

SEZIONE 15.

ECOLOGIA E TECNOLOGIE DI PROTEZIONE AMBIENTALE

DOI 10.36074/logos-15.11.2024.029

INVESTIGATING ATMOSPHERIC AIR QUALITY IN UKRAINE THROUGH CIVIC MONITORING: A CASE STUDY OF THE CITY OF ZAPORIZHZHIA

Olena Skuibida¹

1. Candidate of technical sciences, Associate Professor, Associate Professor of Occupational Safety and Environmental Protection Department
National University Zaporizhzhia Polytechnic, UKRAINE

ORCID ID: 0000-0003-1488-8568

Introduction. Military operations have had a significant impact on air pollution in Ukraine. New sources of pollutant emissions have emerged, and the spatial distribution of emission sources has shifted due to the destruction of infrastructure, industrial facilities, and the use of ammunition. As a result, air pollution has worsened, particularly with toxic chemicals and greenhouse gases, while climate change processes have been exacerbated. Therefore, the need for continuous air pollution monitoring is especially critical during wartime.

Main text. The city of Zaporizhzhia is a large industrial center in Ukraine, known for its high concentration of industrial air pollutants, including emissions from the metallurgical, machine-building, coke-chemical industries, and energy sector. In the current context, it is also a front-line city, located near the active zone of hostilities and vulnerable to missile strikes and air bombing. The city's atmospheric air contains approximately 80 pollutants, of which about 50 are classified as priority pollutants, and 17 are known carcinogens [1].

The city of Zaporizhzhia has a well-developed air quality monitoring network, which includes the following: Zaporizhzhia Regional Center of Hydrometeorology (operates stationary air quality monitoring posts in line with the state monitoring programs); Zaporizhzhia Regional Laboratory Center of the Ministry of Health of Ukraine (utilizes a mobile air quality monitoring post, following the monitoring program); industrial facilities (carry out monitoring at stationary emission source posts and air quality monitoring posts, as specified in their permitting documents); citizens and civic associations (conduct informal air quality monitoring using stationary civic monitoring stations).

The main civic air quality monitoring systems in the city of Zaporizhzhia are the EcoCity and SaveEcoBot. The city is equipped with an extensive network of civic monitoring stations (up to 39 stations operating). These stations monitor a range of pollutants, including nitrogen dioxide, ammonia, carbon monoxide, volatile organic compounds (measured as formaldehyde), ozone, dust, and background radiation [2]. Civic monitoring stations are automated systems that provide continuous, real-time air quality data, operating 24/7 with reporting intervals ranging from 20 to 60 minutes. This continuous data collection enhances the ability to analyze air quality trends compared to the data obtained from stationary posts in the state observation system.

The dynamics of changes in maximum concentrations of pollutants in 2022 (compared to 2021) according to measurements by the Zaporizhzhia Regional Center of Hydrometeorology is shown in Fig. 1.

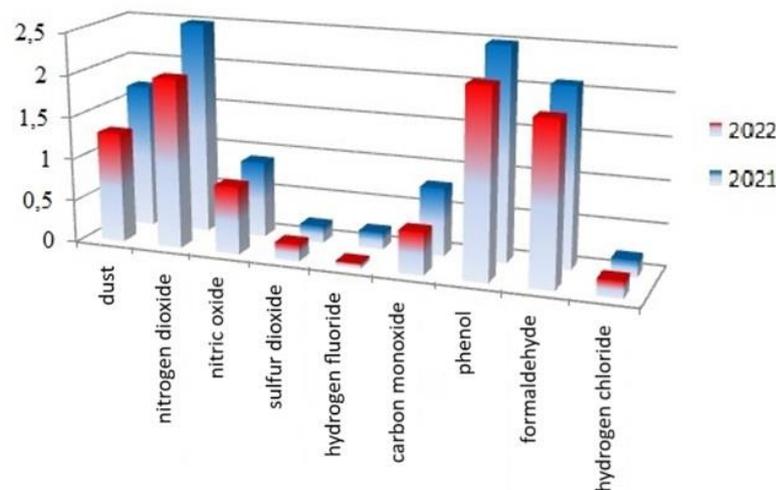


Fig. 1. **Maximum Pollutant Concentrations (in multiples of the MPC) in the Atmospheric Air of Zaporizhzhia for 2021-2022**

In the first half of 2022, Zaporizhzhia Regional Laboratory Center of the Ministry of Health of Ukraine, analyzed 1,894 atmospheric air samples, of which 241 samples (13%) did not meet the established standards. The WHO-recommended safe concentrations of fine particulate matter were exceeded for PM_{2.5} on 23 days and PM₁₀ on 7 days. The exceedances of hygienic standards were primarily due to the following pollutants: dust (33% of total deviations for this pollutant), phenol (28.3%), hydrogen sulfide (16.2%), formaldehyde (9.1%), carbon disulfide (7.1%), and nitrogen dioxide (6%). Exceedances were recorded in the range of 1.1 to 1.7 times the MPC [2].

SEZIONE 15.
ECOLOGIA E TECNOLOGIE DI PROTEZIONE AMBIENTALE

The averaged results of monitoring the content of pollutants in the Ukrainian citizen monitoring network EcoCity [1] for 2021-2022 were analyzed (Fig. 2).

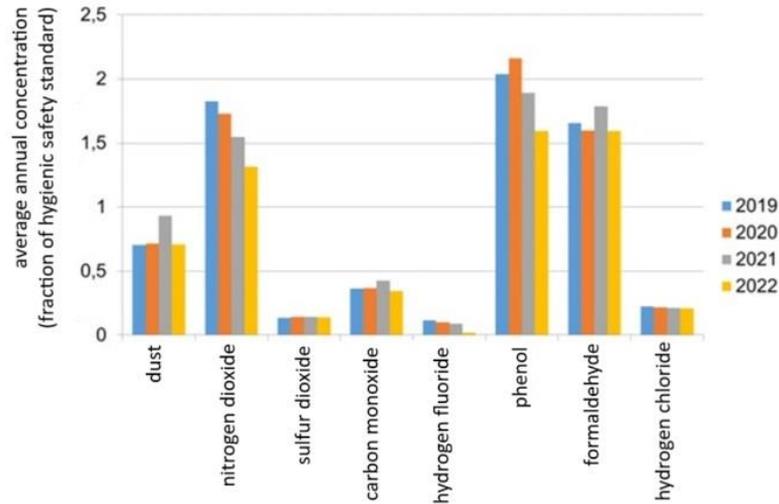


Fig. 2. **Changes in Pollutant Concentrations in Atmospheric Air for 2019-2022 [3]**

The quality of atmospheric air in Zaporizhzhia deteriorated in 2023 compared to 2022, particularly in terms of PM2.5 particulate matter (Fig. 3). The analysis was carried out according to the SaveEcoBot data [4].

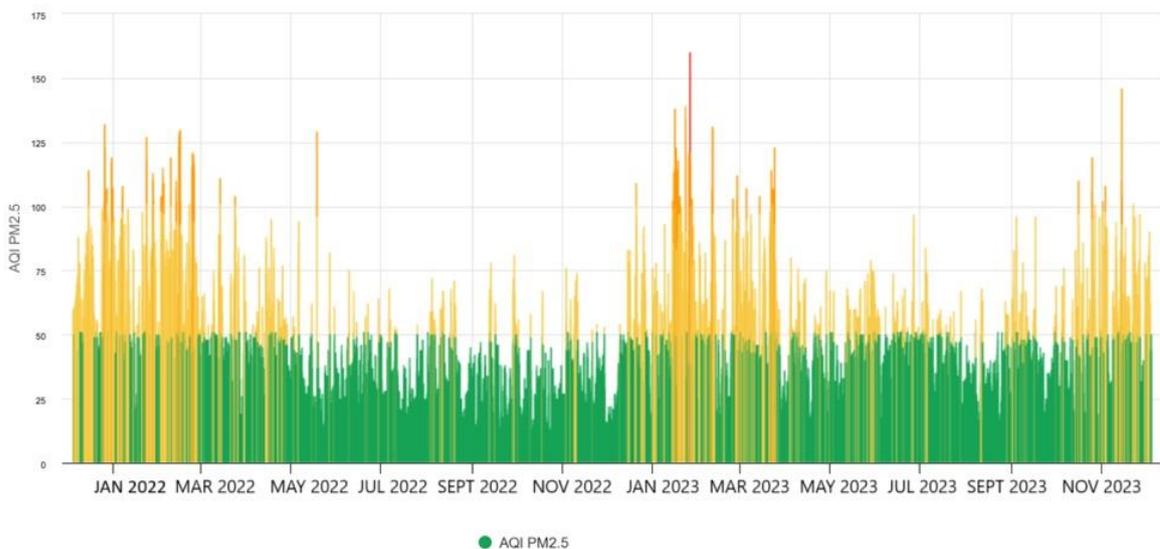


Fig. 3. **Average Air Quality Index in Zaporizhzhia Based on SaveEcoBot Civic Monitoring Data [3]**

Conclusions. Overall, the results of civic monitoring are consistent with the data obtained from the state air quality monitoring system. In 2022, a noticeable trend of decreasing pollutant levels in the atmospheric air of the city of Zaporizhzhia was observed, particularly for phenol and nitrogen dioxide. This decline can be attributed to the reduced production capacity of industrial enterprises, especially those in the first industrial group, during this period. However, in the future, air quality in residential areas significantly deteriorated. According to assessments by experts and representatives of government bodies, this may be due not only to wind direction but also to the emergence of new emission sources resulting from military operations.

Additional contributing factors include non-stationary operating modes of the equipment, unaccounted-for low-emission sources, and the activities of individual entrepreneurs [3].

REFERENCES:

- [1] *Якість атмосферного повітря за 1 півріччя 2022 м. Запоріжжя. Аналітична записка.* (б. д.). Запорізька обласна державна адміністрація. https://www.zoda.gov.ua/files/WP_Article_File/original/000193/193582.docx
- [2] *Банк даних станцій громадського моніторингу у Запорізькій області.* (б. д.). Українська мережа громадського моніторингу якості повітря Eco City. <https://eco-city.org.ua/>
- [3] *Якість повітря у місті Запоріжжя.* (б. д.). SaveEcoBot Єдина в Україні екологічна система. <https://www.saveecobot.com/maps/zaporizhzhia>
- [4] Сорока М. Л. (Ред.). (2022). *Запоріжжя: якість повітря в умовах воєнного стану (аналітична записка).* Arnika. <https://cleanair.org.ua/publication/zpaq2022/>