3900
2014	14300	6700	3300
2015	10200	3800	2100
2016	11100	3900	2200
2017	10300	3700	1600

Table 2 presents the emission ceilings according to the National Transition Plan for the period 2016-2020.

Table 2

Individual contributions to target emissions (TONs)						
LCP	Pollutant emissions	**2016**	**2017**	**2018**	**2019**	**30.06.2020**
LCP no 2	SO_2	1797	1500	1201	908	452
	NO_x	1004	980	963	941	470
	Dusts	225	184	137	90	47
LCP no 3	SO_2	2063	1773	1381	1042	522
	NO_x	1165	1136	1115	1090	55
	Dusts	260	208	158	102	54

3. CONCLUSIONS

The Mintia Thermal Power Plant, a component of the Hunedoara Energy Complex, must apply the necessary technical measures to meet the emission ceilings of the National Transition Plan for the period 2016-2020.

In order to reduce dust emissions, work on the modernization of electro filters should be continued to increase the efficiency of:

- use of efficient emission electrodes
- increasing the number of electric fields
- increasing the step between the electrodes.

Reduction of the SO_2 emissions can be achieved by applying wet flue gas desulphurization technology by using limestone as a desulphurization additive. The final reaction product (the limestone) can be exploited in the construction materials industry.

The reduction of NOx emissions will be achieved by the use of primary and secondary nitrogen reduction from flue gas measures:

- the use of burners with low NOx and the organization of staged burning at the boiler's furnace
- applying the selective catalytic reduction method .

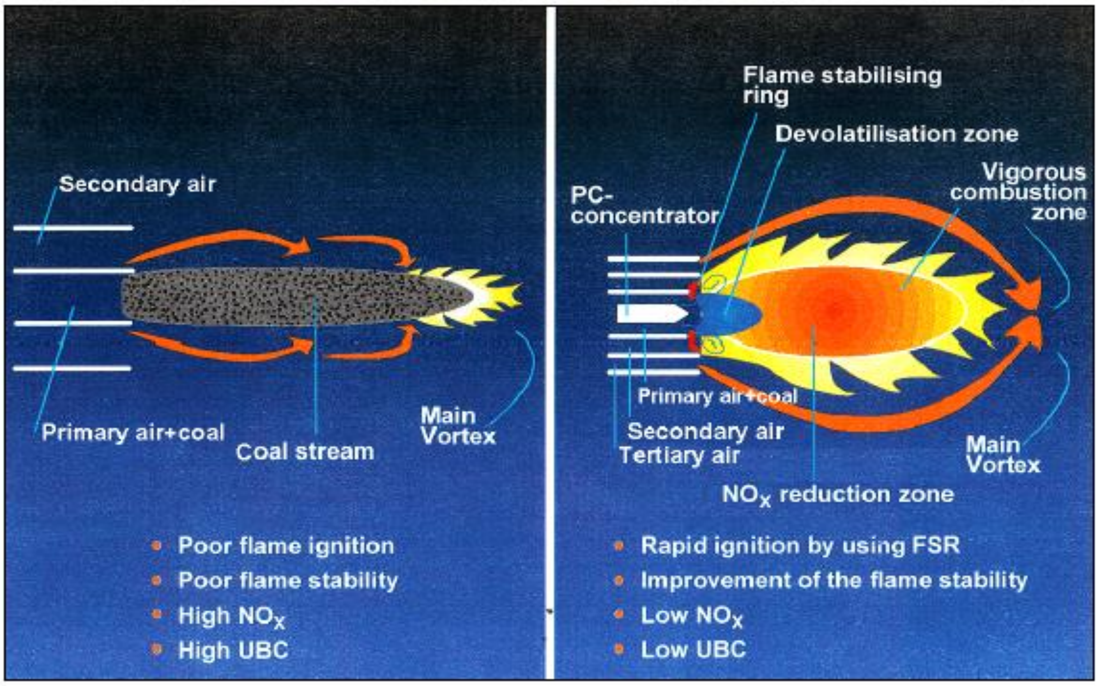

Fig.2 Burners poor in NO_x

The non-catalytic nitrogen reduction from flue gas system will be sized to reduce NOx emissions below 200 mg /m^3N.

One of the issues that have not yet been resolved is CO_2 emissions. CO_2 is considered to be the main trigger for the greenhouse effect of the earth. To reduce CO_2 emissions can be applied the combined combustion of coal and biomass (for example, energy willow or elephant grass) can be applied. These crops can be planted on the surface of the slag and ash deposits of the thermal power plant. In the growing season, plants absorb CO_2 from the atmosphere.

REFERENCES

1. Authorization no 163/09.05.2013, on greenhouse gas emissions for the period 2013-2020, Ministry of Environment and Climate Change;
2. Site Report for the Integrated Environmental Facility, Hunedoara Energy Complex;
3. Law 278/ 2013 regarding industrial emissions;

4. Directive 2010/75/UE regarding industrial emissions;
5. National Transition Plan 2016-2020;
6. Decision 1442/2017 on the Adoption of BAT Conclusions for Large Combustion Plants;
7. Racoceanu, C., Popescu, L.G., Popescu, C. *Research on the impact of the application of clean technologies for burning coal on air quality in the area of Rovinari and Turceni power plants*, 16 th International Multidisciplinary Scientific GeoConference &EXPOSGEM 2016, 28 June -7 July 2016, Albena, Bulgaria, conference WSEAS.
8. Racoceanu Cristinel, Popescu Luminiţa Georgeta, Popescu Cristinel, Cruceru Mihai, *Research on reducing by ash and no$_x$ cuased burning lignite in energy units of 330 MW power plant Turceni*, The 13th International Multidisciplinary GeoConference SGEM 2013**,** 16 **-** 22 June, 2013, Albena Co., Bulgaria, pag. 839-845, ISBN 978-619-7105-04-9.
9. Racoceanu ,C., Popescu, L., Filip, V., Popescu, C. *Research regarding environmental risks due to complex operation Rovinari*, Proceedings of the 12th International GeoConference SGEM 2012 will be held in the period of 17 **-** 23 June, 2012, pag.715-722.
10. Racoceanu C, Şchiopu C. – *Environmental protection and air pollution,*Academic Publishing Brancusi, Targu Jiu, ISBN 978-973-144-346-1, 2010.
11. Racoceanu, C., Popescu C.*Analysis of the environmental impact of energy complexes*, Ed Sitech, Craiova, ISBN 978-973-746-679-2, 2007.
12. Racoceanu, C., Popescu C. *Environmental impact analysis energy complexes*, Sitech Publishing,, Craiova, ISBN 978-973-746-679-2, 2007.
13. Racoceanu Cristinel, *Study on influence of energy efficiency of a steam boiler Benson on environmental pollution*, Fiability& Durability, no.2/2016, pag.35-40, ISSN 1844-640X.