Air quality management – Case study: Călăraşi county, Romania

Cecilia Neagu[1], Mariana Burcea[2]

***Abstract**: This paper aims to highlight the air pollution aspect in Calarasi county. To this end, we have identified key air pollutants from industry, road transport and agriculture during the past three years and registered at two automatic stations existing in the county at present.*

The air quality in Calarasi county is within the limits imposed by law. For reducing the existing pollution, measures must be taken and investments must be made in order to conserve, protect and improve the environment, protect the human health and the sustainable use of the natural resources.

***Key words:** Air Pollutants, Automatic Stations, Emissions, Quality Indices.*

INTRODUCTION

The atmosphere is one of the most fragile environment subsystems due to its limited capacity to absorb and neutralize substances that are continuously released by the human activities. Entered the atmosphere, the pollutants can react with the present atmospheric constituents or contaminants, resulting in new substances with different impacts on humans or on environment [3].

The air pollution involves changing the natural proportions of air or gas or the presence of some components in the atmosphere that are normally not present or their concentration exceeds certain limits [2].

The pollution has local character the concentration of the substance emitted into the air is distributed in a certain area around the point of emission or regional character, due to the dispersion of pollutants into the atmosphere [4].

The towns and their industrial areas, and also the communication ways are the main responsible factors for greenhouse gas [1].

A significant contribution to the degradation of the air quality is provided by the heating stations and means of transport that emit into the atmosphere carbon oxides, sulphur dioxide, nitrogen oxides and particulates.

Călăraşi county is situated in the South-East part of Romania (latitude $44^0$12' N, longitude $27^0$21' E) along the Danube river and Borcea Branch and it is bordered in the North with Ialomiţa county, in the East with Constanţa county, in the West with Giurgiu county and Ilfov county and in the South with Bulgaria Republic.

The importance of protecting the atmosphere of this county located in South-East part of Romania shows precisely what elements deserve special interest: location on the Danube river, the opportunities given by the position of the border town, and Soarelui Highway that crosses the town, the beautiful landscape of the Danube islands, the fact that agriculture, the predominant industry in the county's economy is significantly influenced by environmental conditions.

LAYOUT

MATERIALS AND METHOD

In Călăraşi county, the responsibility for the environment protection belongs to the Agency for Environment Protection. The activity for the environment protection is regulated by Law 195/2005 and it is an obligation of the local public administration authorities, of the institutions, legal entities and natural persons.

The paper aims to highlight the air quality in Călăraşi county. To this end, data were collected regarding the air quality in terms of pollutant emissions from different activities and data on ambient air quality. For the emissions (emissions are pollutants discharged into the environment, which manifest and measure starting from the source site) the interpretation of the data was based on emission inventory of air pollutants produced for fixed and mobile sources in Calarasi county for the years 2010, 2011 and 2012 using

Corinvent program and Corinair emission factors and for immission (immission of pollutants in the atmosphere is transferred to a receiver) data were used for air quality monitoring from air quality monitoring network, using for comparison the corresponding limits presented by Law no. 104/2011. This law aims to protect human health and the environment as a whole by regulating measures to maintain ambient air quality.

CORINAIR methodology (**CO**re **IN**ventory of **AIR** emissions), updated yearly and published on the site of the European Agency of Environment, provides information on the categories of emission in atmosphere, the technological processes that generate them, as well as the factors of emission related to it, based on the questionnaires received from the economic agents in the territory.

The Air Quality Monitoring Network in Călăraşi area, is formed of two automatic monitoring stations that are part of the national of National Air Quality Monitoring Network, equipped with performing analyzers which apply the reference methods imposed by the European legislation [5]. It has the following structure:

Station CL1 (traffic station) is placed in Orizont area and monitors the traffic influence on the air quality, in order to highlight the pollution level the population is exposed to. The monitors pollutants in this station are: SO_2, NO, NO_x, CO, PM_{10} automatically and gravimetrically, Pb (din PM_{10}), Benzen, Toluen, O-xilen, Etilbenzen, m, p – xilen (on line).

Station CL2 (urban type station) is placed in Municipality Stadium area and monitors the pollution level in the urban areas, the influence of human settlements, not being directly influenced by traffic and industry. The pollutants monitored here are: SO_2, NO, NO_x, CO, Ozon, Pb (din PM_{10}), PM_{10}, Benzen, Toluen, o,m,p-xilen, Etilbenzen (on line).

The main activities that lead to air pollution in Calarasi county are: heat production in thermal power plants for commercial, industrial and residential extraction and distribution of fossil fuels, solvent use, road transport, agriculture, and mobile sources (other than road transport).

The potential sources of atmospheric pollution in Calarasi county are: a steel mill, a glass factory, a paper mill, two industrial gas plant, a mill, two stations of asphalt mixtures, obtaining a bio fuels plant, a factory that produces aluminium sulphate, a factory of oils and fats, and two farms: of poultry and animals [5].

RESULTS AND DISCUSSIONS

1. The main emissions of pollutants identified in Calarasi county are:

a. Emission of acidifying gas

The contribution to the emissions of SO_2 și NO_x is due to combustion: thermal heating in area/neighbourhood, non-industrial combustion plants, combustion in manufacturing, production processes (metallurgy, glass, asphalt roads), wood, paper.

The nitric oxides - NO_x, especially NO_2 – are formed in the combustion process when fuels are burned at high temperatures, but more often they are result of road traffic, industrial activities, electric power production.

Regarding the pollution with NH_3, the most important source in the production of ammonia is agriculture, and within it, the largest share is held by the livestock industry. Ammonia emissions are generated by the results of livestock manure and nitrogen fertilizers used in crops.

Table 1. Annual acidifying gas emissions (in tons/ year) in the period 2010- 2012

Pollutant (tons/year)	Year		
	2010	**2011**	**2012**
SO_2	710,57	582,80	483,66
NO_x	1448,57	959,48	829,93
NH_3	7638,58	6228,28	387,44

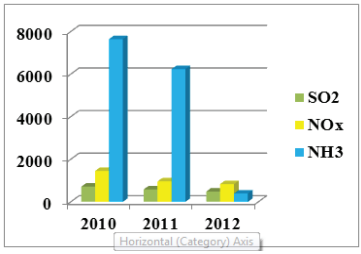

Figure 1. Evolution of annual acidifying gas emissions (in tons/year) in the period 2010- 2012

Despite the increased traffic in the recent years, the data in the figure above indicates a decrease of approximately 34% of the average concentrations recorded at decreasing emissions SO_2. This decrease can find justification in the data provided by Calarasi Regional Statistics Department, the situation of the main socio-economic indicators in Calarasi county in 2012, data which reported a decline in industrial production in the following divisions of the manufacturing industry: textiles (-35.0%), food (18.5%), other non-metallic mineral products (-10.3%), manufacture of chemicals and chemical products (-1,6%) [5].

The slightly descending evolution of SO_2 can be seen because of replacing the fuels used in combustion in boilers or in manufacturing industry, with fuel such as propane or natural gas, these having low sulphur content.

The measures taken by the two largest polluters in the industry – Tenaris Steel Plant and Saint Gobain glass factory, or online monitoring of emissions - exceeded by far the expected effect, the emissions of acidifying gases (NH_3, NO_x) diminished considerably.

The pronounced decrease of NH_3 emission is due to the decline in the livestock sector in 2012 registering a decrease of livestock in the county.

This trend may be due to ammonia emissions and decrease of the number of operators that provided data for the elaboration of the annual emission inventory [5].

b. Emissions of non-methane volatile organic compounds (NMVOC)

The emissions of non-methane volatile organic compounds (NMVOC) result from: industrial activities, road traffic and gas stations.

Table 2. Annual emissions of non methane volatile organic compounds in the period 2010- 2012

Pollutant (tons/year)	Year		
	2010	2011	2012
NMVOC	579,78	84,30	44,11

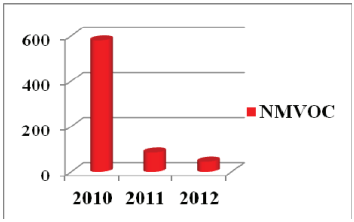

Figure 2. Evolution of annual emission of NMVOC (in tons/ year) in the period 2010- 2012

A justification of the evolution presented in the figure above is to improve vehicle maintenance and replacement of highly polluting vehicles (national scheme for replacement of old vehicles), measures elaborated under the program to improve air quality in the transport sector.

Another reason is to reduce emissions from livestock manure management, the sector suffered a decline in 2012.

c. Other emissions, such as those of: heavy metals, persistent organic pollutants, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), hexachlorobenzene (HCB) were insignificant [5].

2. Air quality index

Based on determined pollutants concentrations, the *specific indices* of air quality are calculated for the following pollutants: SO_2, NO_2, O_3, CO and PM_{10}.

Specific index of air quality represents a system of concentrations codification recorded for each of the following monitored pollutants: sulphur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), carbon monoxide (CO), particulates (PM_{10}).

General index is established for each of the automatic stations within the National Air Quality Monitoring Network as being the highest among the specific indices corresponding to the monitored pollutants. In order to calculate the general index, at least 3 specific indices must be available corresponding to the monitored pollutants. The general index and the specific indices are represented by full numbers between 1 and 6, each number corresponding to a colour, according to the below figure:

Figure 3. Methods for informing the public by displaying quality indicators

As regards the air quality index, we see in the below figure its evolution during the last three years [5]:

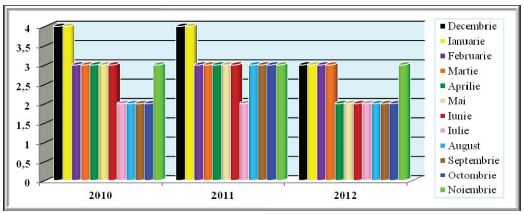

Figure 4. Evolution of air quality index in the period 2010-2012

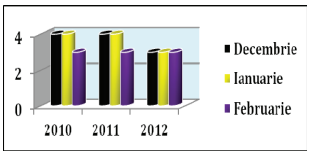

Figure 5. Monthly indices with high level

According to figures 4 and 5 on the evolution of air quality index, it can be seen that in the winter months (December and January) indications take the highest values, indicating a lower quality of air, compared to other months of the year.

This is due to the high level of particulates (PM_{10}) resulting from the use of solid fuel (wood, coal) to heat houses in winter.

CONCLUSSIONS AND FUTURE WORK

The interpretation of data on air quality provided by the automatic monitoring stations in the past three years revealed gaseous pollutants monitored values below the limit imposed by Law 104/2011. In the case of settled particles - PM_{10}, exceeding was recorded of the limit value of the legislation in force at the traffic station CL-1, these are due to the local topo-climate and high summer temperatures.

Following the case study made in Calarasi county, no major problems of air pollution were reported, this hypothesis is supported by monthly air quality bulletins that rarely showed significant exceeding of limits. This may be due to the successful performance of

the PHARE CBC RO 99.11.02.01 project - Common system of air quality monitoring in the border area between Romania - Bulgaria, which was implemented until May 2012.

The evolution of monthly quality index revealed a lower quality of air during the winter months (December and January), this is due to the high level of particulates (PM_{10}) resulting from the use of solid fuel (wood, coal) for domestic heating not supplied from the natural gas network.

The measures implemented during the year 2012 in industry and transport sectors had an ameliorative effect, highlighting the progress on complying with the objectives of the Integrated Air Quality Management Program [6].

Although transportation is not currently a major threat to air quality in Calarasi, this situation might change in few years due to increasing traffic. This potential risk could be stopped by the timely implementation of measures aimed at road transport, measures that have already begun to materialize in 2012, by the project "Rehabilitation and modernization of county roads network, urban streets."

The future situation of air pollution in Calarasi county depends largely on the measures requiring government action, including: improvement of vehicle maintenance in circulation; encouraging the population to use less polluting fuels such as natural gas, for example through a fuel tax system, encouraging the population to insulate their houses according to the international standards.

REFERENCES

[1] Berca M., Environment planning and natural resources management, Ed. Ceres, Bucureşti, 2006.

[2] Enache L., Meteorology, Climatology and Agro-meteorology, Editura Sitech, Craiova, 2007.

[3] Ghinea L., Biology and microbiology of soil- course, Ed. Agroprint Timişoara, 2002

[4] Muntean I. O., Ecology and environment protection, p. 45, Editura Universitas, Petroşani, 2004.

[5]*** Annual report on the environment state in Călăraşi county in the years 2010, 2011, 2012 elaborated by Agency for Environment Protection Călăraşi; http://www.apm.ro

[6]*** Integrated program of Air Quality Management for Călăraşi area, 2004.

About the autors

[1]PhD Lecturer Neagu Cecilia, University of Agricultural Sciences and Veterinary Medicine Bucharest – Călăraşi Faculty Branch, Phone: +40242332077, E-mail: cecilianeagu2005@yahoo.com

[2]PhD Lecturer Burcea Mariana, University of Agricultural Sciences and Veterinary Medicine Bucharest, Phone: +40213182564, E-mail: burcea_mariana2003@yahoo.com

This paper has been reviewed.