On the need to apply a comprehensive assessment to determine the state of the ecosystem of soil and vegetation cover of urban areas

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Abstract. The article substantiates the need for a comprehensive assessment of the state of the ecosystem. To do this, it is necessary to carry out studies of the state of soil, water and vegetation cover with various instruments. Testing in a stationary laboratory using a trial area. For additional control of the vegetation cover, use the results of video filming and research using a thermal imager and a radar station. The latter method is extremely effective if the soil or plants contain large quantities of radioactive substances or heavy metals. For research, use previously compiled maps of contamination of territories using GIS technologies. Comparison of these data will help establish causal factors of pollution. In addition, it is possible to reveal the migration of pollution under the influence of various climatic phenomena, etc. The use of high-resolution instruments (for example, an X-ray spectrometer or a power optical microscope) allows one to determine the entire spectrum of contamination in soil, in water and on plant samples. This allows in the future to assess the behavior of chemical elements in the "soil-plant" system to determine the possibility of cleaning the area using plants. Of particular interest is the burning of fallen leaves with burying waste in the ground.

1. Introduction

The ecological situation in the world is sharply deteriorating now [1-10]. Various technogenic impacts have a great impact on both soil and water [7, 8, 11-23]. Hazardous substances enter the soil, both through the air (in the form of precipitation, and with wastewater and products of human activity) [23-31]. The most difficult situation with ecology in cities [3, 4, 7, 8, 30-34]. Recently, increased attention has been paid to the ecology of the city. Various devices and techniques have been developed to determine the state of the environment [3, 4, 32-40].

We can influence the quality of our life if we know about the state of environmental protection of the cities in which we live, as well as about ways to improve it [41-46]. Therefore, we considered it necessary to carry out research on the soil of St. Petersburg. The selected trial sites covered the most common functional areas of urban ecosystems, namely: industrial, residential and recreational [1-5, 7, 8]. The development of the monitoring research program was based on the data of the terrain
reconnaissance, regulatory documentation, as well as the specifics of the main sources of environmental pollution.

2. Research methodology
Soil sampling was carried out in accordance with regulatory documents (state standards). The selection of green spaces and fallen leaves was associated with the selection of soil samples to assess the accumulation capacity of different species deciduous plants. From each sample site, 2 combined samples were taken from a depth of 20 cm, consisting of 5-point samples by the envelope method that shown in fig. 1.

The samples were then taken to the laboratory for analysis. To improve the quality of the work, the author conducted rapid analysis of samples at the first stage of laboratory research using the Niton XLt 500 series analyzer, which allowed us to establish a list of heavy metals contained in the samples.

Measurement of the samples was carried out in accordance with the certified methods. The determination of heavy metals was carried out according to the method M-MVI-80-2008 "Method for measuring the mass fraction of elements in soil samples, soils and bottom sediments by atomic emission and atomic absorption spectrometry".

The results of the analysis showed the following:
1) more than 35 % of the studied samples are characterized by an abnormally high content of Pb, Ni, Cr, Mo, Cu, Mn, Co, and Fe;
2) analysis of water-and acid-soluble forms of metals showed that 30-50 % of the total
3) content of pollutants are in mobile form and have an increased migration ability;
4) the values of the specific electrical conductivity of soil extracts obtained during the analysis indicate an increased salt content;
5) in the samples taken along the roads, there is a significant excess of chlorides, the spread of which is recorded both in the horizontal and vertical directions;
6) in the current methods of chemical analysis, there is a need to make changes and additions taking into account the technogenesis of the samples, and in some cases it is necessary to develop new methods of analysis to assess the mobility of pollutants under the influence of various physical and chemical factors.
For a comprehensive analysis of the soil and vegetation cover, vegetation samples were analyzed at the next stage. Before performing the analysis for the gross content of pollutants, the samples were washed, dried, ground in a mortar to a powdery state, and then salted in a muffle furnace. The soil analysis, as noted above, showed significant excesses in the following elements: Pb, Ni, Cr, Mo, Cu, Mn, Co, and Fe. In this regard, plant samples were analyzed for these metals by atomic absorption spectrometry with electrothermal atomization.

3. Results
The results of the research allowed us to establish that:

1) the main pollutants of grass cover are Co and Ni, and of tree and shrub species are Pb, Mn, and Co.

2) the main role in the pollution of plants is played by dust exposure: the content of Cu and Pb in dust particles deposited and sorbed on the surface of plants increases the metal content in leaves and grass by more than 30%.

3) leaves of tree and shrub species and the ground part of herbaceous plants accumulate Fe, Mn to a greater extent, Ni and Pb to a lesser extent.

4) the maximum storage capacity is possessed by poplar, which is particularly active in accumulating heavy metals.

For the interpretation of the data was carried out mathematical treatment, which consisted in the determination of the coefficient of variation, coefficient of contrast ratio (the concentration), the total pollution rate biological accumulation, but also in building a series of geochemical Association identify the main sources of pollution.

According to the obtained values of the coefficient of variation, the distribution of contamination by all the studied elements, except Pb, Cr and Cu, is inhomogeneous. The maximum inhomogeneity is established for Co (V=76.3 %).

During ecological and geochemical studies of the environment, along with the study of individual chemical elements, an analysis of the distribution of associations was carried out. The geochemical series of the association showed that most of the studied elements exceeded the background values for Mn, Cu, Pb, and Ni. These elements are characteristic of the island's industrial facilities and road emissions and show the greatest tendency to accumulate in deciduous plants.

At the final stage, ecological and geochemical mapping of the study area was carried out using the MapInfo 12. 5 software product. For this purpose, the IDW and TIN data interpolation methods were used. The results of data visualization using the IDW interpolation method are shown in fig. 2.
As can be seen from Figure 3, the interpolation of the obtained data using this method gives a significant error. Because the resulting image does not take into account the specification of urban development. This can be avoided by creating an additional clipping layer.

The second interpolation method that was used to map the data is called the TIN interpolation method. Unlike the previous method, this method gives a more accurate distribution of contamination over an area, but it requires a dense sampling grid. This drawback is clearly visible in fig. 3.
4. Conclusion
The results obtained made it possible to substantiate a method for utilizing fallen leaves in urbanized areas. The most effective is the heat treatment of the material according to a specially developed program.

Measurements with optical instruments [37, 41-42] showed a low concentration of a dust-air mixture in the air. The results of the research will allow us to formulate a competitive and environmentally effective proposal for recycling polluted fallen leaves for large industrial cities.

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