

Original Research/Review

ASSESSMENT OF SEDIMENTABLE PARTICULATE MATTER IN TIMISOARA

DOI: 10.5937/EcoTER26217Z

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Abstract

Preliminary proposal work on sedimentable particulate matter (SPM) monitoring in the city of Timisoara (Romania), using passive samplers located in areas with different traffic intensities. The study aims to assess the level of particle deposition and create a database for further research on the chemical composition and pollution sources.

Keywords: SPM, air quality, settleable particulate matter, gravimetric method, environmental monitoring.

INTRODUCTION

Air pollution is one of the most important environmental challenges globally, being associated with significant effects on human health, ecosystems and urban infrastructure. Among the numerous air pollutants, particulate matter (PM) is considered one of the most relevant indicators of air quality, due to its ability to transport toxic compounds and deposit on exposed surfaces in the environment [1]. In urban environments, the main sources of particulate matter are road traffic, industrial activities, construction processes, residential heating and dust resuspension from road surfaces [2]. In addition to the inhalable fractions PM₁₀ and PM_{2.5}, settleable particulate matter (SPM) is an important component of air pollution, as it reflects the process of gravitational deposition of larger particles on soil, vegetation, buildings and other exposed surfaces. These particles can accumulate heavy metals, polycyclic aromatic hydrocarbons and other contaminants originating from anthropogenic activities, contributing to environmental degradation and contamination of urban soils [3]. Road transport is one of the main sources of particulate emissions in urban environments, both through combustion processes in vehicle engines and through non-exhaust sources, such as tire wear, brake wear and resuspension of particles deposited on the roadway. Recent studies show that, as exhaust emissions are reduced by modern technologies, the contribution of non-exhaust sources is becoming increasingly important in the total balance of particle pollution in cities [4]. Also, traffic intensity and road infrastructure characteristics significantly influence the level of particles present in the atmosphere and the rate of their deposition on urban surfaces [4]. In recent years, the interest of researchers in the study of

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atmospheric deposition processes has increased considerably, as they provide complementary information to the monitoring of suspended particle concentrations. The analysis of settleable particles allows the assessment of the cumulative impact of pollution sources on the environment and the identification of areas with high contamination potential. Recent research has highlighted the fact that particle deposition rates vary significantly depending on traffic density, industrial activities and local meteorological conditions [5,6]. At European level, particulate pollution continues to be a major environmental problem. According to recent reports by the European Commission and the Joint Research Centre (JRC), many European cities still exceed the values recommended by the World Health Organization for atmospheric particulate matter, highlighting the need to expand monitoring programs and studies on atmospheric deposition [2]. In this context, the assessment of sedimentable particulate matter in the city of Timișoara (Romania) represents a first step in the development of a comparative database on atmospheric deposition in the western region of Romania. The study aims to highlight the spatial distribution of sedimentable particulate matter in areas characterized by different intensities of traffic and urban activities, contributing to a better understanding of the influence of anthropogenic sources on environmental quality.

MATERIALS AND METHODS

The study was conducted in the municipality of Timișoara, one of the largest urban centers in western Romania, characterized by intense road traffic, industrial activities, and continuous urban development. The objective of the monitoring paper was to evaluate the spatial distribution of settleable particulate matter (SPM) and to obtain preliminary information regarding atmospheric deposition in areas exposed to different anthropogenic influences.

Six monitoring locations were selected across the city, considering traffic intensity, land use, population density, and proximity to potential pollution sources (Figure 1). A seventh location was set-up in a rural area, with no industrial/road sources. The sampling points included areas located near major road intersections, public transportation stations, educational institutions, residential neighbourhoods, and railway infrastructure. Settleable particulate matter samples were collected using passive deposition samplers, were constructed at University Politehnica laboratory, following the principles described in ASTM D1739-98 (R17), Standard Test Method for Collection and Measurement of Dustfall (Settleable Particulate Matter). The sampling system consists of a glass collecting container, mounted on a steel metal support and protected by an aluminium wind deflector, with the role of reducing the influence of air currents on the particle deposition process. All samplers were installed at a height of approximately 1.7 m above ground level, ensuring uniform collection conditions at all monitoring points.

The sampling container has a diameter of 0.16 m, achieving a collection surface of approximately 0.02 m², which allows for the efficient capture of sedimentable particles deposited gravitationally during the exposure period. Sedimentable particle samples were collected after a variable exposure period. The deposited material was recovered by washing the collection containers with type II distilled water and transported to the laboratory for processing. In the preliminary stage, the samples were passed through a 1 mm stainless steel

sieve to remove impurities and foreign materials. Subsequently, the samples were filtered through glass fiber filters, using a Buchner funnel, to separate the soluble and insoluble fractions of the sedimentable particles. Both fractions were dried at 105 °C until a constant mass was obtained, then cooled in a desiccator to avoid absorption of moisture from the atmosphere. The determination of the amount of sedimentable particles was performed gravimetrically, using an analytical balance with a precision of 0.01 mg.

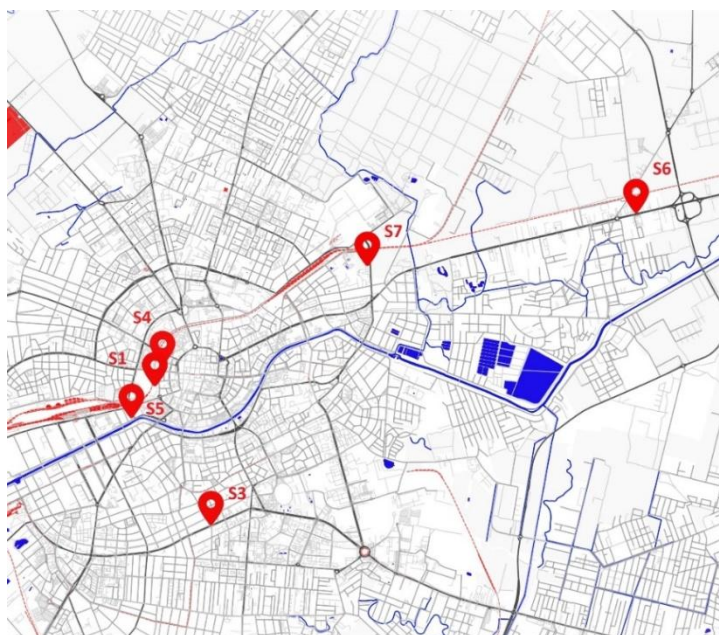


Figure 1 Location of SPM monitoring points in Timisoara

This method is based on the natural gravitational settling of atmospheric particles into collection containers exposed to outdoor conditions over a predefined sampling period. In Figure 2 an example of sampler placed on a sampling site is given.



Figure 2 SPM sampler in Timisoara, at S6 - Damaro site, with industry, rail & road traffic sources

A recent study by del Pozo *et al.* [5] on sedimentary particles collected in different urban and industrial areas highlighted the presence of metals such as copper (Cu), lead (Pb), cobalt (Co), cadmium (Cd), chromium (Cr), silver (Ag), arsenic (As) and mercury (Hg). The authors showed that these elements are mainly associated with road traffic, industrial activities and combustion processes, demonstrating the usefulness of sedimentary particles as an indicator of air pollution and the impact of anthropogenic activities on the environment. The application of a standardized sampling methodology ensures the reliability of the collected data and provides a basis for assessing the influence of urban activities and transport-related emissions on atmospheric particle deposition within the study area.

RESULTS AND DISCUSSION

The calculation of SPM deposition rate was done following ASTM-D1739-98(R17) rules:

$$C_{SPM} = \frac{m_{SPM}}{A} \cdot \frac{30}{n} \quad \left[\frac{g}{m^2} \cdot month \right] \quad (1)$$

In Equation (1), C_{SPM} represents the concentration of settleable particulate matter, while m_{SPM} denotes the mass of the collected particles. A is the effective collection area of the sampling vessel (m^2), n represents the exposure period expressed in days, and the factor **30** is used to normalize the results to a standard monthly deposition rate.

The monitoring study conducted in Timisoara municipality allowed the preliminary assessment of the spatial distribution of sedimentable particulate matter (SPM) in areas characterized by different degrees of anthropogenic influence. The values obtained highlighted variations between monitoring points, suggesting the influence of local factors, such as traffic intensity, density of urban activities and proximity of potential emission sources.

The results obtained for a variable period between 2025–2026 are presented in Table 1.

Table 1 C_{SPM} concentrations, in $[g/m^2 \cdot month]$

Period	Days	S1 Brediceanu	S2 Cornesti	S3 Astro	S4 Lenau	S5 Incuboxx	S6 Damaro	S7 Meteo
01/04/2025-31/05/2025	60	16.6975	0.8175	5.6205	17.82	6.6865	6.523	3.24
31/05/2025-01/09/2025	92	16.4918	1.94	6.0324	5.978	4.2831	5.688	3.5157
01/09/2025-31/10/2025	60	12.0625	6.895	4.9175	6.7075	5.9575	5.2875	3.9775
31/10/2025-09/12/2025	39	2.0692	0.2384	0.1038	-	0.957	0.9807	2.2961
09/12/2025-02/03/2026	83	-	-	-	3.7391	5.6439	6.1969	3.1102
02/03/2026-15/05/2026	74	5.1162	-	2.1628	2.2095	2.5662	4.8324	3.5391

As expected, the values recorded for sedimentable particles (SPM) were higher in Timisoara, which can be attributed to the higher degree of urbanization, the intensity of road traffic, the development of industrial activities and the higher population density. These factors contribute to the increase in particle emissions into the atmosphere and, implicitly, to the intensification of their deposition processes. It is to be noted that in Romania the limit

value for C_{SPM} is 17 [g/m²·month] and that this value refers to environmental assessment of mining industry and not for assessment of air quality in urban areas.

CONCLUSION

The results highlight the influence of local environmental conditions and anthropogenic factors on the distribution of settleable particulate matter within the urban environment. Furthermore, the study demonstrates the usefulness of passive monitoring techniques for evaluating atmospheric deposition and identifying areas potentially affected by increased particulate pollution.

Future investigations will focus on the physical and chemical characterization of the collected particles, particularly the determination of heavy metals associated with traffic and urban activities, with focus on elements specifically identified in EN 14902: Pb, Cd, As and Ni.

ACKNOWLEDGEMENT

This research was partially supported by the cross-border cooperation project AEPS (<http://aeps.upt.ro>) “Academic Environmental Protection Studies on surface water quality in significant cross-border nature reservations Djerdap/Iron Gate national park and Carska Bara special nature reserve, with population awareness raising workshops”, RORS-462, project funded by the INTERREG IPA-CBC Romania-Serbia Programme.

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