

INFLUENCE OF DETECTED NO₂ AND O₃ ON AIR QUALITY OF THE CITY OF NOVI SAD

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Abstract

Within regular legislation of the Republic of Serbia, air quality monitoring is done on a daily basis, which we compared with the indicative measurement on a location which is in the vicinity of the measuring station “Novi Sad – Liman”. Location of the conducted indicative measurement is in the city park called “Liman park”. Mean values of the measured pollutant concentrations of O₃ and NO₂ were taken into account (the indicative measurements were done in a period of one hour). Both measuring points are located near the biggest boulevards which have a lot of traffic activity. Indicative measurements were done using the Aeroqual monitor with a GSE (gas sensitive electrochemical) sensor, while the comparative measurements were taken by automatic measuring stations put out by the state. Such a comparison of the measured NO₂ and O₃ concentrations in the air of city of Novi Sad was not done before and it can give us insight into a possible harmful impact on the public health of the citizens of Novi Sad as well as the harmful impact on the environment. Results of the measurements pointed out the variations of air pollutant values; for O₃ a 27.78% and for NO₂ 92.78% difference between the two locations that are 450 m apart from one another. The measurements were performed at the same time on the same day, temperature and relative humidity were nearly identical.

Key words: Air Quality, Nitrogen-Dioxide (NO₂), Ozone (O₃), City of Novi Sad

Introduction

City of Novi Sad is the administrative center of the South – Backa district and the autonomous province of Vojvodina. The city is located on the bank of the Danube river, occupying 699 ha with two municipalities, Novi Sad and Petrovaradin. According to the list from 2018. Novi Sad has a population of 402861 and population density of 488 citizens per 1 km². Novi Sad is an urban area with a high degree of economic development and with a low share of agricultural activities [1].

Novi Sad has an extremely favorable natural geographical position, which is confirmed by the fact that it lays on the intersection of roadways and waterways. It is positioned on the east tourist route which connects the north, central and west part of Europe with the Adriatic, Aegean and Black sea. Importance of this route, as well as Novi Sad, is emphasized even more by Corridor VII (Danube river) and Corridor X (Central Europe – Black and Aegean Sea), which have a direct effect on the Novi Sad area. The city lays on a main European road E-75, which is the main artery for the south, central and east Europe [2].

Complex chemical processes that occur in the air under influence of primary air pollutants directly change the air quality. In order to have insight into the quality of air of an urban area such as the city of Novi Sad, an analysis of the pollutants has to be done. Comparative analysis was done in the course of one day on two different locations which are distanced only 450 m from one another (by air). An average value of the measured pollutants was calculated in the

period of one hour (13:00) when most of the insolation is present, when the temperature is highest and when the traffic is the heaviest.

The measurement positions (both indicative and the ones used for comparison) are both close to each other but the indicative measurements were done in a “green zone” - in a city park. On the satellite picture below we can see the two measuring points and their distance.



Picture 1. Satellite view of the two measuring points
Indicative measurement (mobile, Novi Sad “Liman park”)
Automatic measuring station (Novi Sad – Liman)

Experimental

To measure our indicative relevant data regarding to the quality of air, relative to the NO_3 and O_3 pollution, the portable device Aeroqual series 500-monitor was used, which can measure and report changes of the levels of pollution in real time. A non-standard and indicative method was used based on an interchangeable gas sensitive electrochemical sensors (GSE). These GSE sensors permit continuous monitoring of a range of gases at low mixing ratios [3]. The measurements from the static measuring station were taken from the measuring station which was installed by the IPA 2012 sustainable project "Establishment of an integrated environmental monitoring system for air and water quality" [4] which was realized with the “Serbian Environmental Protection Agency (SEPA)”.

Results and discussion

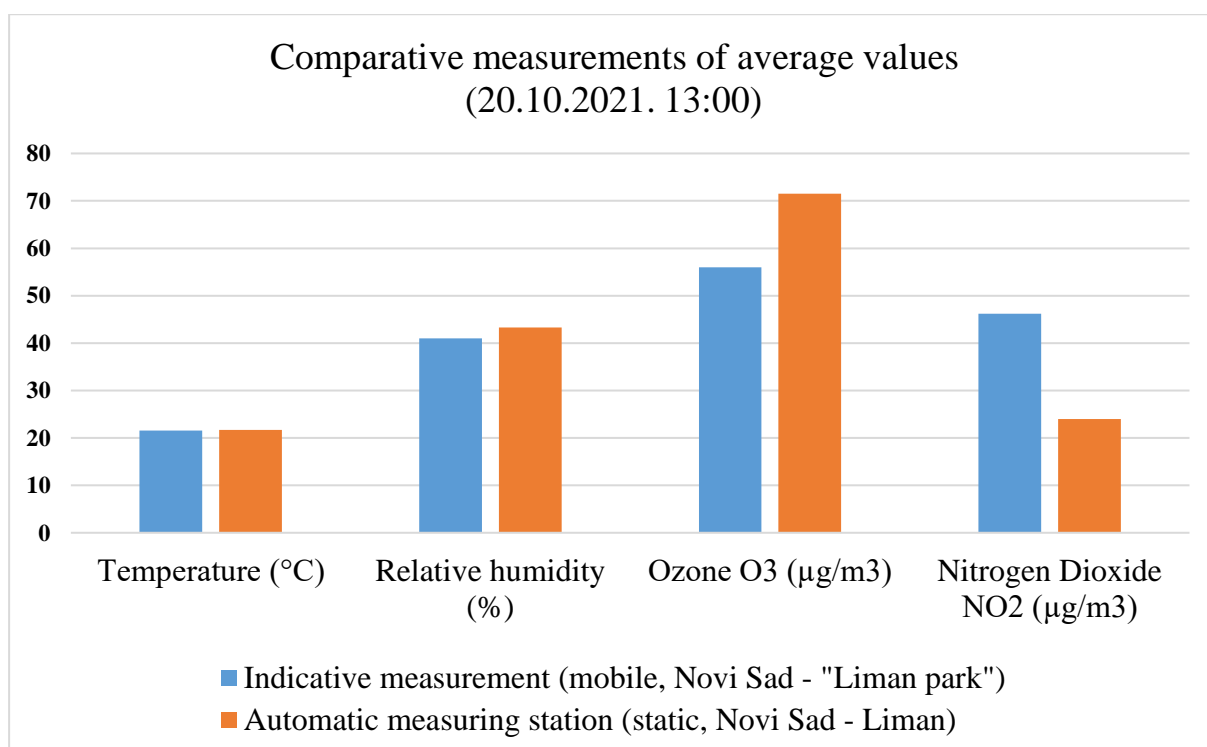
The urban part of the city of Novi Sad that was used as a representative sample for the analysis of air quality represents one of the most densely populated areas of Novi Sad with a supplemented green park zone called “Liman park”, intended for pastime and recreation of citizens. Spending time in parks on fresh and clean air is of a great importance, considering that the modern man has very little free time for departing urban areas. Green park zones and city park zones are usually the only accessible areas for daily contact with nature and clean air. Observing the common anthropological meaning of adults and children going to the park, which contributes to the development and maintenance of the physical and psychological health, maintaining vitality, quality of life, relaxing and having fun all of this represents the special pastime activity of adults and children. Those are sets of activities which directly affect the modern man, upgrading physical and psychological public health [5].

Comparative analysis of the measured concentrations of ozone (O₃) and nitrogen-dioxide (NO₂) that were done with the portable Aeroqual series 500 device and on the automatic measuring station Novi Sad – Liman are shown in the table below (table 1). The measurements were done in the same time (13:00) of the same day (20.10.2021).

Table 1. Average values of the measured data

Location	Temperature [°C]	Relative humidity [%]	Ozone (O ₃) [µg/m ³]	Nitrogen-dioxide (NO ₂) [µg/m ³]
Indicative measurement (mobile, Novi Sad – “Liman park”)	21.58	41	56	46.21
Automatic measuring station (static, Novi Sad - Liman)	21.71	43.27	71.56	23.97

If we take a look at the obtained data on the two locations that were measured in the same time, next is concluded: the temperature was nearly identical, as was the relative humidity with a small increase of 2.27% on the static measuring station Novi Sad – Liman but the concentrations of pollutants ozone and nitrogen-dioxide were at a visible discrepancy. Provided that the location “Liman park“ is surrounded by two big four lane boulevards with heavy traffic (one of the boulevards is connected to a regional road) and that the other location is enclosed by the residential and commercial buildings.



Graph 1. Comparative measurements of average values

The detected presence of NO₂ in “Liman park” is 92.78% more than on the automatic measuring station Novi Sad – Liman, while O₃ measurements are 27.78% less in “Liman park”. This extremely visible difference in the detected amount of nitrogen-dioxide in the park is a consequence of the proximity of heavy traffic roads (four lane boulevards) that surround the green zone as well as the high presence of public transportation and high number of cars which still use obsolete propulsions based on diesel and other fossil fuel engines. Additionally, “Liman park” is a green zone that isn’t adequately protected by a “green barrier” that should decrease the air pollution inside of it (from the satellite view picture it can be seen that “Liman park” has minimal tree canopy protection). Concentration of the detected O₃ which is 27.78% less on the automatic measuring station is unexpected and can be explained by the fact that the indicative measurements were done in a location which is surrounded by tree canopies, so that less amount of sunlight could penetrate into the measuring zone. The fact that the location of the automatic measuring station Novi Sad – Liman is directly exposed to sunlight and UV rays is also a factor which resulted in an increase of the detected bad ground level ozone.

Presence of detected NO₂ and O₃ pollutants has a harmful effect on the respiratory system of the citizens and also has a negative impact on the environment. Fact is that the content of ozone is increased on warm and sunny days (when people usually spend time in parks and outdoors) which is especially harmful for public health. Vulnerable groups (children and older people) that have diagnosed asthma and other respiratory diseases are the ones most exposed to the harmful effect of bad ground level ozone. Besides these groups, outdoor workers and citizens with vitamin C and vitamin E deficiency are also at risk [6]. Breathing air with a high concentration of NO₂ can irritate airways in the human respiratory system. Such exposures over short periods can aggravate respiratory diseases, particularly asthma, leading to respiratory symptoms (such as coughing, wheezing or difficulty breathing), hospital admissions and visits to emergency rooms. Longer exposures to elevated concentrations of NO₂ may contribute to the development of asthma and potentially increase susceptibility to respiratory infections. People with asthma, as well as children and the elderly are generally at greater risk for the health effects of NO₂ [6].

Conclusion

Air quality control in the urban areas of city of Novi Sad covers two different locations which have diametrically different purposes, one is intended for residency while the other is intended for recreation and relaxation. The fact that a different pollutant amount was measured between these two locations (which are 450 m apart by air) leads us to the assumption that the location directly influences the detected amounts of O₃ and NO₂. To raise the level of air quality, one of the recommended actions would be the greening of urban areas and the transition of public transport to alternative green energy drives to decrease the pollution that is currently being made by obsolete public transportation as well as personal vehicles that consume fossil fuels. Another recommended action would be the construction of transit roads which would relieve the traffic system of the city and decrease heavy traffic and to encourage the use of bicycles and other man powered transportation devices. Putting a permanent air quality measurement station in the green zones would also be of great help with the analysis of pollutant concentration in these zones.

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