ASPECTS ON AIR POLLUTION WITH SULPHUR DIOXIDE IN ORADEA CITY

Nandor KÖTELES, Ana Cornelia MOZA

University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048 Oradea; Romania,
Corresponding author: kotelesnandor@yahoo.com

Abstract: *At the level of Oradea city, the observations on the air quality are being ensured by the Environment Protection Agency by the intermediate of its own domestic monitoring system; there are three steady monitoring points namely: at the headquarters of the Environment Protection Agency – Bihor branch, on Corneliu Coposu Street at the Children Hospital, and at Environment Protection Faculty. The placement of monitoring points was carried out by taking into consideration the pollution generating factors concentrated in these areas. The air quality monitoring in Oradea is being performed through long term measurements of the air polluting substances, scheduled on 24 hours, respectively. The aim of this paper is to assess the air pollution with sulphur dioxide in the Oradea city area, this indicator being monitored for a 15 year time span, from 1994 to 2008, respectively. The main methods used in the current research are the following: analysis method, comparative method, mathematics-statistics method and graphs. By means of statistics-mathematics methods, we computed the data collected from the Environment Protection Agency. The results we had obtained through mathematics and statistics method were then translated into graphs in order to highlight clearly the air polluter's unsteadiness in time. This gas monitoring must be corroborated with the fact that, in Romania, there is an antipollution maximum rated value, which, for median values is 0.250 mg/m^3/24 hours, and for a 30 minutes time, span must not exceed the maximum rated value of 0.75 mg/m^3 (750 µ/m^3). In the case of the period we monitored, the average values of sulphur dioxide within Oradea city area did not overrun the standards rather than temporarily and accidentally. At this fortunate situation the wind, blowing from South directions, was a major factor in dispersing the polluters. The variations of sulphur dioxide gas emissions for a one year time span highlight the fact that larger amounts are in the cold period of the year (from November to March), when the heating stations and other heating sources activity is intensive as well as during summer time, when road traffic quotas are higher than in the rest of the year. The critical areas from the air pollution point of view are located at the proximity of streets and boulevards with an intensive traffic, major crossroads, industrial waste dumps, unprotected waste dumps/refuses, animal farms, chemical industry, although the later ones have reduced substantially their production gen erating activities.*

Key words: *polluting, sulphur dioxide, maximum rated values of concentration, monitoring point.*

INTRODUCTION

Air quality control is a concept defining the quantitative, qualitative and repetitive' monitoring and measurement of the rate of one or several air constituents. The data collected out of the monitoring and surveillance network and control system allow the identification of polluted areas and a rapid strategic and tactic decision making in order to combating pollution and prevent its spreading. The air quality surveillance network must be chosen in such a manner to allow for a comprehensive monitoring of cumulated effects of industry, traffic, commercial and households' heating effects and impact on air parameters.

Au quality monitoring action is useful as it provides direct information as regards the state of play existing on a certain moment within an important segment of urban environment.

Starting with 1st of January 2003, the order no 592/2002 of the (former) Ministry of Agriculture, Forrest and Environment on the endorsement of the norms setting the maximum

rated values, threshold values, and assessment criteria and methods for the following pollutants: sulphur dioxide, nitrogen dioxide, nitrogen monoxides, powders in suspension (PM_{10} and $PM_{2,5}$), lead, benzene, carbon monoxide and ozone in the environmental air, entered into force (see www.Apmcj.ro).

Sulphur oxides (SO_2, SO_3) are inorganic polluters resulting from fuels combustion in fix sources (power plants), industrial processes, from combustion in urban and rural area' households and from mobile sources (transportation, agriculture).

SO_2 emissions are originating in power plants on coal, which have the largest share of local level pollution with these gases followed by mobile polluting sources, namely the transports. Independent household thermal heating, based on coal, gas or crude oil contributes in a large extent to this pollutant dissemination in the environmental air.

Sulphides are present in many fuels (coal, oil) and their combustion conducts to sulphur oxidation in SO_2.

The incidence of acid rains is caused by the presence into air of sulphur dioxide and of favourable meteorological conditions. The chemical reaction between the water vapours leads to formation of sulphuric acid (H_2SO_4).

MATERIAL AND METHODS

In order to analyse the sulphur dioxide within Oradea city area one employed the data provided by the Environment Protection Agency – branch of Bihor, for a 15 years time span, namely from 1994 up to 2008.

The data collected were processed by means of mathematics and statistics methods. The results thus obtained were than translated intro graphs in order to highlight clearly the variability in time of the targeted air pollutant.

In order to analyse the air quality, the presence and amounts of toxic elements in the air are taken into consideration, and their comparison with the maximum rated values of concentration, set up by STAS 12574/1987.

RESULTS AND DISCUSSIONS

Monitoring is performed at the above mentioned monitoring points. At the monitoring point located at the Faculty of Environment Protection, the observations started with the month of June of 1999.

The annual evolution of the sulphur dioxide concentration rate

At Oradea city, at the three monitoring points throughout the 15 years of observation, the highest amount of sulphur dioxide was recorded at the Environmental Protection Agency, the multiannual average reaching the level of 0.006 mg/m^3, followed by the Children Hospital with a value of 0.005 mg/m^3, while the lowest concentration has been recorded at the Faculty of Environmental Protection, namely of 0.003 mg/m^3 (see figure 1).

In 1998 the highest concentration ratio of 0.020 mg/m^3 was recorded at Children Hospital, followed by Environmental Protection Agency (APM) with a ratio of 0,018 mg/m^3 during the same year.

While studying the evolution of sulphur dioxide during 1994 – 2008 time span, one notices that the maximum rated value admitted from the health point of view of 0.250 mg/m^3/24 hours, imposed by STAS 12574/1987, was not exceeded.

Monthly evolution of sulphur dioxide concentration rate

Throughout one year, on Dacia Blvd. at headquarters of Environmental Protection Agency - branch of Bihor (A.P.M. – Bihor), there were recorded the highest SO_2 concentrations ratios, namely of 0,009 mg/m^3 during the months of January and February, while the minimum rates

of concentration in year, respectively 0.005 mg/m^3 were recorded during the months of April and September (see Table 1, and figure 2).

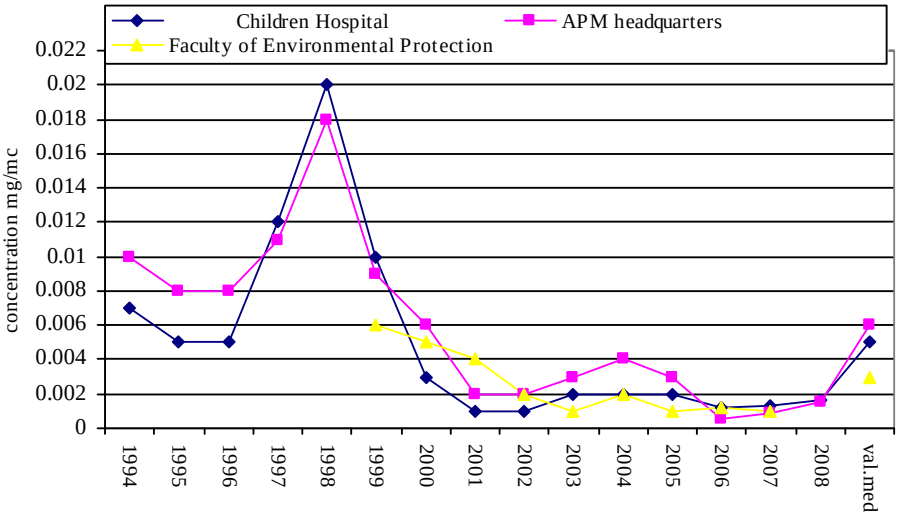

Figure 1: The evolution of annual average of SO_2 (mg/m^3) concentration rates in the monitoring points within Oradea city area

Table 1

The evolution of monthly average of SO_2 (mg/m^3) concentration rates in monitoring points within Oradea city area within 1994 – 2008 time span

Month/ Monitoring points	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Average rate
Children Hospital	0.008	0.007	0.006	0.005	0.005	0.004	0.006	0.005	0.005	0.006	0.005	0.008	0.006
APM headquarters	0.009	0.009	0.007	0.005	0.006	0.006	0.007	0.007	0.005	0.007	0.007	0.007	0.007
Faculty of Environmental Protection	0.006	0.004	0.003	0.001	0.002	0.003	0.002	0.003	0.002	0.002	0.003	0.004	0.003
Average rate	0.008	0.007	0.005	0.004	0.004	0.004	0.005	0.005	0.004	0.005	0.005	0.006	0.005
C.M.A	STAS 12574/1987						0.250 mg/m^3/24 ore						

Source: Environmental Protection Agency - branch of Bihor

On C. Coposu street at Children Hospital, the second polluted area as regards the level of SO_2 concentration among the three points monitored by Environmental Protection Agency, the highest rates are recorded in the months of January and December, namely 0.008 mg/m^3, while the lowest concentration of 0.004 mg/m^3 was recorded in June.

On Magheru General Blvd., at the headquarters of Faculty of Environmental Protection, have been recorded the lowest monthly concentration rates, the maximum rate of 0.006 mg/m^3 being recorded in the month of January while the minimum rate of 0.001 mg/m^3, being recorded in the month of April (see Tables 1 and figure 2).

The variations of the sulphur dioxide gas emissions throughout a year highlights the fact that the highest rates are specific for cold months (November – March) when the heating plan and other heating sources activities reach their maximum level of intensity as well as during summer period mainly due to traffic which is more intense during this time of the year.

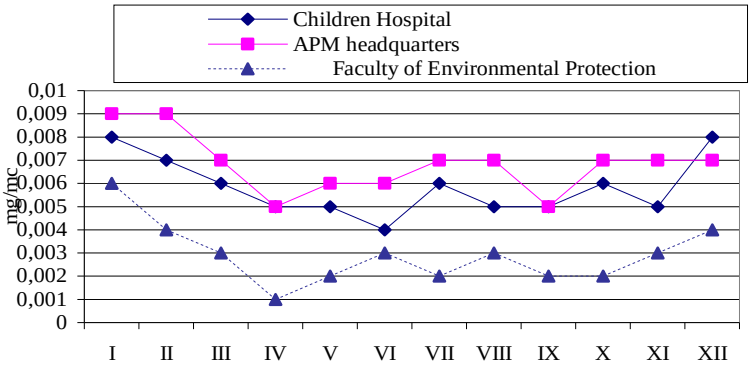

Figure 2: The variability of monthly average of SO_2 (mg/m^3) concentration rates in monitoring points within Oradea city area within 1994 – 2008 time span

The monthly evolution of sulphur dioxide in connection with air temperature

The thermal balance of the subjacent active surface plays a decisive role in the vertical distribution of the air located lower troposphere layers. When the values are negative, namely at nights during the year and at daylight during some days in winter season, the air temperature is lower in the proximity of the active surface and increases progressively with altitude. This type of distribution does characterise thermal inversions, as meteorological phenomena with a higher rate of incidence during winter season. This highlights the purification role the temperature has on the atmospheric air.

Table 2

Variation of monthly average concentration rate of SO_2 (mg/m^3) and air temperature (ºC) in Oradea city

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Average rate
SO_2	0.008	0.007	0.005	0.004	0.004	0.004	0.005	0.005	0.004	0.005	0.005	0.006	0.005
Temperature	-0.7	0.8	4.9	11.1	16.9	20.0	21.6	21.2	15.8	11.0	5.6	0.1	10.7

Source: Environmental Protection Agency - branch of Bihor and the archive of National Meteorological Authority (ANM)

The correlation between the evolutions of monthly SO_2 concentration rate is showed in the figure no 3, out of which a reversed trend of the two phenomena can be perceived. Thus, the highest sulphur dioxide concentration in Oradea city is recorded in the month of January (0.008 mg/m^3) when the lowest annual average temperature rate occurs (-0,7ºC - see figure 3).

CONCLUSIONS

For the analysed time span, the average rates of sulphur dioxides within Oradea city area exceeded the maximum rated values of concentration only accidentally and for very short periods of time. The wind direction, mainly from South and favouring the pollutants dispersion, made its contribution to this fact.

The critical areas from the air polluting point of view are located in the vicinity of some major roads with heavy traffic, industrial dumps, unmonitored garbage dumps, animal farms, chemical industry, although the later has diminished substantially their production activities.

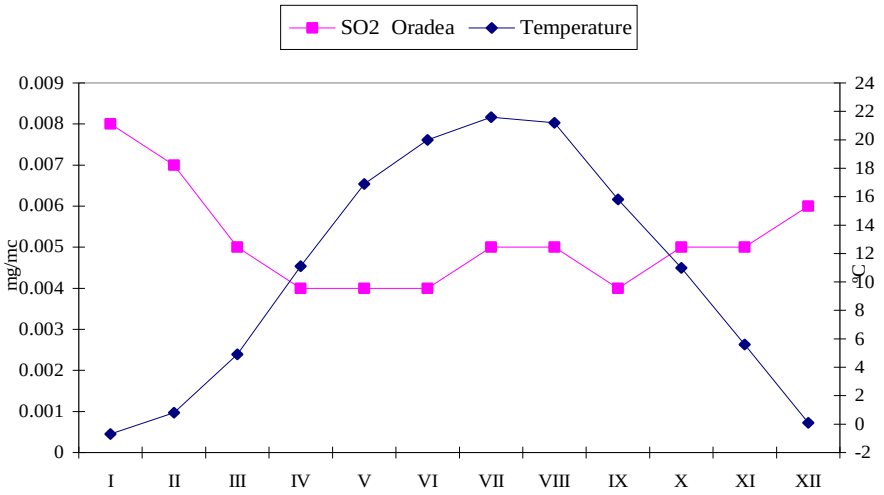

Figure 3: Variation of monthly average concentration rate of SO_2 (mg/m^3) and air temperature (ºC) in Oradea city

BIBLIOGRAPHY

BĂBEANU NARCISA, BERCA M., BORZA I., COSTE I., COTIGĂ C., DUMITRESCU N., OLTEANU I., (2002), Ecologie şi protecţia mediului, Editura „Ion Ionescu de la Brad", Iaşi, ISBN 973-8014-72-7.

BOGDAN OCTAVIA, MIHAI ELENA, (1972), Interdependenţa dintre poluarea aerului şi condiţiile meteorologice, S.C.G.G.G.-Geogr., XIX, Bucureşti, pag. 5-12.

CIULACHE S., (2004), Influenţa condiţiilor meteorologice şi climatice asupra poluării aerului, Com. Geogr. V, Editura Univ. Bucureşti.

DUMITER AURELIA FLORINA, (2005), La pollution et la protection de l'atmosphere dans la ville d'Oradea, Analele Universităţii din Oradea, Seria Geografie, Tom.XV, pag. 157-164.

MAHARA GH., (1969), Contribuţii la studiul nocivităţii atmosferice în oraşul Oradea, Institutul Pedagogic Oradea, Lucr.Ştiinţifice Seria A, Oradea, pag.139-147.

MAHARA GH., (1976), Poluarea aerului şi a apelor din spaţiul Câmpiei Crişurilor şi a zonelor limitrofe, în Buletinul Societăţii de Ştiinţe Geografice din RSR, Seria IX, Vol IV (LXXIV), Bucureşti 1976, pag.170-177.

MĂHĂRA GH., DUDAŞ A., GACEU O., (2003), The dynamics of the atmosphere and the impact of the air pollution due to the waste dumps situated close to the western industrial platform of Oradea, The Environmental and Socio-Economic Impact of Industrial Tailing Ponds, Universitatea din Oradea, Tom XIII, pag. 5-18.

MĂNESCU S., CUCU M., DIACONESCU MONA, (1994), Chimia sanitară a mediului, Editura Medicală Bucureşti.

MOZA ANA CORNELIA, (2009) Clima şi poluarea aerului în bazinul hidrografic Crişul Repede, Editura Universităţii din Oradea, ISBN 978-973-759-775-5.

PETREA RODICA, (2001), Aspecte de poluare şi de protecţia mediului în Municipiul Oradea, Analele Universităţii din Oradea, Seria Geografie, Tom XI, Oradea.

ROJANSCHI V., BRAN FLORINA, DIACONU GHEORGHIŢA (1997), Protecţia şi ingineria mediului, Editura Economică Bucureşti.

VANCEA V., PĂCALĂ N., MARTIN MARIA, (1992), Unele aspecte privind poluarea aerului în zona Municipiului Oradea şi măsuri de protecţie, Analele Universităţii din Oradea, Geografie, Tom.II, pag. 55-59.

*** Ministerul Apelor şi Protecţiei Mediului, (2002), Normativ din 25 iunie 2002, privind stabilirea valorilor limită, a valorilor de prag şi a criteriilor şi metodelor de evaluare a dioxidului de sulf, dioxidului de azot şi a oxizilor de azot, pulberilor în suspensie (PM10 şi PM2,5), plumbului, benzenului, monoxidului de carbon, şi ozonului în aerul înconjurător, Bucureşti.