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ANALYTICAL INVESTIGATIONS FOR DETERMINING AIR QUALITY IN URBAN AND PERI-URBAN AREAS. CASE STUDY

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Introduction

Air pollution is one of the most important challenges to the sustainable development of cities, with cumulative effects on public health, ecosystems, and urban infrastructure. In Romania, the vulnerability of the urban environment is amplified by the increasing frequency of heat waves, changes in precipitation patterns, and the intensification of extreme weather events, which influence the dispersion and concentration of atmospheric pollutants. This paper presents the results of analytical investigations of urban air pollution carried out in a city in southern Romania, namely Ploiesti, during the springs of 2024, 2025 and 2026. Measurements were performed in spring, when meteorological parameters were characterized by stable conditions, without major or abrupt changes in weather conditions.

Materials and methods

Investigations were carried out in the urban and peri-urban areas at three monitoring points (P1-Blvd. Republicii, P2-St. Mihai Bravu, P3-St. Gageni). Pollution was monitored for total suspended particles, PM10, metals, NO_2, SO_2, CO, as well as meteorological parameters. Measurements were performed in May of each year. Meteorological conditions were characterized by clear skies, as well as cloudy and rainy weather in 2025, moderate winds with speeds of 6–18 km/h, relative humidity of 36–88%, atmospheric pressure of 1007–1020mbars, temperatures of 13–29°C.

To determine total suspended particles and PM10, samples were collected using Sven Leckel PM10 particulate samplers, and weighing was performed using a Mettler Toledo balance. Determinations were carried out according to SR EN 12341:2014-Air quality. Standard gravimetric measurement method for the determination of the mass fraction of PM10 or PM2.5 particulate matter in suspension. STAS 10813-76 – Air purity was applied for the determination of total suspended particles. An Inductively Coupled Plasma Mass Spectrometer, NexION 2200, was used to determine the mass concentration of metals in ambient air. ICP-MS analysis was applied in accordance with SR EN 14902:2006 – Ambient air quality. Standardized method for the measurement of Pb, Cd, As and Ni in the PM10 fraction of suspended particles. Determination of gaseous pollutants (CO, SO_2, NO_2) in ambient air was performed using HORIBA automatic analyzers complying with the following

standards: SR EN 14626:2025 for CO, SR EN 14212:2025 for SO_2, and SR EN 14211:2025 for NO_2.
Meteorological parameters, including temperature, atmospheric pressure, wind speed, and wind direction, were determined using a Vantage weather station.

Results and conclusions

Road traffic pollutes the air with particulate matter, nitrogen oxides, heavy metals, and other pollutants originating from fuel combustion and the wear of brakes, tires, and other vehicle components. Law No. 104/2011 sets limits for PM10 suspended particles, CO, SO_2, NO_2, and metals (lead, arsenic, cadmium, nickel). STAS 12574-87-Air from protected areas – establishes the maximum allowable concentrations for suspended particles. At all three monitoring points in the city of Ploiesti, similar concentration levels were recorded for the monitored pollutants over the three years. The measured concentration levels were influenced mainly by the intensity of road traffic in the areas where the monitoring points were located and by industrial activities carried out in the urban and peri-urban areas. The measurement results were below the concentrations established by the applicable legislation.
In spring 2025, a decrease in concentrations was observed compared with the spring 2024 measurements. This was largely due to the meteorological conditions in 2025, namely rainy weather and high atmospheric humidity: 72–88% humidity in May 2025 compared with 58–62% in May 2024. Thus, atmospheric conditions did not favor the dispersion over large areas of pollutants from sources located at a distance from the monitoring points. At the same time, rainfall acted as a wet filter, helping to reduce pollutant concentrations in the ambient air measured at the monitoring points. The measurements from May 2026 were generally at levels similar to those recorded in 2024, which can be explained by similar traffic and meteorological conditions. Lower pollutant concentrations at the measurement points are influenced by lower road-traffic levels in the area, the presence of more vehicles complying with low-emission standards, including zero-emission vehicles, lower industrial emissions, and better pollutant dispersion around the measurement points due to meteorological factors and local topography. Meteorological factors also influence pollution levels in urban areas, with rainfall being one example. Rain reduces air pollution levels, but the effect varies depending on the pollutant. Rain "washes" the atmosphere by capturing particles and certain water-soluble gases, which are then deposited on the ground. This process is known as wet deposition. Pollutants that decrease significantly during rainfall include PM10 and PM2.5 suspended particles and heavy metals contained in these particles. SO_2 is relatively soluble in water and can be efficiently removed by precipitation.
In conclusion, higher pollution levels are observed when the weather is warm and atmospheric humidity is low, while lower pollution levels are observed during rainy weather.

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