

QUANTITATIVE ASSESSMENT OF THE AIR POLLUTION LEVEL

TĂȚAR Adina Milena

Grup Scolar Auto Traian Vuia Tg-Jiu , addina.tatar@yahoo.com

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Abstract: The measurements of polluting agents emissions into the surrounding air consist in determining the concentrations of SO₂, NO_x, (NO₂), CO, suspension powders and their comparison with the VL or CMA. For the calculation of polluting agents dispersion in the atmosphere it is necessary to calculate the quantities of polluting agents released in the atmosphere and the burning gas flow for every case. The prognosis of surrounding air pollution level generated by the studied objective related sources was made through mathematic modeling of concentrations fields. The result of the modeling consists in pollution maps.

1. GENERAL CONSIDERATIONS

The assessment of the atmospheric polluting agents impact on the sensitive receptors from the impact area was made in compliance with the Order no. 592/2002 issued by MAPM and STAS 12574/1987 through measurements of polluting agents emissions in the surrounding air and through mathematic modeling of atmospheric polluting agents dispersion.

The measurements results of the polluting agents emissions in the surrounding air and their comparison to the limit values or the maximum admitted concentration regulated by the relevant legislation are described in table no. 1.

Table no.1: Polluting agents concentrations in the surrounding environment, the Central Heating and Power Plant Rovinari

Polluting	Mediation time	U.M.	Measured/ determined value	VL cf. ORD MAPM nr.592/2002	CMA cf.STAS 12574/87
NO ₂	1 h	µg/m ³	75	200	
SO ₂	1 h	µg/m ³	90	350	-
TSP	30 min.	µg/m ³	36	-	500

By comparing the concentrations of polluting agents in the surrounding air at the site, we notice that these values are below the limits.

Because of the high chimneys, the concentrations of polluting agents released by the objective have high values at long distances from the emission sources. With the measured values of released polluting agents, we were able to estimate the polluting level in the impact zone of the objective through mathematic modeling of concentrations fields.

2. POLLUTING AGENTS DISPERSION IN THE ATMOSPHERE

In order to calculate polluting agents dispersion in the atmosphere, it is necessary to calculate first the amounts of polluting agents released in the atmosphere and the burning gas flows for every chimney separately. The amounts of polluting agents are calculated according to the "Operative assessment methodology for emissions of SO₂, NO_x, powders and CO₂ in steam power plants – PE 1001/1994". The calculation method is based on fuels consumption and on emission factors.

The amount of polluting agent released in the atmosphere is determined with formula 1:

$$E = B \cdot H_i \cdot e$$

(1)

E – the amount of polluting agent released in the atmosphere within a certain period of time (kg)

B – the amount of fuel consumed during that period (kg)

H_i – low calorific power of the fuel (kJ/kg)

e – emission factor (kg/kj)

The emission factor is the amount of polluting agent released in the atmosphere, in relation to the heat unit introduced with the fuel in the boiler.

The burning gas flow resulted from the burning of B_s (tones/h), coal, B_l (tones/h), black oil and B_g (Nm³/h), gaseous fuels in the furnace of a boiler is given by the formula

$$B_{ga}^{Caz} = 1000 \cdot [V_{gs} \cdot B_s (1 - 1/100) + V_{gl} \cdot B_l + V_{gg} \cdot B_g] \text{ Nm}^3/\text{h} \quad (2)$$

The dispersion model used for assessing the pollution level in the steam power plant site area is based on the Gaussian plume equation.

The polluting agent concentration at a point from the soil surface is determined by equation 3.

$$C(r, z, t) = \frac{Q}{(2\pi)^{3/2} \sigma_r^2 \sigma_z} \cdot \exp\left(-\frac{r^2}{2\sigma_r^2}\right) \cdot \left\{ \exp\left(-\frac{(z+H)^2}{2\sigma_z^2}\right) + \exp\left(-\frac{(z-H)^2}{2\sigma_z^2}\right) \right\} \quad (3)$$

H – actual height; Q – emission of polluting agent

σ_y, σ_z – horizontal and vertical dispersion parameters

Mathematic modeling of the concentrations fields was performed for the main polluting agents released by the objective related sources. Tables 2 and 3 describe the maximum values of the analyzed polluting agents concentrations and their comparisons with limits(VL) or maximum allowed concentrations (CMA) or alert thresholds(PA).

Maximum concentrations on various mediation intervals:

Table no. 2: Long mediation intervals – annual averages

Polluting	Maximum concentrations			Remarks
	C_{max} [$\mu\text{g}/\text{m}^3$]	(PA) [$\mu\text{g}/\text{m}^3$]	(VL) or CMA [$\mu\text{g}/\text{m}^3$]	
TSP	0,165	52,5	75	<VL
NO _x	0,72	-	60 ⁽¹⁾ /40 ⁽²⁾	<VL
SO _x	1,96	-	20«	<VL

(1) VL + Tolerance margin up to 01.01.2005

(2)VL up to 01.01.2010

Table no.3: Short/ medium intervals

Polluting	Time the mediation model	Maximum concentrations			Remarks
		Cmax [$\mu\text{g}/\text{m}^3$]	(PA) [$\mu\text{g}/\text{m}^3$]	(VL) or CMA [$\mu\text{g}/\text{m}^3$]	
TSP	1 h	27,7	350	500	< VL; < PA
	24 h	2,69	105	150	< VL; < PA
NO ₂	1 h	123	400	300 ⁽¹⁾ / 200 ⁽²⁾	< VL; < PA
CO	8h	3,4	-	10000 ⁽¹⁾ / 6000 ⁽²⁾	< VL
SO ₂	1 h	373,0	500	500/350 ⁽²⁾	< VL
	24 h	37,7	-	125	< VL

(1) VL Tolerance margin up to 01.01.2005 and 01.01.2004 (for the case of CO and SO₂)

(2) VL up to 01.01.2010 (for the case of NO₂) and 01.01.2007 (for the case of PM₁₀ and CO)

The results of the modeling are presented by polluting maps in figures 1 – 4.

3. CONCLUSIONS

a. Pollution with total suspension particles (TSP)

The annual average concentrations reach the highest values of 0.16 – 0.2 $\mu\text{g}/\text{m}^3$ on larger areas at 4000 – 6000 m distance, North-West, North and North-East, being below the limits (fig. 1).

b. NO₂ pollution

The annual average concentrations reach the highest values of 0.6 – 0.8 $\mu\text{g}/\text{m}^3$ on larger areas at 4000 – 6000 m distance, North-West, North and North-East, being very much below the limits (fig. 2).

c. SO₂ pollution

The annual average concentrations reach the highest values of 1.6 – 2 $\mu\text{g}/\text{m}^3$ on larger areas at 4000 – 6000 m distance, North-West, North and North-East, being below the limits (fig. 3).

d. CO pollution

The maximum concentration for 8 hours (dynamic averages) can reach values of 3.2 – 3.4 $\mu\text{g}/\text{m}^3$ at 2000 – 3000 m distance North or 4000 – 8000 m distance North-West, being much below the limits.

Figura 1

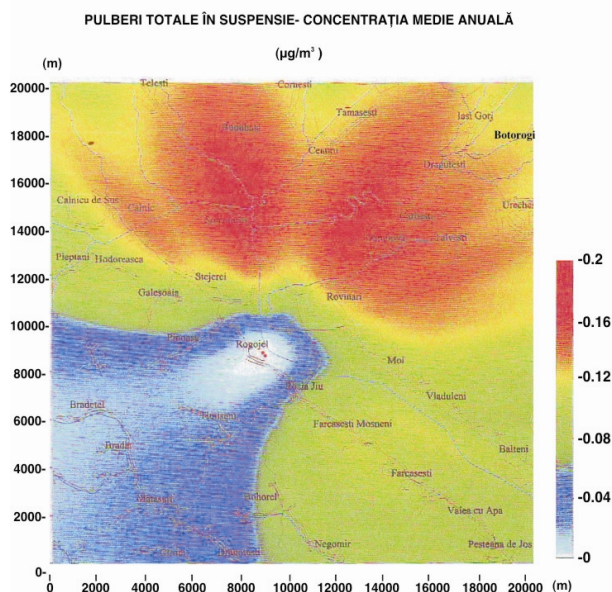


Figura 2

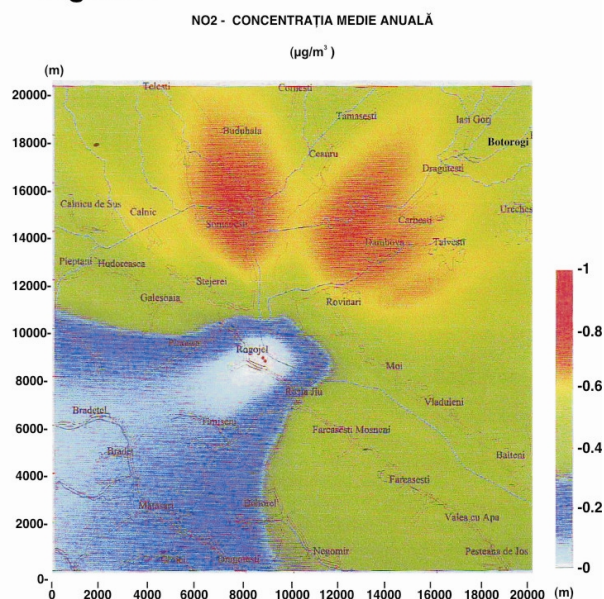


Figura 3

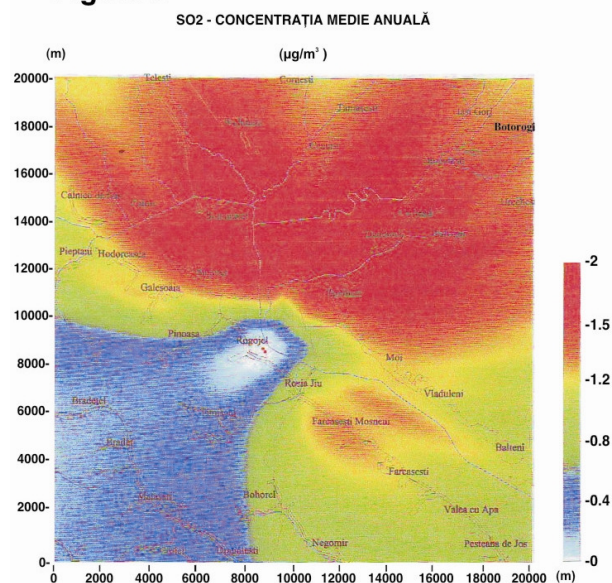
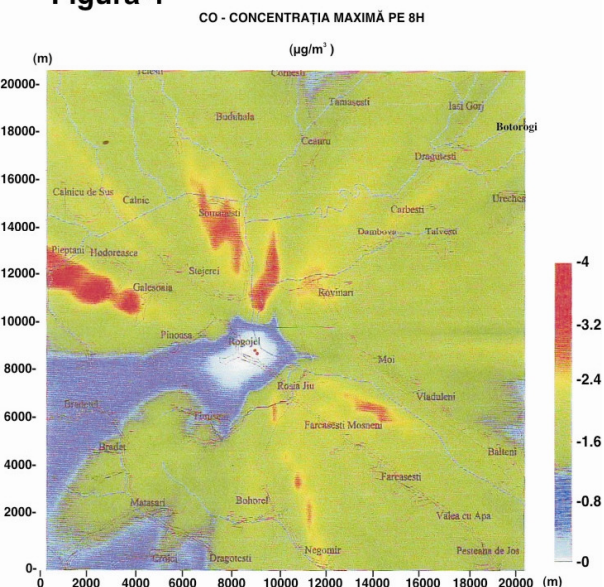


Figura 4



● Pozitie cosuri de dispersie

REFERENCES

- [1]. Ioana I., Ungureanu C., Termoeenergetica si mediul, Ed. Tehnica, Bucuresti , 1996
- [2]. Sandu I., Modelarea matematica a dispersiei poluantilor emisi de termocentrala PALAS pentru determinarea gradului de poluare a atmosferei in zona de amplasare, INMH, Bucuresti ,1997
- [3]. Tatar Adina-Milena , Modelarea proceselor dinamice din atmosfera 2010. Referat nr.III, Universitatea din Petrosani ,2010
- [4]. Vorduca A., Moldoveanu A.M ,Moldoveanu G.A, Poluarea , prevenire si control, Ed. Matrix Rom, Bucuresti, 2002