

HEAVY METALS IN KALININGRAD ANTHROSOLS

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ABSTRACT

Soils which are involved in urbanization process are under negative influence and are polluted, particularly, with heavy metals. Moreover, the soils of Kaliningrad are polluted by industrial and household waste, building dust, and also by pathogenic microorganisms and finally become the most polluted environment.

Quantity of heavy metals falls with atmospheric precipitations on the surface within Kaliningrad has been given. Park zones with a natural soil cover and wide-leaf vegetation are estimated as pure territories in Kaliningrad (Ashmann Park). The average content of heavy metals in the parking areas with natural soils are shown. The high concentration of heavy metals in soils is observed in city residential areas. Quantity of heavy metals in soils has been researched in these areas.

According to landscape-geological researches in various areas of the city shows that the city territory is characterized by a high level of heavy metal accumulation in soils. Urban territories are under different-powerful pressure through heavy metal-carried atmospheric flows. The most powerful pressure can be observed within city territory.

Ecology-geochemical researches show that the urban ecological situation is the combination's result of natural and anthropogenic factors. Natural landscape-geochemical factors have great influence to geochemistry of urbanized territory. Nature factors have transforming role to heavy metal migration. But now the problem of influence has not been researched properly.

KEYWORDS

Heavy metals; Anthrosols; Urban environment's pollution; Geochemical landscape.

1 INTRODUCTION

Soils which are involved in urbanization process, such soils are under negative influence and are polluted, particularly, with heavy metals. Urban landscapes are under technogenic and urbanization processes influence. Considerable transformation of all soil-forming factors, essential geochemical changes of major physico-chemical and chemical soil properties are widely spread in urban landscapes. Soil properties are not the same as nature soils have. Soil properties develop in accordance with new technogenic-initiated trends. Changing of soil properties leads to changing of geochemical conditions. These new new-created geochemical conditions can be found in soils within industrial and transport areas. These conditions are responsible for migration processes and how pollution is spread, as well. Conditions have influence on urban technogenic anomalies intensity and structure.

The estimation and forecast of soil environmental are necessary for designing, arrangement of territories, carrying out of ecological expertise.

Landscape – geochemical research of anthrosols is necessary for revealing the negative ecological processes influencing on each field of city territories. This research determines geochemical fields, developing in upper horizon.

2 REVIEW

According to Stroganova's research [1], there are different types of soils, such as urbanozem, industrialzem and culturalzem. Urbanozem is presented basically in historical parts of city, industrialzem - in industrial zones and culturalzem is forming in park and zones.

Urbanozems (anthrosols in International Soil Nomenclature) often are under various physical influences, that is why some analyses results become non-comparable. So, anthrosols may be the biogeochemical barrier, which absorbing dust-gas emissions and can become a secondary source of pollution.

The soils of Kaliningrad are polluted by industrial and household waste, building dust, and also are polluted by pathogenic microorganisms and finally become the most polluted environment [2].

It is noted by Koroleva [2], that for Kaliningrad territory it is characteristic that heavy metals are getting with atmospheric precipitations and it is atmospheric influence extremely high.

2.1 Atmospheric precipitations with heavy metals

Even if there is low heavy metal background concentration in soils and plants, urban territories are under different-powerful pressure through heavy metal-carried atmospheric flows. The most powerful pressure can be observed within city territory [2, 3].

2.2 Heavy metals anthrosol pollution

Pedogeochemical indication is on the basis of soil ability to accumulate heavy metals during all influence period of time. So soil is able to fix, "to conserve" static pollution nidus throughout years. Microelement anthrosol composition has been transformed because of atmospheric technogenic precipitations in the city. Anthrosols themselves is polluted by heavy metals [3, 4].

Complicated-structure fields of heavy metal pollution can be observed in anthrosols of various functional city areas.

2.3 Geochemical transformation of anthrosol properties

Character and intensity of anthrosol pollution, especially in industrial and transport areas, is conditioned by how close to pollution sources anthrosols are, how powerful these sources are, and physico-chemical properties of anthrosols themselves. These properties may further for pollution or for self-purification of urban environment [3, 4].

Geochemical transformations of metal migration's conditions take place in urban landscapes. The cause of transformation is technogenic pollution. The most powerful transforming influences have coal power plants – they put in the air lots of carbonate dust, which is neutralized by acid rains.

As the result, alkalization of anthrosol is wide spread. Moreover, alkaline geochemical barrier has appeared in upper horizon of anthrosols. This barrier weakens heavy metal's migration ability, because heavy metals may migrate better in acid surroundings [4, 5].

Landscape-geochemical conditions have diverse influence to the level of urban environment's heavy metal pollution. Landscape-geochemical conditions may weaken or intensify, when level pollution is under formation. These conditions determine urban environment's ecology-geochemical state, for example, contrast, size of technogenic anomalies, how expressed they are.

Technogenic heavy metals anomalies in urban environment are forming if:

1. natural geochemical microelement's background is low;
2. Carbonate acidification's process is widely spread;
3. Washing type of aquatic conditions is predominated in anthrosols [4].

3 METHODS OF HEAVY METAL'S EVALUATION

The spatial structure analysis of soils pollution was made on the basis of results of landscape-geochemical shooting various zones of the city. Soil samples were selected up to depth of 50-70 cm and more. The maintenance of heavy metals was determined by a spectral method in geochemical laboratories of the St.Petersburg State University.

In order to estimate of danger of soils pollution by heavy metals were used roughly-admissible concentration for total forms.

4 RESULTS AND DISCUSSION

- According to our database [6], the anthrosols of "40 letia VLKSM" city park is containing following amounts of heavy metals mkg/g: (See table 1)

Table 1. Heavy Metal amounts of "40 letia VLKSM"

Heavy metals	Quantity, mkg/g
Cu	31.80
Zn	107.30
Mn	268.00
Ni	30.00
Pb	12.50
Cr	42.30
Cd	1.74

Those elements is concerning to polluting substances and its typical for soils of parking area with man-spread surface.

- Park zones with a natural soil cover and wide-leaf vegetation are estimated by us as pure territories in Kaliningrad (Ashmann Park).

The average content of heavy metals in the parking areas with natural soils are [7]: (see table 2)

Table 2. Average amounts of heavy metals in parking areas with natural soils

Heavy metals	Quantity, mkg/g
Cu	15.00
Zn	31.30
Mn	280.00
Pb	8.20
Cd	0.10

According to radiological researches of soils in Ashmann Park, the content of radionuclides in the taken samples is within the limits of clark value [6].

- The high content of heavy metals in soils is observed in city residential areas (Proletarskaya st., Gorkogo st., Sibirjakova st.), especially in area Sibirakova st., because of Water-heater station's smoke emissions.

In the soils of these areas, the quantity of heavy metals is studied and data are shown in Table 3.

Table 3. Heavy metal contents in residential areas

Heavy metals	Quantity, mkg/g
Cu	132.10
Zn	200.00
Ni	22.00
Pb	130.00
Hg	0.75
Cd	2.90

It is necessary to note, that the annual increasing of pollution materials in residential areas makes from 0.1-1.0 % that testifies to growth of soils pollution of the given research area. The arrangement of maximum of pollution concerning a source is connected with the form of carry of heavy metals in structure of smoke emissions Northern Kaliningrad power plant.

Dust-gas estimates of urban prospects, roads and nearby landscapes had revealed high level of presence such metals as Pb, Cd, V, Co, Cs and Ni in the air.

- Quantity of heavy metals, which falls with atmospheric precipitations on the surface within Kaliningrad are shown in Table 4.

Table 4. Heavy metal contents due to atmospheric fall out.

Heavy metals	Quantity, mkg/g
Cu	4.64
Zn	29.60
Mn	160.00
Ni	4.60
Pb	10.80
Cr	1.37
Cd	1.15

According to landscape-geological researches, was held by us in various areas of city, have shown, that the city territory is characterized by a high level of accumulation of heavy metals in soils. Intensive industrial, economic activities of the urbanized territories are accompanied by deterioration of environment and dangerous influence on people health. Newly created soils and anthropo-modified are forming in the city conditions, and of course, it is essentially different from naturally historical soils. The most of anthropogenous loading of the city we can see where high population density, a lot of transport and there are a lot of industrial and municipal enterprises. All gas and dust emissions of enterprises and transport are settling on the surface of a soil-vegetative cover

It is necessary to say, that natural landscape-geochemical factors have great influence to geochemistry of urbanized territory. Nature factors have transforming role to heavy metal migration.

But now the problem of influence has not been researched properly.

High level of urban landscape's heavy metal pollution, even when level of atmospheric heavy metal delivery is moderate, can be explained through non-favourable landscape-geochemical factors.

The content of heavy metals in soils is the sum of the initial contents and technogenic bringing, which create in soils difficultly soluble connections that is why pollution by heavy metals is especially dangerous.

5 CONCLUSIONS

As we can say, Kaliningrad Anthrosols contain high concentrations of heavy metals even in the soils of residential areas. This is the result of heavy traffic situation and smoke emissions of water-heater station and Northern Kaliningrad power plant.

So, the most quantity of heavy metals is getting into Kaliningrad environment with atmospheric precipitations. Urban territories are under different-powerful pressure through heavy metal-carried atmospheric flows, which came from another region, especially from West Europe. The most powerful pressure can be observed within city territory as the result of combination with city emissions.

Ecology-geochemical researches, were held by us, show that urban ecological situation is the combination's result of natural and anthropogenic factors. That's why evaluation of urban

landscape's ecological situation must be on the basis of natural landscape geochemical situation's analysis:

1. conditions for heavy metal migration;
2. urban landscape's location in cascade migration systems;
3. natural environment's pollution and self-purification peculiarities.

On the other hand, on the basis of technogenic factor's analysis:

1. geochemical specialization of pollution's sources;
2. physico-chemical heavy metal's properties.

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