

ASSESSMENT OF AIR POLLUTION BY SETTLEABLE PARTICULATE MATTER IN THE MUNICIPALITY OF ZALĂU

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RESEARCH ARTICLE

Abstract

The study analyzes the atmospheric air pollution with settleable dust in the area of Zalău, data provided by the Environmental Protection Agency Sălaj. The research covers the period 2017-2023 and includes the monitoring of sedimentable dust concentrations in seven sampling points representative for residential, industrial and heavy traffic areas. The monitoring has been carried out on a monthly basis and the maximum permissible limits (MACs) are stable at 17 g/mp/month according to STAS 12574/1987.

The main findings indicate significant variations in concentrations, frequent exceedances of the maximum permissible values in areas with heavy traffic and near industrial activities. The main factors contributing to pollution include road traffic, industrial activities (manufacturing industry represented by companies such as Tenaris Silcotub and Michelin Romania) and construction activities. In contrast, precipitation plays a crucial role in reducing pollution concentrations.

The results emphasize the need to implement measures to reduce industrial emissions and more efficient traffic management. It is also recommended to promote environmentally friendly transport and to intensify monitoring measures to minimize the impact of pollution on human health and the environment. These conclusions emphasize the importance of integrated management of pollution factors in order to develop air quality in Zalău.

Keywords: sedimentable dust, maximum admissible concentrations, sources of air pollution

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INTRODUCTION

Air pollution is a major problem affecting health and climate, requiring rigorous studies and monitoring (Pereș et al, 2011). In the context of the city of Zalău, the paper analyzes the variations in settleable dust between 2017 and 2023, identifying the main sources of pollution and the influence of environmental factors on pollutant concentrations. Statistical data on air quality at 7 monitoring points were examined, highlighting the frequency of exceedance of maximum allowable concentrations and the impact of meteorological conditions on pollution.

Sedimentable dusts - have a diameter greater than 10 μm , have low stability in the atmosphere and therefore low diffusivity (Moza, 2009). They settle on the earth's surface near pollution sources. Sedimentable dusts originate from the building materials industry, the steel industry, road construction, mechanized

processes, soil erosion, road wear, etc. (Măhăra et al, 2003).

The municipality of Zalău, residence of the county of Sălaj, is located in the north-west of Romania, in Transylvania, in an area of hills and depressions, at the foot of the Meseș Mountains. The city is situated in the Zalău Depression, at an altitude of 275 m above sea level, on the Zalău River, and has an administrative area of 90.09 km².

MATERIAL AND METHOD

Data from the Environmental Protection Agency of Sălaj were used to analyze the atmospheric air pollution with sedimentable dust in the area of Zalău.

Sedimentable dust is determined at 7 sampling points in the city of Zalău with a monthly sampling frequency.

The monitoring points are the following:

- A.P.M. Sălaj - Str. Parcului, nr. 2

- Weather Station - Str. Meteorologiei, nr. 93 - residential area
- Str. 22 Decembrie 1989, nr. 175 - traffic station

- Str. Vânătorilor, nr. 3 A - residential area
- Str. Sărmaș, nr. 4 - conversion from industrial and storage area - to residential area - from 2023

- Station CFR Marfă Zalău Nord, bd. M. Viteazu, nr. 100 - industrial station

- Str. Cascadei, nr. 2 B - residential area

The monitored pollutants are analyzed for a period of 7 years, i.e. for the interval 2017 - 2023.

Maximum permissible concentrations for the pollutant settleable particulate matter MAC = 17 g/mp/month according to STAS 12574/1987.

RESULTS AND DISCUSSIONS

Sources of air pollution

Industrial sources

Manufacturing industry represents the main industrial branch of the municipality. The main companies operating in Zalău are Tenaris Silcotub and Michelin Romania.

Tenaris Silcotub is the largest producer of small-diameter seamless industrial pipes in Romania. Silcotub exports to international markets products used in the oil and gas industry, the energy industry, the automotive industry, etc.

The *Michelin Group* acquired the Sylvania tire factory in 2001 and has since invested in technological development. The Michelin Zalău factory, with over 1500 employees, produces various types of tires.

Rominserv Valves operated in the manufacturing industry of the Municipality of Zalău until 2022. The company designs, manufactures and commercializes industrial valves for various industries, including petroleum, petrochemical and thermal.

The Romanian companies *Universal Group - Uniconf and Rosko Textil*, specialized in the manufacture of clothing, including underwear and sportswear, are also active in the manufacturing industry in Zalău.

Zalău's industrial sector is diversified, including sub-sectors such as material extraction, food production and preservation, textile and footwear industry, wood processing, packaging, soap and detergent manufacturing, glass and concrete processing, metal products

and machinery manufacturing, and furniture manufacturing.

Mobile sources

Transportation has a profound impact on the environment and is one of the areas with the greatest influence on air quality. This influence is felt not only locally but also globally. According to available data, transport accounts for about a quarter of the world's total energy consumption, making it one of the main sources of greenhouse gas emissions.

The main substances emitted by transport are carbon dioxide (CO₂), nitrogen oxides (NO_x) and hydrocarbons. Carbon dioxide is the main greenhouse gas emitted from the combustion of fossil fuels in internal combustion engine vehicles, contributing significantly to global climate change (Pereș et al, 2011; Köteles and Pereș, 2022). Nitrous oxides are responsible for the formation of smog and acid rain, affecting human health and biodiversity. Hydrocarbons also contribute to the formation of smog and fine particulate matter, with negative effects on air quality and public health (Moza, 2009).

Starting in 1990, in the county of Sălaj there has been an upward trend in the contribution of road traffic emissions to total air pollutant emissions. This development was influenced primarily by the shrinking industrial sector, which led to a decrease in emissions from this source. On the other hand, the exponential growth in the car fleet has contributed significantly to the increase in road traffic emissions.

This change in the pollutant emission profile reflects changes in the economy and society of the county of Sălaj during that period. The reduction of industrial activities, possibly due to economic change and modernization, had a direct impact on industrial pollution sources. At the same time, economic growth and urbanization led to an increased demand for road transport, which resulted in a significant increase in the number of motor vehicles in circulation and, consequently, an increase in emissions from this source.

It is important to monitor these trends and adopt appropriate measures to manage and reduce the negative impact of road traffic emissions on air quality and public health in the county of Sălaj. These measures may include promoting public transportation, encouraging the use of less polluting vehicles, and developing infrastructure for alternative transportation, such as bicycle lanes and sidewalks for pedestrians.

Annual and multi-annual evolution of settleable dust

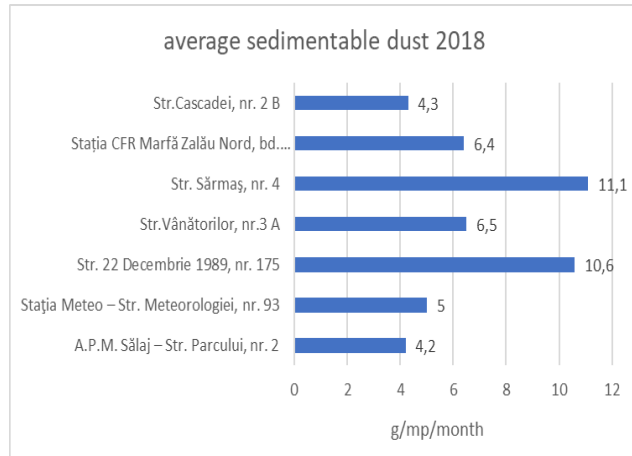


Figure 1. Evolution of the average concentrations of settleable dust in Zalău in 2018

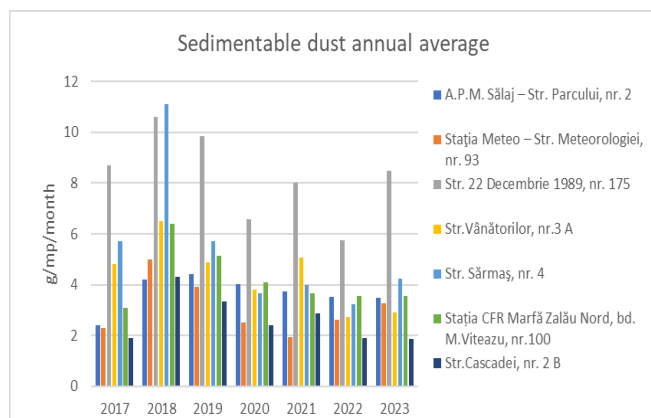


Figure 2. Evolution of annual average concentrations of settleable dust in the municipality of Zalău, in the period 2017-2023

The areas with the highest concentrations include the Consinit concrete plant, the industrial area and areas with heavy traffic. The lowest concentrations were recorded on Cascadei Street, a residential area far from pollution sources.

In Zalău, the multi-annual average of sedimentable dust pollution over the last 7 years indicates the highest levels on Str. 22 Decembrie 1989 (8.3 g/m²) and Str. Sărmaș (5.4 g/m²). Str. Sărmaș, converted from an industrial to a residential area in 2023, is affected by pollution from the Consinit concrete plant and construction sites.

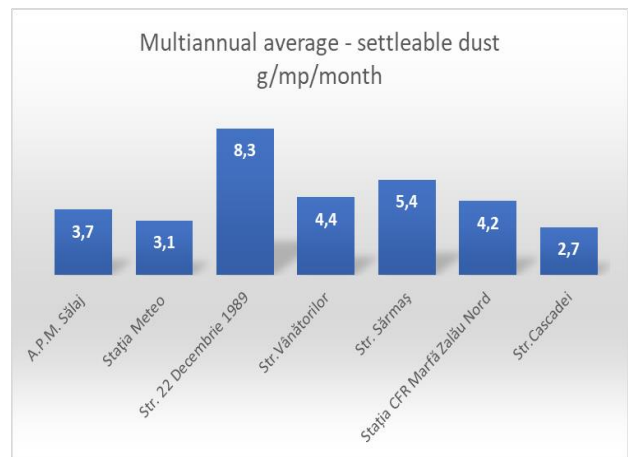


Figure 3. Evolution of the multi-annual average concentrations (2017-2023) of settleable particulate matter in the 7 monitoring points in Zalău

The lowest values were recorded on Str. Cascadei (2.7 g/m²) and at the Weather Station (3.1 g/m²).

Monthly evolution of settleable dust

The monthly trends of settleable dust in the area of Zalău show significant fluctuations in concentration.

According to the data, the highest concentration recorded was in April 2018, with 12.40 g/m², followed by May 2018, with 9.89 g/m². In contrast, the winter months recorded the lowest concentrations, with minimum values in January (ranging from 1.22 g/m² in 2022 to 2.09 g/m² in 2021).

This information emphasizes seasonal variations and highlights the impact of different meteorological and environmental conditions on settleable dust concentrations in the area.

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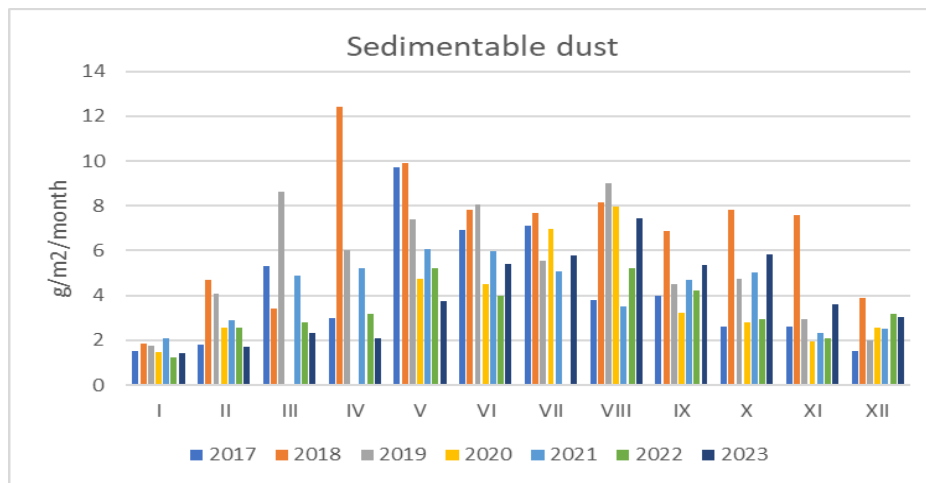


Figure 4. Monthly trends of settleable dust in the municipality of Zalău (average of 7 points), in the period 2017-20

During the studied period, multiple cases were identified where the maximum permissible concentration of 17 g/m²/month for settleable particulate matter was exceeded in certain areas of the city of Zalău. In particular, the 22 Decembrie 1989 street recorded exceedances due to heavy traffic and the area of Sărmaş street was affected by industrial and construction activities, including a concrete plant.

In May 2017, the concentration reached 29.9 g/m² in the area with heavy traffic on December 22, 1989 street. In 2018, there were three other exceedances of the maximum permissible concentration: two in April and one in November. In the Sărmaş area, exceedances were recorded in November (27.18 g/m²) and April (17.4 g/m²). In the area with heavy traffic on 22 Decembrie 1989, the exceedance was recorded in April, with a value of 18.1 g/m².

These data underline the negative impact of traffic and industrial activities on air quality in these areas.

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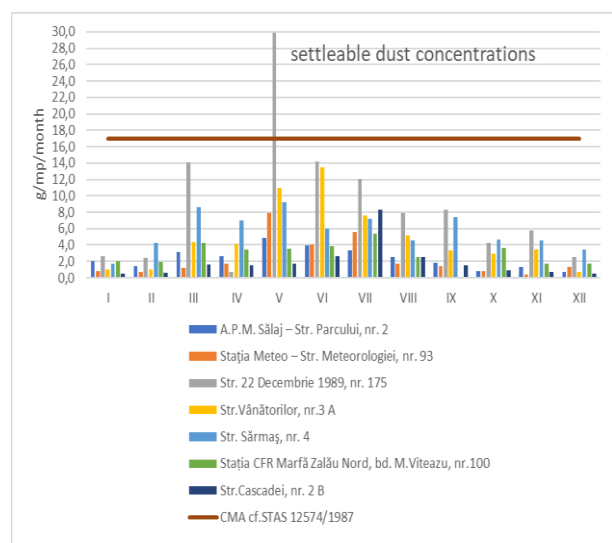


Figure 5. Monthly trends of settleable dust in Zalău in 2017

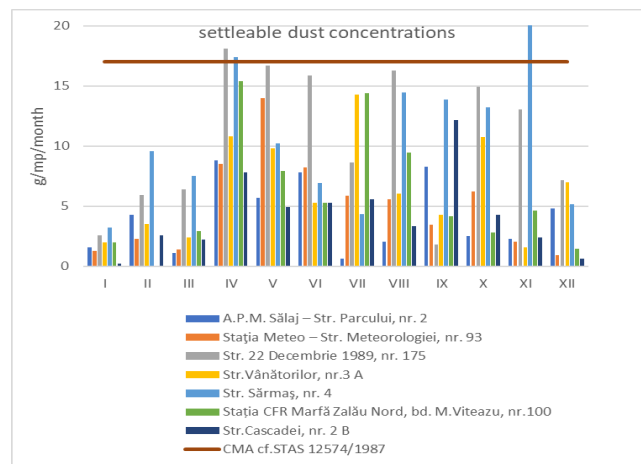


Figure 6. Monthly trends of settleable dust in Zalău in 2018

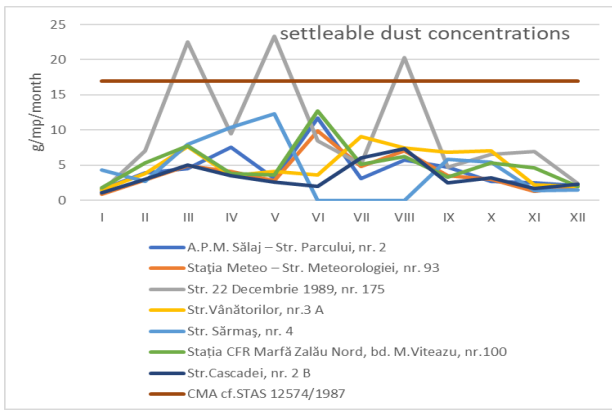


Figure 7. Monthly trends of settleable dust in Zalău in 2019

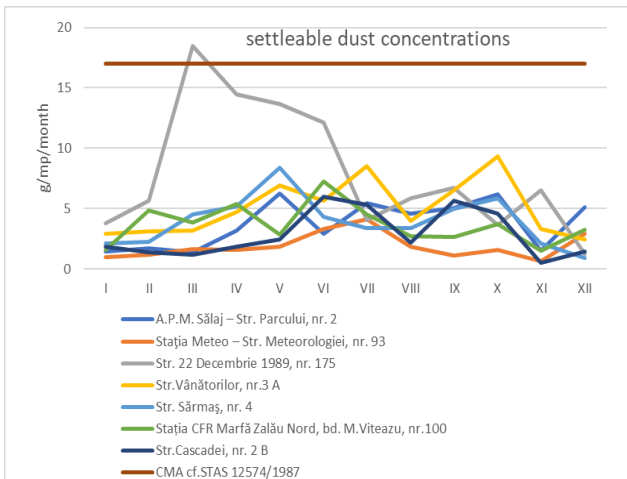


Figure 8. Monthly trends of settleable dust in Zalău in 2021

In 2019, there were three exceedances of the maximum allowable concentration for settleable particulate matter in the area of December 22, 1989 Street due to heavy traffic. The values ranged from 20.24 g/m² to 23.36 g/m² and were recorded in March, May and August.

In March 2021, a similar exceedance was recorded due to heavy traffic on the same street with a value of 18.45 g/m². This data highlights the continuing negative impact of traffic on air quality in the area.

Data indicate that the highest amount of settleable dust is recorded in the warm period of the year, ranging between 6.08 g/m² and 6.67 g/m², when the amount of precipitation also reaches maximum values (72.2 - 99.1 mm).

This emphasizes the purifying role of precipitation for air quality, as it contributes to the removal of atmospheric impurities by trapping and depositing them on the ground during fall (Sabău, 2014).

In contrast, the lowest amount of settleable dust is recorded during the cold period of the year when precipitation is low. In January, in particular, the concentration is lowest at 1.61 g/m².

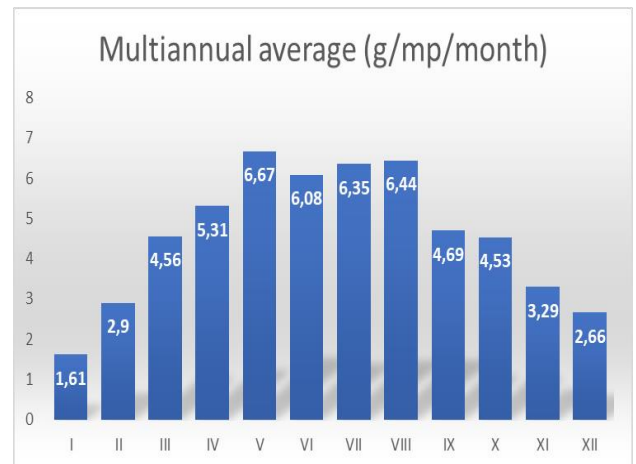


Figure 9. Evolution of monthly multiannual mean concentrations of particulate matter in Zalău (average of 7 points), in the period 2017-2023

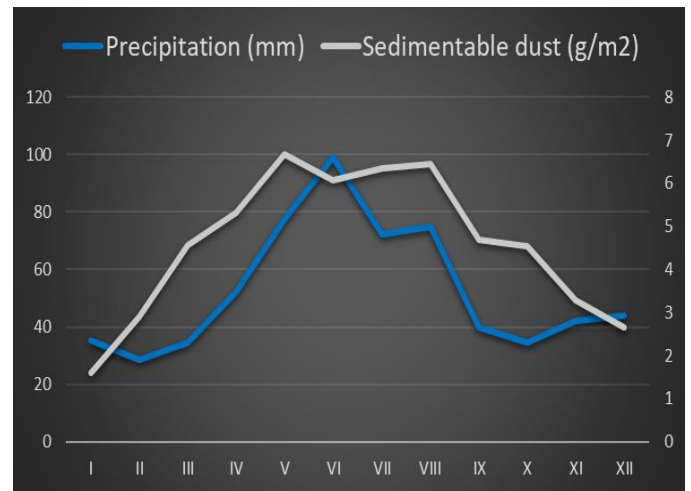


Figure 10. Variation of the monthly mean concentration of settleable dust and atmospheric precipitation, in Zalău, period 2017-2023

CONCLUSIONS

In conclusion, the analyzed data and information highlight the significant impact of air pollution on the Zalău area. The significant variations in the concentrations of settleable dust, the exceedances of the maximum permissible values in areas with heavy traffic and the proximity of industrial and construction activities, as well as the crucial role of precipitation in air purification, emphasize the importance of monitoring and managing air pollution in this area.

The manufacturing industry, represented by renowned companies such as Tenaris Silcotub and Michelin Romania, is vital to the local economy, but requires strict monitoring and the implementation of effective measures to reduce emissions.

Also, exceedances of the maximum permissible limit values caused by heavy traffic highlight the need for responsible traffic management and the promotion of more environmentally friendly means of transport.

Finally, it is essential that authorities, industry and the community work together to protect the environment and ensure clean and healthy air for all residents of Zalău.

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