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The “Engineer” publishes the most significant results of scientific and applied research carried out in universities of transport profile, as well as other higher educational institutions, research institutes, and centers of the Republic of Uzbekistan and foreign countries.

The journal is published 4 times a year and contains publications in the following main areas:

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- Architecture.

Tashkent State Transport University had the opportunity to publish the international scientific journal “Engineer” based on the **Certificate No. 1183** of the Information and Mass Communications Agency under the Administration of the President of the Republic of Uzbekistan. **ISSN 3030-3893.** Articles in the journal are published in English language.

Analysis of existing methods for measurement of air pollution in road areas

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Abstract: The problem of air pollution in roadside areas is relevant due to the increase in traffic flow and urbanization. Air pollution has a significant impact on public health, especially in urban areas. The purpose of this study is to analyze existing methods and instruments for measuring air pollution in roadside areas. Objectives include a review of existing methods and an evaluation of their effectiveness.
Keywords: Exhaust gases, vehicle emissions, air pollution, environment, urban streets

1. Introduction

Air pollution is a global problem, causing millions of premature deaths every year. This applies not only to developing countries but also to developed countries, with cities in particular struggling to meet air quality limits to adequately protect human health. Overall exposure to air pollution is often disproportionately affected by the relatively short time spent commuting to work or in close proximity to vehicles. Road transport is the largest source of nitrogen oxides (NOx) and a significant source of fine particulate matter (PM2.5) (particulate matter smaller than 2.5 microns). Emissions from traffic typically have a significant impact on air quality because they are released into the air near ground level [1].

In order to implement the tasks defined in the Development Strategy of New Uzbekistan for 2022-2026 [2], increase the effectiveness of measures taken to ensure "green" and inclusive economic growth within the framework of the Strategy for the Transition of the Republic of Uzbekistan to a "green" economy, as well as further expand the use of renewable energy sources and resource saving in all sectors of the economy, the Program for the Transition to a "green" economy and ensuring "green" growth in the Republic of Uzbekistan until 2030 was approved [3] by Resolution of the President of the Republic of Uzbekistan, dated December 2, 2022 No. PP-436 [4].

2. Methodology

Existing research shows that measuring air pollution in roadside areas requires the use of various methods and instruments, such as gas analyzers, dust meters, and mobile monitoring stations. These methods allow the concentration of harmful substances such as carbon monoxide, nitrogen oxides, sulfur dioxide, and suspended particles to be assessed. For the planned experimental studies, the traditional measurement method using a mobile gas analyzer was chosen.

The analysis used data obtained using stationary and mobile monitoring stations as well as laboratory research data from the Hydrometeorological Service Agency under the Ministry of Ecology, Environmental Protection, and Climate Change of the Republic of Uzbekistan (Uzhydromet) [5].

Air quality monitoring in Tashkent is carried out at 13 stationary posts of Uzhydromet for the following indicators: dust, sulfur dioxide, nitrogen dioxide, nitrogen oxide, carbon monoxide, phenol, hydrogen fluoride, ammonia, formaldehyde, and heavy metals. Observations are carried out in accordance with regulatory documents GOST 17.2.3.01-86 [6], SanPiN 0053-23 [7], daily, three times a day (7:00, 13:00, and 19:00 local time).

Figure 1 shows an interactive map of the atmospheric air quality of the city of Tashkent for 13 stationary posts of Uzhydromet [5]: PNZ No. 1 - Tashkent: Yunusabad district, st. Chingiz Aitmatova; PNZ No. 2 – Tashkent: Yashnabad district, Magtymguly Ave.; PNZ No. 4 – Tashkent: Yakkasaray district, st. Babura; PNZ No. 6 – Tashkent: Mirzo-Ulugbek district, st. Small ring village; PNZ No. 8 – Tashkent: Chilanzar district, st. Chilanzar; PNZ No. 12 – Tashkent: Almazar district, st. Ahmad Donish; PNZ No. 14 – Tashkent: Mirabad district, st. Yangizamon; PNZ No. 15 – Tashkent: Mirabad district, Amir Temur Ave.; PNZ No. 18 – Tashkent: Yashnabad district, st. Asalobod; PNZ No. 19 – Tashkent: Yunusabad district, Amir Temur Ave.; PNZ No. 23 – Tashkent: Sergeli district, st. Chartak; PNZ No. 26 – Tashkent: Chilanzar district, st. Zargarlik; PNZ No. 28 – Tashkent: Kibray, st. Koramurt.

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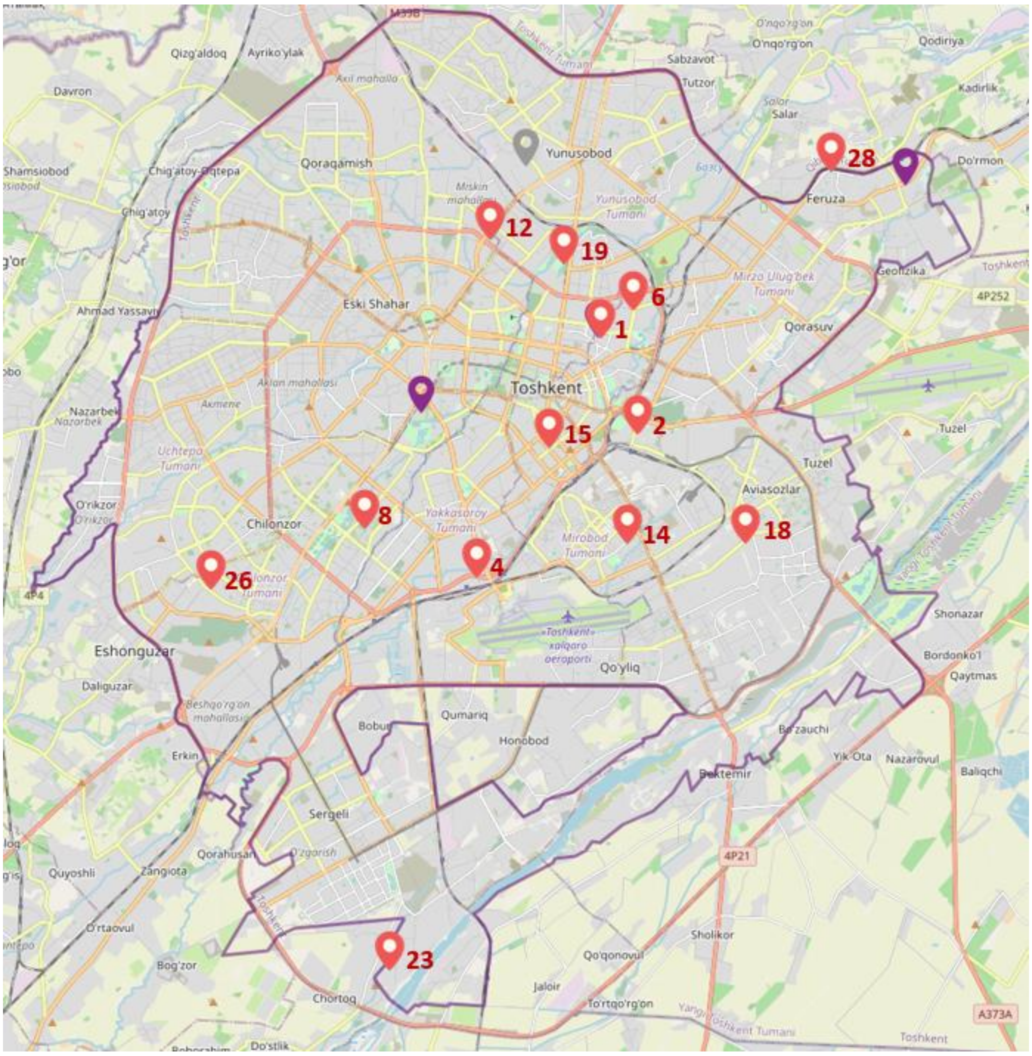

Fig. 1. Map of Uzhydromet stationary posts for monitoring air pollution in the city of Tashkent

To conduct observations and collect information on monitoring the level of dust in the atmospheric air with fine particles, as well as the content of total dust at the same time, the department for monitoring sources of emissions into the atmospheric air, at the expense of its own funds from the Center for Specialized Analytical Control in the Field of Environmental Protection (CSAC) [8], purchased the following measuring instrument: the portable dust analyzer “DustTrak DRX 8534” (Fig. 2).

Fig. 2. Gas analyzers of the Center for Specialized Analytical Control: a) “DustTrak DRX 8534”; b) "Testo 350"; c) Aspirator; d) ECOLAB

In addition, at the expense of CSAC funds, the following modern devices for monitoring sources of pollutant emissions were purchased: a portable automatic gas analyzer, “Testo 350”, designed for automatic monitoring of the concentrations of harmful substances at organized sources of industrial emissions for the content of pollutants such as nitrogen dioxide, oxide nitrogen, nitrogen oxides, carbon monoxide, and sulfur dioxide. An aspirator for taking air samples through absorption devices and special filters, designed for use in sampling both sources of industrial emissions and atmospheric air (in populated areas). Has the ability to operate on battery power.

Automatic multichannel portable gas analyzer ECOLAB (with a module for storing sensors and recharging an additional kit), designed for automatic monitoring of the concentrations of harmful substances in the atmospheric air (settled areas) for the content of pollutants such as nitrogen dioxide, carbon monoxide, sulfur dioxide, formaldehyde, hydrogen sulfide, methane, phenol, ammonia, hydrogen fluoride, etc.

The presence of existing types of gas analyzers in the Republic of Uzbekistan is shown in Fig. 3.

Fig. 3. Portable gas analyzers (source: https://glotr.uz/) [9]

3. Results and Discussion

When studying the level of atmospheric pollution by exhaust gases, the dependence of the content of impurities in the atmosphere on the intensity of vehicle traffic, the width of streets and highways, time of day, and weather conditions, as well as on the type and density of buildings, the height of buildings, and the degree of landscaping, is established.

Observations are carried out on all days of the working week, hourly, from 6 a.m. to 1 p.m. or from 2 p.m. to 9 p.m., alternating days with morning and evening periods. At night, observations are carried out once or twice a week.

Observation points are selected on urban streets in areas with heavy traffic and are located on various sections of the streets in places where cars are often broken and the largest number of harmful impurities are emitted. In addition, points are organized in places where harmful impurities accumulate due to weak dispersion (under bridges, overpasses, tunnels, narrow sections of streets, and roads with multi-story buildings), as well as in areas where two or more streets intersect with heavy traffic.

Places for placing devices are selected on the sidewalk, in the middle of the dividing strip, if there is one, and outside the sidewalk, at a distance of half the width of the one-way roadway. The point furthest from the highway must be located at least 0.5 m from the wall of the building. On streets crossing a main highway, observation points are located at the edges of sidewalks and at distances exceeding the width of the highway by 0.5, 2, or 3 times [6].

The choice of pollutants, such as carbon monoxide (CO), nitrogen monoxide (NO), nitrogen dioxide (NO2), sulfur dioxide (SO2), etc. (Fig. 4 and Fig. 5), to study the impact of exhaust gases from vehicles on the environment on sections of urban streets is justified by several key factors: direct origin from automobile emissions; significant health impact; widespread in urban environments; possibility of management and reduction.

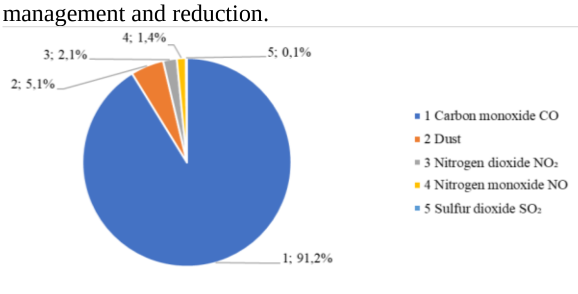

Fig. 4. Composition of atmospheric air pollutants studied for analysis from 2018 to 2023

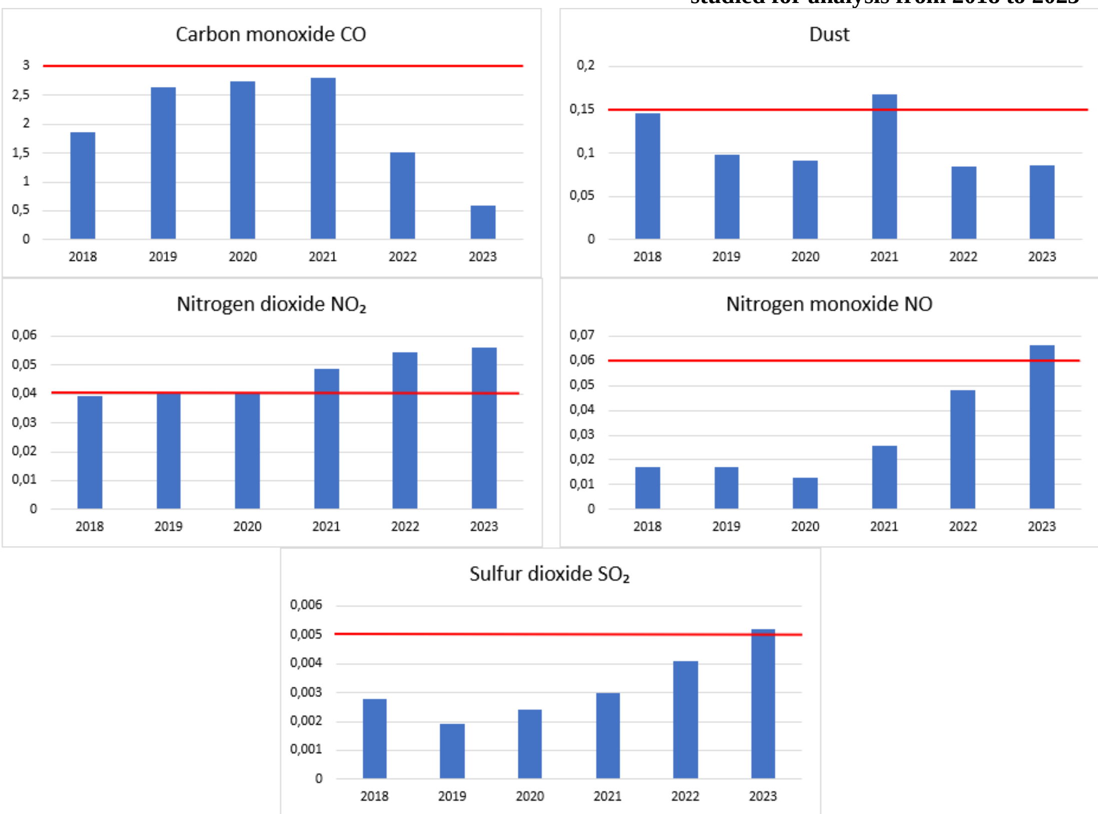

Fig. 5. Dynamics of changes in average annual concentrations (mg/m3) of pollutants by year (2018–2023)

From Fig. 4, it can be seen that the main pollutants are carbon monoxide and dust. In Fig. 5, you can see that certain substances' concentrations either increase or decrease over the years. An increase or decrease in the average annual concentration of pollutants in the atmospheric air can be caused by many factors. The reasons for the increase in concentration may be: industrial activity, increased motorization, urbanization, seasonal factors, waste combustion, natural factors, etc. The reasons for the decrease in concentration may be: environmental measures, decrease in industrial activity, increase in the number of electric vehicles and electric buses, improvement of public transport, natural conditions, etc. These factors may vary depending on the region, time of year, and current economic conditions, which makes the analysis of changes in the concentration of pollutants a complex and multifactorial process. In the future, research should include an in-depth study of these factors influencing the reasons for the increase or decrease in the average annual concentration of pollutants in the atmospheric air.

Future studies should conduct a comparative analysis of the processed data from experimental studies obtained using a gas analyzer and the data provided by Uzhydromet. This will identify differences and similarities between the two data sources and determine the accuracy and reliability of each method's measurements. The analysis will help improve air quality monitoring methods and assess the environmental situation in the study region.

4. Conclusion

Having analyzed all existing methods for determining and measuring the level of air pollution from exhaust gases on various sections of urban streets, it was concluded that the most optimal option for gas analyzer experiments was selected. The automatic multi-channel portable gas analyzer ECOLAB is effectively suitable for conducting experiments to determine the level of air pollution from exhaust gases in various sections of urban streets.

The goal and objectives of the study in the future are to study the impact of vehicle exhaust gases, depending on the intensity of traffic flow and its composition, on the environment of the Republic of Uzbekistan, especially in large cities, as well as their negative impact on drivers, passengers, pedestrians, and cyclists in various sections of city main streets.

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