

## STUDY REGARDING THE INFLUENCE OF AIR POLLUTION EMISSIONS ON THE ENVIRONMENT IN ZALĂU CITY

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### Abstract

*The paper presents statistical data regarding the evolution of gas emissions in the air of Zalău city, over a period of 9 years. Thus we monitored gas emissions that have an acidifying effect, emissions of nitrogen monoxide and dioxide, emissions of non-methane volatile organic compounds, emissions of heavy metals, emissions of persistent organic pollutants and emissions of polycyclic aromatic hydrocarbons. The paper was written in collaboration with the Environmental Protection Agency of Zalău.*

**Key words:** gas emissions, Zalău, monitoring, pollution.

### INTRODUCTION

The problems regarding the pollution of air, water and soil, three main components of the environment, are more and more important nowadays, especially in cities with large human densities.

The city of Zalău has been an important economic centre in this part of the country from ancient times to the present day. The industrial process became noticeable starting with the beginning of the 20<sup>th</sup> century. It is then that the exploitation of the Meseș stone quarry began, two steam mills were founded, as well as a brick factory, whose development benefited from the existence of good quality clay close to the town, and so on. The dawn of the 20<sup>th</sup> century also witnessed the introduction of electricity in Zalău. After 1918, a positive evolution in economy was recorded, so that during the socialist period, the city had a wide range of industrial branches, some of which still exist nowadays, such as: metalworking and machine building industries (Silcotub, Rominserv Valves), wood processing industry, rubber processing industry (Michelin Silvania, Michelin Cord), food industry, textile industry, construction materials (Cemacom) and others. After World War II, nationalization led to the disappearance of private property, the city of Zalău being subjected to a process of forced industrialization. After 1989, the economic landscape of Zalău saw the emergence of many tertiary sector activities, having private capitals, which indicates a vigorous economic evolution, based on supply and demand.

Some economic objectives in Zalău are: Michelin, Silcotub, Cuprom, Rominserv, Valves, Cemacon, Silvania Spumante, Simex, Samtex, Comfex. At this time the main economic activities in Zalău are industrial, railway and road transports as well as agricultural activities.

### MATERIAL AND METHOD

Air quality in the Sălaj County is monitored through constant measurements at the automatic station set up in the city of Zalău, on Meteorologiei Street, this station being part of the National Air Quality Monitoring Network. The determinations surveyed the way in

which pollutants influence the health of the population and were done in cooperation with the Environmental Protection Agency of Zalău.

## RESULTS AND DISCUSSIONS

### *Acidifying gas emissions*

The acidifying of the environment is mainly determined by three types of pollutants: sulfur oxides (SO<sub>x</sub>), nitrogen oxides (NO<sub>x</sub>) and ammonia (NH<sub>3</sub>), which in contact with sunlight and water vapors form acid compounds. These compounds are often transported over long distances, far from where they were produced, determining the appearance of acid rain.

In 2009, in the Sălaj County, the emissions of sulfur dioxide (SO<sub>2</sub>) recorded an increase compared to the previous year, especially due to the emissions generated by combustions in the processing industry.

Besides these combustions resulted from the processing industry (57%), emissions of SO<sub>2</sub> are also generated by road transport (37%), non-industrial combustion plants (5%) and burnings in energetic and transformation industries (1%).

Table 1.

Annual emissions of sulfur dioxide (SO<sub>2</sub>)

Sălaj County	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
SO <sub>2</sub> emissions t/year t/an	6601,4	6437	2708,3	2174,08	323,88	426,82	86,47	87,39	62,04	70,76

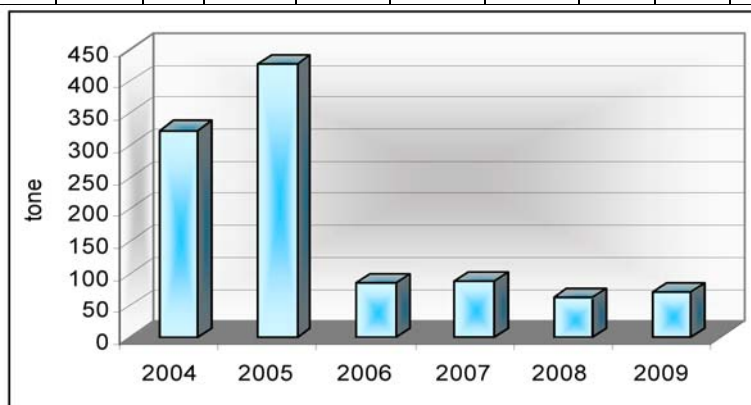


Fig. 1. Annual emissions of sulfur dioxide (tons/year)

The emissions of nitrogen monoxide and dioxide (NO<sub>x</sub>) have decreased compared to the year 2008. Road transport represents the main source of NO<sub>x</sub> pollution (75%), as well as combustions in the energetic and transformation industries (12%), combustions in the processing industry (7%) and non-industrial combustion plants (6%).

Table 2.

Annual emissions of nitrogen monoxide and dioxide (NO<sub>x</sub>)

Sălaj County	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
No <sub>x</sub> emissions t/an	639,56	656	994,07	1333,12	865	1197,52	1050,13	1173,72	1287,39	1096,389

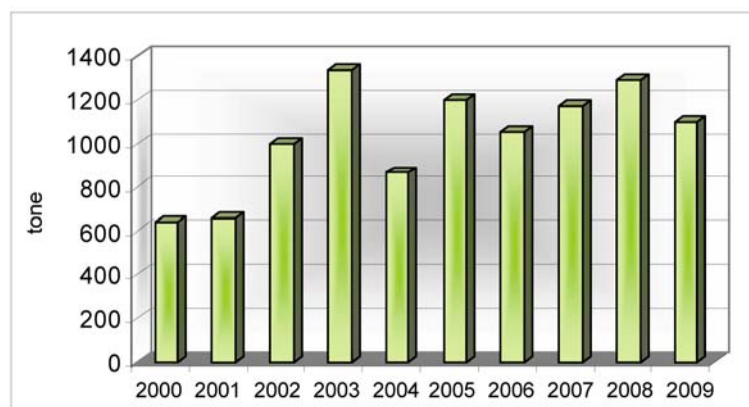


Fig. 2. Annual emissions of ammonia (tons/year)

In 2009 in the Sălaj County, the *emissions of ammonia* (NH<sub>3</sub>) recorded a significant increase compared to the previous year. The highest quantity of ammonia emissions comes from agriculture (93%). Smaller quantities are also generated by road transport (5%) and non-industrial combustion plants (2%).

Table 3.

Annual emissions of ammonia (NH<sub>3</sub>)

Sălaj County	2003	2004	2005	2006	2007	2008	2009
NH <sub>3</sub> emissions t/an	72,54	55,19	59,16	71,92	16,08	11,43	58,10

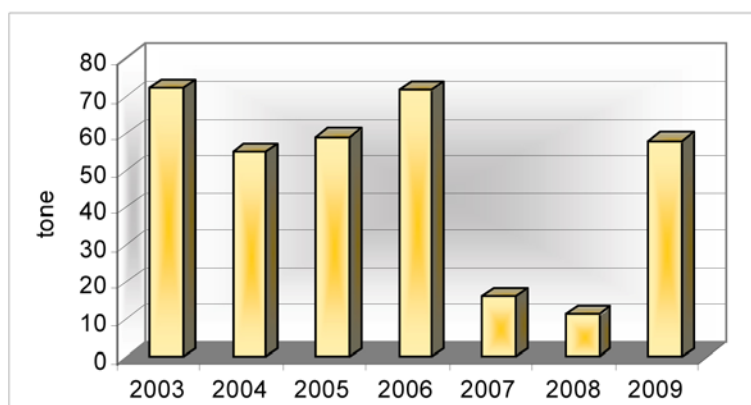


Fig. 3. Annual emissions of ammonia (tons/year)

#### *Emissions of non-methane volatile organic compounds*

In 2009, the emissions of non-methane volatile organic compounds (NMVOC) have decreased considerably compared to 2008.

Emissions of non-methane volatile organic compounds come especially from road transport (43%), using solvents and other products (25%), as well as from the extraction and distribution of fossil fuels (16%).

Table 4.

Annual emissions of non-methane volatile organic compounds (NMVOC)

Sălaj County	2003	2004	2005	2006	2007	2008	2009
COV emissions t/an	1695,8	1540,3	1720,4	1661,3	1748,5	1793,7	648,2

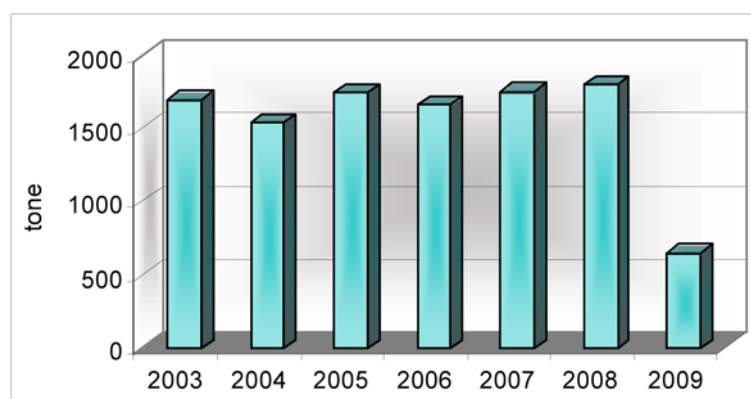


Fig. 4. Annual emissions of non-methane volatile organic compounds (tons/year)

#### *Emissions of heavy metals*

It has been noticed that in the Sălaj County, the emissions of mercury (Hg) have been on a constantly decreasing slope between 2006 and 2009. The highest share of Hg emissions in 2009 is generated by non-industrial combustion plants (52%). In 2009, the

emissions of cadmium (Cd) have increased significantly compared to previous years. Cadmium emissions result chiefly from non-industrial combustion plants (31%).

Table 5.

Annual emissions of heavy metals (Hg, Cd)

Sălaj County	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hg kg/an	0,01	3	1,5	378,41	1,13	2,18	1,47	0,82	0,63	0,53
Cd kg/an	0,05	1,19	0,06	51,8	0,68	1,2	0,87	0,77	0,71	1,86

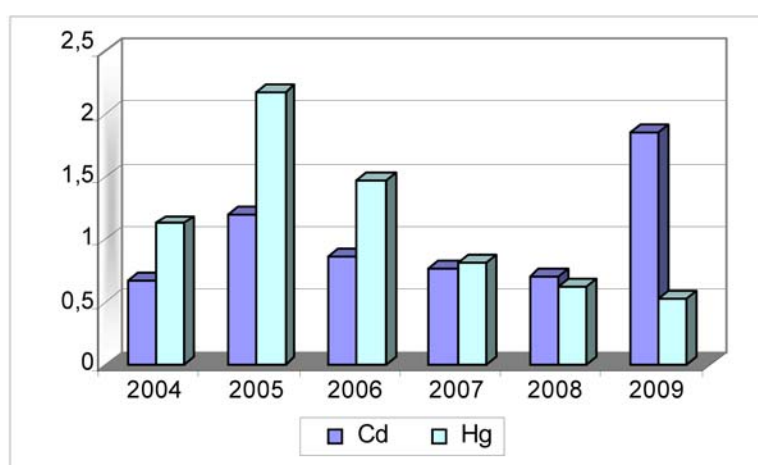


Fig. 5. Annual emissions of Cd and Hg (kg/year)

#### Emissions of lead

In 2009, the emissions of lead (Pb) have recorded a significant increase, compared to the last two years. Air is polluted with lead particularly due to emissions from processing industry combustions (43%), non-industrial combustion plants (34%), as well as road transport (19%).

Table 6.

Annual emissions of lead (Pb)

Sălaj County	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Pb kg/an	1,48	2,2	3,35	3728,13	1328	25,44	19,13	2,89	2,39	6,76

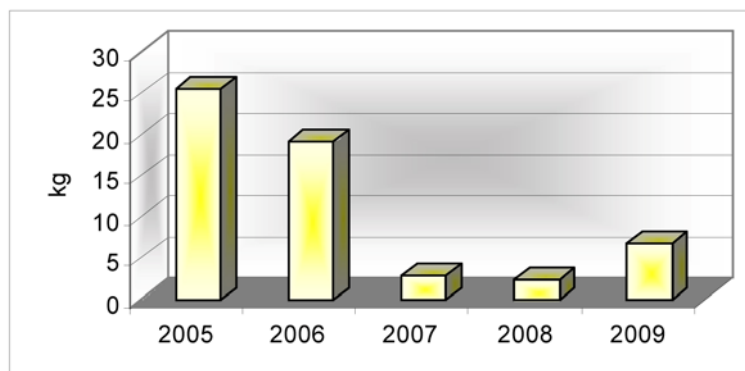


Fig. 6. Annual emissions of lead (kg/year)

*Emissions of persistent organic pollutants*

The emissions of dioxins have shown a considerable increase compared to previous years. The main source of dioxins is represented by non-industrial combustion plants (72%), and also the combustions in the processing industry (22%). Small quantities of dioxin emissions are generated by combustions in the energy and transformation industries (4%) and by production processes (2%).

Table 7.

Annual emissions of dioxins

Sălaj County	2003	2004	2005	2006	2007	2008	2009
Dioxins (g)	0,01094	0,007194	0,0064350	0,00495	0,0022	0,0021	0,0146

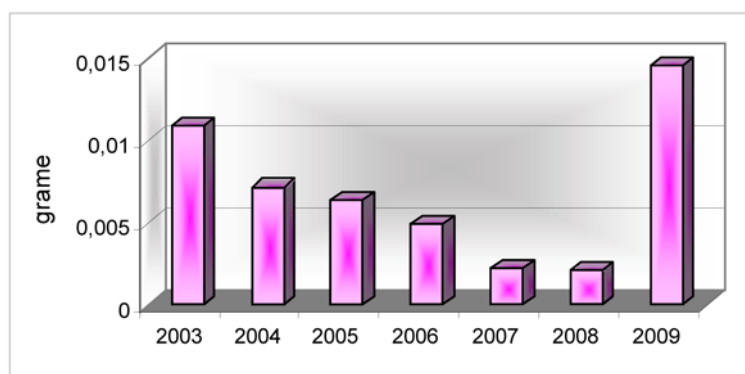


Fig. 7. Annual emissions of dioxins (g/year)

*Emissions of polycyclic aromatic hydrocarbons*

In the Sălaj County in 2009, the emissions of polycyclic aromatic hydrocarbons (PAH) have recorded a significant growth compared to previous years.

Air pollution with PAH emissions is due to production processes – in the gray iron and steel processing industries.

Table 8.

## Emissions of polycyclic aromatic hydrocarbons (PAH)

Sălaj County	2003	2004	2005	2006	2007	2008	2009
PAH (g)	2993,4	1810	701	425	650	658	8324

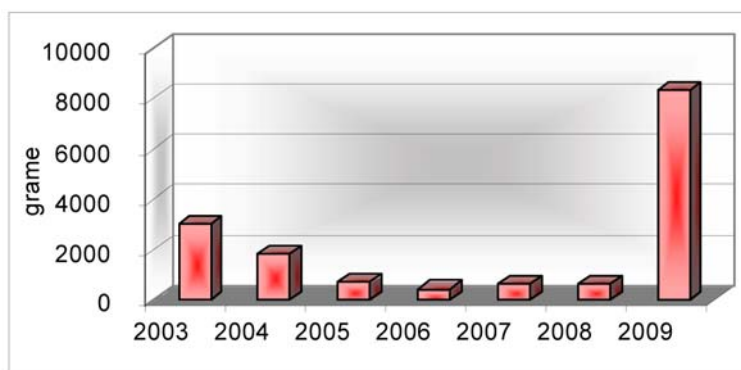


Fig. 8. Emissions of polycyclic aromatic hydrocarbons (g/year)

*Emissions of polychlorinated biphenyls*

In 2009 the emissions of polychlorinated biphenyls (PCBs) show a particular increase compared to previous years. Non-industrial combustion plants (61%) represent the sector most responsible for generating PCBs emissions this year. The other sectors are: production processes (27%) and combustions in the processing industry (12%).

Table 9.

## Annual emissions of polychlorinated biphenyls (PCBs)

Sălaj County	2003	2004	2005	2006	2007	2008	2009
PCBs (g)	0,4	0,4	0,7	0,5	0,28	0,22	6,4

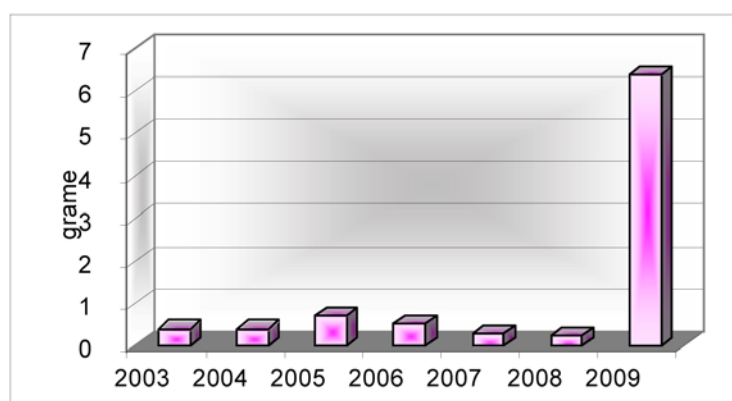


Fig. 9. Annual emissions of polychlorinated biphenyls (g/year)

## CONCLUSIONS

- Knowing the values of gas emissions represents an important element in defining the impact of social and economical development on the environment; it also creates the necessary basis for devising environmental protection policies.
- In the Sălaj County in 2009, the emissions of sulfur dioxide (SO<sub>2</sub>), ammonia (NH<sub>3</sub>), non-methane volatile organic compounds (NMVOC), cadmium and lead and polycyclic aromatic hydrocarbons (PAH) showed an increase compared to the previous year.
- The emissions of nitrogen monoxide and dioxide (NO<sub>x</sub>) have decreased in 2009 compared to the year 2008, but are still at high levels compared to the year 2000.

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