ASSESSEMENT OF HEAVY METALS CONTENT IN THE AIR IN THE INFLUENCE AREA OF ROVINARI THERMAL POWER STATION IN GORJ COUNTY

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ABSTRACT: In the paper are presented surveys on air pollution with heavy metals in the influence area of Rovinari thermal power station in Gorj county. The heavy metals measured in the ambient air in the influence area of Rovinari thermal power station are: lead, arsenic, cadmium and nickel. The method used for these has been in compliance with standard SR EN 14902/2007, Ambient air quality. The standard method for the measurement of Pb, Cd, As and Ni in the PM_{10} fraction of suspended particulate matter. The results of measurements regarding content of heavy metals in ambient air in Rovinari area show values of communities for Pb, As, Cd and NI which are bellow the allowed limit values.

KEY WORDS: Rovinari, heavy metals, pollution

1.INTRODUCTION

One of the most important issues of modern age is the atmospheric pollution. This phenomenon, extremely complex, has become the object of interest for many international organizations, as the consequences of atmospheric pollution are felt beyond the country's boundaries.

Rovinari Thermal Power Station is located in Gorj county, on the right bank of Jiu River, at about 20 km south-west from the town of Tg-Jiu. Rovinari thermal power station has an installed capacity of 1320 MW (4x330) composed of energetic units 3, 4, 5 and 6, commissioned during the period 1976-1979. Each energetic unit is fitted out with Benson boilers of 1035t/h.

Current abundance of heavy metals in life environments is the resultant of two components: one of geogenic nature and one of anthropogenic nature. Natural concentration at level of different parts of the environment is usually in compliance with the primary presence of rocks and the necessary requested by the geochemical and biochemical processes where these elements are involved. The existence of subsoil fields is reflected at the level of soil by the appearance of pedogeochemical anomalies. Depending on their largeness, the anomalies will differently influence the other components of the environment.

Anthropic activity represents the most important source of accumulation of heavy metals in the environment.

Atmosphere serves as collector not only for organic pollutants, but also for metals, especially for some toxic metals such as mercury, lead, cadmium[1,2].

Heavy metals arrive in the air under the shape of solid aerosols which result from burning of coal, oil, peat and some ores, from smoke of melting furnaces for producing steel and metallic alloys. As result of anthropic activity, in the atmosphere arrive several times higher concentrations of cadmium, lead, tin, selenium, tellurium and other metals than from natural sources.

A characteristic of heavy metals, whether biologically essential or not, is that in excess they are highly toxic.

2.EXPERIMENTAL

Heavy metals measured in the ambient air in the influence area of Rovinari thermal power station were lead, arsenic, cadmium and nickel. For these, the used method was in compliance with standard SR EN 14902/2007. Ambient air quality: Standard method for measuring Pb, Cd, As and Ni in PM_{10} fraction of suspended particulate matter.[6]

After conditioning, the filters on which have been retained powders in suspension (PM_{10}) are subject to mineralization with the help of a digester. Mineralization is carried out with nitric acid and oxygenated water.

Reading of heavy metals from mineralized samples has been made with an atomic absorption spectrometer Perkin Elmer – Aanalyst 700, with flame and graphite furnace, with automatic change of atomization source.

Mass of each analyzed element on the filters is calculated with the formula:

$$m_a = \beta_a \times V_s \times F \times \frac{A_{tot}}{A_{pc}}$$

where:

m_a = is the mass of analyzed element, in ng;

β_a = is the mass concentration of element is the test solution, in ng/ml;

V_s = is the volume of test solution, in ml, indicated by the soft;

F = is the dilution factor, indicated by the soft (F=1 when is not carried out the dilution of test solution);

A_{tot} = is the surface of the exposed filter, in cm^2;

A_{part} = is the surface of disaggregated part of the filter, in cm^2 (in this case $A_{tot} = A_{part}$).

Thus, the equation becomes:

$$m_a = \beta_a \times V_s \times F$$

The same procedure is used for the control tests, too.

Then, is calculated the concentration of Ca of each element in the absorbed air, in ng/m^3 with the following equation:

$$C_a = \frac{m_a - \overline{m_{La}}}{V}$$

where:

C_a = is the mass concentration of element a in absorbed air, in ng/m^3;

m_a = is the mass of the element collected on filter, in ng;

m_{La} = is the average value of laboratory control filter, in ng;

V = is the volume of absorbed air, in m^3.

According to SR EN 14902, the concentrations relate to the ambient conditions (conditions of sample taken).

3.RESULTS AND DISCUSSIONS

Interpretation of results for lead has been made in compliance with the Order of the Minister of waters and environment protection no. 592/2002 to approve Norms regarding the establishment of limit values, threshold values and criteria and methods for evaluation of sulphur dioxide, nitric dioxide and nitric oxides, suspension powders (PM_{10} and $PM_{2,5}$), lead, benzene, carbon monoxide and ozone in the environment.[7]

For arsenic, cadmium and nickel, the interpretation of results has been made in compliance with the Order of M.M.G.A. no.448/2007 to approve Norms regarding the evaluation for arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in the environment.[8] The results of measurements regarding the content of heavy metals in environment in Rovinari area are presented in table 1

Table 1Monthly and annual average concentrations for heavy metals in the air in Rovinari *area*

Month	2011				2012			
	Pb μg/m³	As ng/m³	Cd ng/m³	Ni ng/m³	Pb μg/m³	As ng/m³	Cd ng/m³	Ni ng/m³
January	-	-	-	-	0,0050	3,5093	0,5216	2,4748
February	-	-	-	-	0,0052	4,2458	0,7149	1,2498
March	-	-	-	-	0,0016	2,0463	0,2342	1,3191
April	-	-	-	-	0,0032	2,9089	0,7935	1,6862
May	-	-	-	-	0,0045	1,3345	0,7029	1,9995
June	-	-	-	-	0,0028	0,7506	0,4719	0,6147
July	-	-	-	-	0,0063	1,5965	0,8950	0,3116
August	-	-	-	-	0,0083	2,0498	0,6228	3,4158
September	0,0088	2,8675	0,3611	4,1812	0,0071	2,0663	0,5161	3,4158
October	0,0097	3,3557	0,4872	2,8845	0,0059	2,0942	0,3073	0,9723
November	0,0064	2,2732	0,3733	0,9508	0,0048	1,6723	0,4261	1,3728
December	0,0051	1,5946	0,5471	0,6932	0,0054	2,1463	0,6423	1,7245
Annual average	0,0075	2,5227	0,4422	2,1774	0,0050	2,2017	0,5707	1,6443
Allowed Limit Value	0,5	6	5	20	0,5	6	5	20

Coal and crude oil contain lead. Particles in the air that come from their combustion contain appreciable quantities of lead.[9-11]. Burning of coal contributes by about 0,5% lead to the lead in the atmosphere, while burning of crude oil has a contribution of about 0,01%. Quantities of 150 ppm in the ash in the air and 358 ppm in the soot around electric power plants which burn coal have been found.

For lead, the Order no.592/2002 stipulates an allowed limit value of 0,5μg/m³, as annual average.[7]. By analyzing the concentrations of lead obtained during the two years of study, it is found that they are far bellow under the allowed limit value.

Thus, the annual average calculated in 2011 represented only 1,5% of the allowed limit value. The highest concentration of lead has been registered in the month of October 2011, its monthly average representing 2% of the allowed limit value, and the lowest monthly average has been in December and represented about 1% of the allowed limit.

In 2012, the annual average represented 1% of the allowed limit value, and the monthly averages were between 0,32% and 1,66% of the allowed limit.

The most important sources of air pollution with arsenic are metallurgic products, burning of coal and use of compounds with arsenic as pesticides.

For arsenic, the Order no.448/2007 stipulates an allowed limit value for human health protection of 6 ng/m³.[8].

Both in 2011 and in 2012, the average annual concentrations were bellow the allowed limit value. Thus, in 2011 the annual average represented 42% of the allowed limit value. The highest monthly average in this year has been registered in the month of October and represented 55,9% of the allowed limit value, and the lowest in the month of December and represented approximately 26,5% of the allowed limit.

In 2012, the annual average concentration represented 36,7% of the allowed limit value.

Monthly average concentrations in this year presented values which have oscillated between 12,5% and 70,7% of the allowed limit value. The highest concentrations have been registered in the month of February, and the lowest in the month of June.

As an ascertained fact in the case of arsenic is that the amount of concentrations in the first two months of the year which correspond to the cold season, represented about 31% of the amount of all concentrations, while the amount of monthly concentrations during June – August, corresponding to the hot season, represented only 16,6% of the amount of all concentrations.

For cadmium, the allowed limit value in the environment is of 5ng/m^3.

In 2011, the average of the four months of monitoring was greatly bellow the allowed limit value, representing only 8,8% of it.

In 2012, the annual average concentrations situated also bellow the allowed limit value and represented 11,4% of it. This time, the highest monthly average concentration has been registered in the month of July and represented 17,9% of the allowed limit value. The lowest monthly average concentration has been registered in the month of March, representing about 4,7% of the allowed limit value.

For nickel, regulations in force stipulate an allowed limit value for human health protection of 20 ng/m^3.

Concentrations registered in the two years of study situated the annual averages far bellow the allowed limit value.

Thus, in 2011 the annual average concentration represented about 10,9% of the allowed limit value. The highest monthly average concentration has been obtained in the month of September and represented almost 21% of the allowed limit value and about half of the total of monthly average concentrations.

In 2012, the annual average concentration represented even less of the allowed limit value, that is only 8,2% of it.

This time, the highest monthly average concentration has been obtained in the month of September, but its value represented 17% of the allowed limit value.

The lowest monthly average concentration has been registered in the month of July and represented a little above 1,5% of the allowed limit value.

Comparing the annual average concentrations of the four elements monitored during the two years of study with allowed limit values for each one, it is found that the highest concentrations, as compared to the allowed limit value of each one, have been obtained for arsenic, and the lowest for lead. (Fig1.).

Similarly, the highest difference among annual average concentrations has been registered in the case of arsenic, and the lowest in the case of lead, in both cases higher values of annual average concentrations registering in 2011.

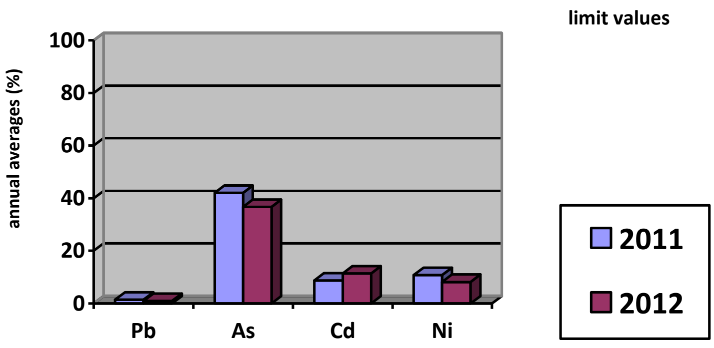

Fig. 1.Evolution of annual average concentrations as compared to limit values (in %)

CONCLUSION

• Electricity production from coal power has a direct impact on air and an indirect impact on soil through the phenomenon of atmospheric deposit.

• Main pollutants which result from

the activity of electricity production from coal power are mainly gas (SO_2 and NO_x) and powders, with the two components, settleable and suspended.

• Taking into account the transition periods negotiated with the European Union regarding placement among the allowed limit values in emission, at present are found exceeds of these values for sulphur dioxide and powders.

• Concentrations of heavy metals in the air situated bellow the allowed limit values.

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