The study of the parameters of the dust features of the roadside territory of the coastal city

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Abstract. The article considers the level of air pollution in several zones of the roadside territory in the city of Gudauta. Four zones are selected: roadside, residential, resort and industrial. Chemical analysis of dust samples of each zone was carried out. Comparative chemical analysis was performed between all samples. The chemical background characteristic for each zone was revealed. The dispersed analysis of the selected dust in each zone was carried out and analyzed.

1. Introduction
In contrast to the downward trend in air pollutant emissions in industrialized countries, emissions are currently increasing in some cities in non-industrial countries.
So the level of air pollution in the Republic of Abkhazia is determined mainly by emissions of vehicles, which make up more than 80% of the total amount of incoming substances.
The dustiness of roadside territories is determined by four main factors: exhaust emissions from motor vehicles, tire and brake pad wear, road destruction and dirt from the road surface under the dynamic influence of road transport. The most important pollutants emitted by vehicles are: ozone precursors, greenhouse gases, oxidizing agents, particulate matter (PM), toxic substances and heavy metals [1].
Along with chemical reactions in the atmosphere, dispersion processes occur that lead to air pollution. Concentrations of various substances vary depending on meteorological conditions, especially on the direction and speed of the wind, turbulence and stability of the atmosphere [2]. Measurements can be used to quantify these processes.

2. Theoretical part
The city of Gudauta is a linear city (an extended urban settlement formed along the main transport route in accordance with the characteristics of the terrain or transport routes). On the north side, at a distance of 15 km, a chain of high mountains of the Caucasus Range adjoins the city, on the south side the city is washed by the Black Sea.
Dust samples were taken in various areas of the city for the purpose of their further investigation (chemical analysis was performed): in a zone with a fairly high traffic intensity, in a resort zone.
(supposed clean zone), in a residential zone, in an industrial zone (warehouse of reinforced concrete products) [3].

3. Objective and tasks of research
Research Objectives:
1. To consider the level of air pollution in several zones of the roadside territory in the city of Gudauta.
2. Identify areas for sampling and further research.
3. Carry out a chemical analysis of the dust samples from each zone.
4. Carry out a comparative chemical analysis between all samples.
5. Determine the chemical background characteristic of each zone.
6. Perform a dispersed dust analysis in each zone.
4. Materials and methods
Microscopic analysis of dust samples was performed using a Versa 3D Dual Beam scanning electron microscope. The elemental composition of the samples was investigated using scanning transmission electron microscopy (STEM). High Vacuum Mode (Hi Vac) using different detectors: secondary, backscattered and transmitted electron (ETD, CBS, STEM), allows to obtain high-resolution images of metal, composite materials and powder. The dispersed analysis of dust samples was carried out according to the micrographs obtained as a result of microscopic examination using the specialized Image J software (Figure 3) [4].

![Figure 3. X-ray microanalysis of dust, on the example of a roadside zone.](image)

5. Results and discussion
After analyzing the chemical composition, we can conclude that the studied dust particles of all fractions contain such elements as Mg, Si, Al, Ca, Fe.

The elemental composition of dust samples is given, as well as their percentage ratio of molecular weight and dust weight table 1.

| Element | Roadside zone Weight % / Atomic % | Resort area Weight % / Atomic % | Residential area Weight % / Atomic % | Industrial zone Weight % / Atomic % |
|---------|----------------------------------|---------------------------------|-------------------------------------|-------------------------------------|
| C       | 31.82 / 43.45                    | 51.65 / 61.66                   | 39.87 / 50.61                       | 4.02 / 6.78                         |
| O       | 43.96 / 45.07                    | 37.52 / 33.63                   | 44.61 / 42.51                       | 49.31 / 62.41                       |
| Mg      | 3.01 / 2.03                      | 0.34 / 0.2                      | 0.19 / 0.12                         | 0.2 / 0.17                          |
| Al      | 1.03 / 0.63                      | 1.44 / 0.77                     | 1.42 / 0.8                          | 2.06 / 1.55                         |
| Si      | 4.53 / 2.65                      | 4.52 / 2.31                     | 4.75 / 2.58                         | 32.21 / 23.23                       |
| Ca      | 13.64 / 5.58                     | 1.87 / 0.67                     | 7.09 / 2.7                          | 9.21 / 4.65                         |
| Fe      | 2 / 0.59                         | 1.96 / 0.5                      | 1.3 / 0.35                          | 2.44 / 0.88                         |

In this case, the dispersed composition of dust characteristic of each zone was investigated (Figure 4).

6. Conclusions
In small quantities, chemical elements are not harmful to human life. However, an increase in their content above normal causes a toxic effect and poses a threat to health.

Air quality management should be carried out in those cities where strategic planning is weak or absent (for example, the city of Gudauta). Due to the lack of information on air quality, there is a need to improve the monitoring and assessment system for air pollution [5].
Dispersion analysis revealed that the dust size in the roadside, resort and residential areas is in the range of 60 - 90 microns, however, the percentage of fine dust in the roadside zone exceeds the same indicator in the residential and resort areas and is 1% for particles of 10 microns [6-8].

The warehouse area of the concrete products has the finest dispersed dust of all studied, which corresponds to the type of material stored on it.

The average particle size for each zone is: \( d_{50} = 42 \) microns for the roadside and resort area, \( d_{50} = 80 \) microns for residential area, \( d_{50} = 15 \) microns for the warehouse zone of concrete products.

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