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OUTDOOR AMMONIA, BENZENE, TOLUENE AND OZONE LEVELS IN URBAN AREA MONITORED BY PHOTOACOUSTIC SPECTROSCOPY

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Introduction

Nowadays, the air pollution problem has become an important problem that affects human health. With the industrialization and expansion of residential areas around the cities, air pollution has increased, which contributes to the emergence of greenhouse gases. The aim of this study was to monitor the concentrations of ammonia (NH3), benzene (C_6H_6), toluene (C_7H_8) and ozone (O_3) in the environment of a small town located near Bucharest, using a photoacoustic laser spectroscopy system (LPAS).

Materials and methods

Ammonia, benzene, toluene and ozone concentrations in air samples were determined by a CO_2 laser photoacoustic spectroscopy (CO_2LPAS) system. This system has a multicomponent system design to detect multiple trace gases with a high sensitivity and selectivity at ppbv (parts-per-billion by volume) and ppmv (parts-per-million by volume) levels.

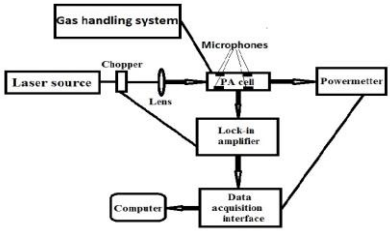

Fig.1. Scheme of the LPAS system

The experimental setup consists of three main parts (see Figure 1): the laser system, the photoacoustic (PA) cell, the detection and data acquisition systems, and the gas handling system. The air pollution monitoring was performed from three points (see Figure 2): 1. The first point – P1 (44°21'02.7''N 26°01'42.0''E) was located 150 m near a school, in a roundabout located between residential buildings. 2. The second point – P2 (44°21'10.4''N 26°02'31.0''E) was located in a small forest, 50 m from the road leading to a nuclear research institute and 150 m from the ring road of Bucharest. 3. The third point – P3 (44°22'09.6''N 26°02'34.2''E) was located on a

principal road at 50 m of a gas station and a concrete station (which produces all types of concrete needed for building bridges, houses, etc.).

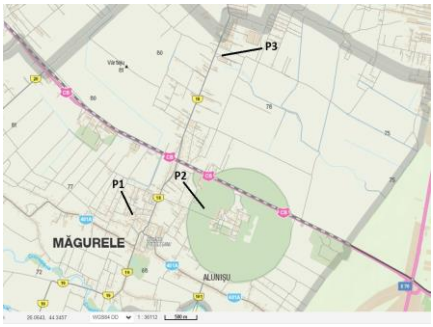

Fig.2. Spatial distribution of the monitoring area

JMP software was used to conduct statistical analysis. Multiple linear regression has been analyzed under the following assumptions: errors must have a normal distribution; the variance of the errors must be constant for any value of the independent variables and errors must be independent of each other.

Results and conclusions

The objective of this study was to study the outdoor concentrations of ammonia, benzene, toluene and ozone in three different zone. This study examines the urban air quality in spring and summer seasons using a spectroscopic system. The mean diurnal concentrations varied from 12.50 ppb to 147.80 ppb NH_3, from 0.435 ppb to 2.50 ppb C_6H_6, from 1.11 ppb to 23.55 ppb C_7H_8 and from 6.90 ppb to 26.90 ppb in case of O_3 in the 3 selected points over a period of 3 months, in the spring season (March, April and May). The mean concentrations were compared with the limit levels according to EEA (European Environmental Agency) and OSHA (Occupational Safety and Health Administration). The mean gases concentrations at all samples were low or average, with the exception of some high values of O_3, C_6H_6 and C_7H_8 during the summer period with high temperatures. The greatest deviations in concentrations are presented in areas P1 and P3 in the summer, especially in the first part of the day. This study provides useful information for understating the status of air quality in sensitive outdoor and to demonstrate that the multi-gas detection with ppb-level performance of the LPAS system has application in air pollution monitoring. The regression analyzed how the reference season (spring and summer) impact the pollutants and what would be the conclusion related with the results obtained.

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