- реагенты, добавляемые в композицию, следует выбирать таким образом, чтобы обеспечить физические и механические свойства тампонажного раствора (растекаемость, плотность, время начала и окончания схватывания, прочность и т. д.).

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Monitoring of technogenic soil pollution in manufacture

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doi 10.18411/gq-31-03-2021-21
idsp sciencerussia-31-03-2021-21

Abstract

The growth of production zones in the city of Aksai in the West Kazakhstan region leads to contamination of the soil cover, which, in turn, causes a chain reaction of pollution. Due to soil contamination, soil moisture and the underground surface are polluted. As a result, the processes in the soil change, the vital activity of plants, animals and microorganisms are disrupted.

The article presents data on the study of changes in soil cover under the influence of human activity. The results of the conducted studies on the determination of the humus content and pH level, the content of heavy metals in technogenically disturbed soils in the adjacent territory of the natural gas processing enterprise are presented. The obtained data on the gross content and mobile forms of heavy metals indicates that the maximum permissible concentration level for these pollutants is not exceeded.

Key words: nature protection, technogenic impact, environmental assessment, humus content, pH level, heavy metals.

Introduction

An effective environmental policy published in the current environmental legislation can only be implemented on the basis of detailed information on the characteristics of natural objects and a comprehensive assessment of the data obtained. Recognizing the importance of assessing the state of the entire natural environment, it is also necessary to emphasize the relevance of assessing the state of the soil, which, due to its specificity, is a medium that retains pollutants and determines the resistance of the ecosystem to negative anthropogenic influences. Its role was underestimated for a long time, which was reflected in the lack of proper attention to both environmental monitoring of soils and the rationing system in this area.

In this regard, there is a need to conduct a more in-depth analysis of the state of soils in the following areas: 1) study of basic soil characteristics in conditions of intense anthropogenic load; 2) assessment of the specifics and degree of impact of diversity of human economic activity on soil cover pollution, including on the territory of industrial zones.

The purpose of the study is an ecological assessment of the features of man-made polluted soils on the example of intensive industrial zones of Aksai, West Kazakhstan region, and the study of heavy metal contamination of soils in the territory and planning of rational use of soils in the zone of industrial impact.

Changes in the soil cover of territories with intense man-made impacts are of great interest both from a scientific and practical point of view. Many researchers believe that it is necessary to pay attention to the fact that the influence of the main factors of soil formation identified by V. V. Dokuchaev in such regions is supplemented by the processes of anthropogenesis, which determines the formation of Altered soils due to man-made influences, which differ significantly in their natural properties [1]. In the soil on the territory of industry, in contrast to natural analogues, new components, new energy and material connections are formed, which are characteristic of urbanized ecosystems [2]. It should be borne in mind that soils subject to anthropogenic changes are an important component of urboecosystems, and similarly, both in the currently published scientific literature and in the current environmental legislation, have a significant impact on the quality of the human habitat.

The soil, being a product of the interaction of a complex of natural factors, participates in the formation and operation of landscape connections, conducts or retains the main flow of substances, including pollutants [3]. In industrialized areas with a large population, the flow of pollutants consists of highly toxic elements and compounds and negatively affects the structure and functioning of natural and anthropogenic recreated ecosystems, which are among the ecotoxics.

In this regard, the study of the features of soil changes subject to intense man-made influences is necessary to assess the load limits and consequences of individual and complex impacts of human economic activity. Its results can serve as the basis for making managerial decisions on optimizing Environmental Management.

When considering the features of soil cover changes under the influence of human activity, much attention is paid to the qualitative composition and intensity of pollutants entering the soil. As a rule, the study focuses on the most dangerous heavy metals (mercury (Hg), lead (Pb), cadmium (Cd), copper (Cu), nickel (Ni), zinc (Zn), chromium (Cr) and some other elements).

As the main industrial sources of soil pollution with heavy metals, researchers call the mining and metallurgical industries (about 35%), thermal power plants (27%), oil refineries (15%), construction industry (up to 8%) and transport (13%) [4].

Man-made substances entering the environment are divided into two groups according to the types of impact: biochemically active and pedochemically active. The first one primarily affects living organisms. Biochemically active substances include fillers specific to each type of economic activity: heavy metals, various xenobiotics, petroleum hydrocarbons, etc. in man-made emissions, pedochemically active substances predominate significantly and they affect the physico-chemical and oxidative properties of soils. These include iron, calcium and magnesium carbonates, and mineral acids. These substances are also toxic to living organisms when they reach a certain concentration, but they have a much greater effect on the basic properties of the soil.

In the environmental assessment of the state of landscapes, attention is paid to substances of the first group, since their impact on organisms is obvious. Environmental and ecological-economic assessment of soil pollution (in particular, heavy metals) has been one of

the most serious problems for the past decade. This is due to the distribution of toxic concentrations of heavy metals in environmental objects, as well as a wide range of their adverse effects. This requires the development of appropriate measures to eliminate heavy metals or reduce their amount. The effectiveness of economic investments in such activities is usually based on an assessment of the level of soil pollution and the amount of damage caused by this pollution. Currently, a number of criteria are used to assess the degree of soil contamination. At the same time, some of them belong to standard (included in regulatory and methodological documents), and the other-to alternative (recommended in scientific publications by individual scientists or research groups) criteria. In addition, all indicators used in the assessment work can be divided into direct (characterizing the content of pollutants in the object) and indirect (taking into account indicators that significantly depend on the content of toxicants, for example, the biological activity of the soil). As for the latter group, it is sometimes difficult to evaluate according to these criteria due to the poor development of the experimental and information base.

The geochemical situation in urbanized landscapes varies significantly due to changes in the concentration of heavy metals in the soil, surface and ground water, as well as in bottom sediments. The contrast and duration of the accumulation of these elements is determined by natural and man-made factors that directly and indirectly determine the nature of their migration. Attention was paid to the geographical location of metal contamination zones in the territory that is the subject of this study, as well as areas with identified types of functional use. Natural factors that cause the spread of metals in the industrial area include soil features (humus content, environmental reaction, etc.), vegetation cover, the nature of air movement, and terrain. At the same time, it should be borne in mind that the specified landscape characteristics of the terrain within the city limits have significantly changed, and they can only be attributed to natural factors with certain conditionality.

When protecting the environment and using them, the problem of restoring degraded soil fertility caused by anthropogenic and man-made impacts is relevant. In order to maintain the fertility of degraded soils, it is necessary to minimize the damage caused by a person by his own economic activities on the territory of oil and gas condensate deposits.

The content of petroleum products and heavy metals in the soils of the region as a whole does not exceed the maximum permissible concentrations, but with changes in the natural morphological profile, chemical and biological properties of the industrial zone of oil and gas developments, there is a violation of the integrity of the genetic layers of the soil cover. As the field is used, the area of disturbed land increases annually.

One of the most pressing problems of the region is the problem of restoring the fertility of oil and gas condensate deposits and territories adjacent to the field, disturbed by man-made impacts. The choice of ways to restore the fertility of man-made disturbed lands depends on the type, nature and scale of pollution (depth and area of pollution, concentration in the soil or soil, depletion-pollution, etc.), selected depending on natural, soil-plant and man-made conditions, the type, composition and properties of the soil or soil to be restored, the nature of land use, the degree of degradation and the ecological state of the territory [5-7].

«The most important property of the soil is fertility. The natural fertility of the soil is determined by the combination of its properties and modes, the entire complex of environmental conditions under which the soil develops» [8]. Therefore, assessing the soil by fertility is one of the most important tasks. It can be solved based on the analysis of complex and diverse relationships between soil and agricultural plants.

Research methods

Currently, the pollution of the biosphere by a group of pollutants, which received the common name «heavy metals» is of particular importance. Heavy metals include chemical elements of D.I.Mendeleev's periodic table with an atomic weight of more than 40 a.m. with

an atomic weight of more than 50 a.m. Sometimes heavy metals with a density of 7-8 thousand names elements exceeding kg/m^3 (except precious and rare metals). Some of the man-made heavy metal emissions entering the atmosphere in the form of aerosols spread over significant distances and cause global pollution. The other part, which has a hydrochemical composition, can fall into non-flowing reservoirs and accumulate in reservoirs and bottom sediments and become a source of secondary pollution. The main mass of emissions is deposited in the immediate vicinity of sources of pollution – this is most often observed in industrial enterprises. Heavy contamination with heavy metals (lead, cadmium and zinc) was found near the highway.

The indicators obtained during the determination of the amount of humus by the method of I.V.Tyurin were determined with the help of the equation specified in the methodological manual in the «free» analysis of the number of milliliters of Moraine salt solution, during reverse titration after humus oxidation, the norm of Moraine salt solution is 0.2 n., the size of the soil taken for analysis, the % content of humus in dry soil, the pH level of soil water match were determined using the pH meter device [9-10].

In soil analysis, the method of atomic absorption spectrometry was used, which was determined by high values of the maximum permissible concentration (MPC) of toxic metals in the soil [11].

Research results

According to the results of the analysis, the % humus content in the soil cover was 3% in the surface layer, and 2.52% in the 5–20 cm layer of soil (Table 1). This showed that the amount of humus decreases in accordance with the previously analyzed data due to the depth of the soil layers, corresponding to the level of humus in the soil of the studied area.

Table 1.

Quantitative indicators obtained during the determination of humus content by V.Tyurin method

Soil sample	Content of humus , %
0 – 5 cm	3,0
5 – 20 cm	2,52

In the course of the study, the level of soil acidity was determined (Table 2). The pH level (7.57 – 7.93) in the analyzed soil samples (surface layers of 0–5 cm and 5–20 cm) showed less alkaline soils. It was found that the pH level of the soil layers corresponds to the characteristics of the soils of the region where the study was conducted, such as humus content indicators.

Table 2.

Soil acidity level

Layer of soil	pH level	Acidity of soil
0 – 5 cm	7,93	Weak alkali
5 – 20 cm	7,57	Weak alkali

In the process of determining the content of heavy metals in the soil, the reagents and their compounds necessary for analysis were prepared. It was determined by an atomic spectrometer device using ready-made concentrations of detectable heavy metals (Co, Cu, Cd, Ni, Zn, Pb) in the water extract of the soil.

The amount of heavy metal concentrations detected during the study is shown in diagram 1. The total content of heavy metals in the soil showed the range from 0.224 mg/kg to 9.2 mg/kg according to the 1st option (0–5 cm on the soil surface). The lowest indicator was found for the metal cadmium (0.224 mg/kg), and the highest indicator was nickel (9.2 mg/kg).

Diagram 1 – Gross content of heavy metals in the soil

And according to the 2nd option (in a layer of 5–25 cm of soil cover), it was observed that the content of heavy metals is between 0.216 mg/kg and 8.8 mg/kg. In this version, the lowest indicator was for a metal cadmium (0.216 mg/kg), and the highest indicator was for a metal nickel (8.8 mg/kg).

In the course of the research, the total content of heavy metals in the soil cover surface was cadmium – 0.224 mg/kg, lead – 0.874 mg/kg, cobalt – 5.7 mg/kg, zinc – 5.910 mg/kg, copper – 5.94 mg/kg and nickel – 9.2 mg/kg. It was found that the total content of heavy metals in the 5–20 cm layer of the soil cover is less than in comparison with the surface – cadmium – 0.01 mg/kg, lead – 0.01 mg/kg, cobalt – 1.08 mg/kg, and nickel – 0.4 mg/kg. Turning to the data in general diagram 1, it can be seen that a high concentration of the gross content of heavy metals in the soil is concentrated in the surface layer of the soil.

Diagram 2 – Mobile forms of heavy metals in the soil

The mobile forms of heavy metals was between 0.128 mg/kg (Cd) and 2.3547 mg/kg (Zn) on the soil surface (diagram 2). In this interval, it was found that lead is 0.29 mg/kg, cobalt is 0.394 mg/kg, copper is 1.014 mg/kg, and nickel is 1.270 mg/kg. And if we consider the 5–20 cm layer of soil cover, the chain of indicators of mobile forms of heavy metals in it is determined as cadmium (0.138 mg/kg) – lead (0.23 mg/kg) – copper (0.319 mg/kg) – cobalt (0.344 mg/kg) – zinc (0.8537 mg/kg) – nickel (1.009 mg/kg). The amount of rolling stock of heavy metals in the soil was characterized by stability of concentration in the surface layer of the soil in accordance with the total composition.

Maximum permissible concentrations of the gross content of heavy metals in the soil: cadmium – 2 mg/kg, cobalt – 15 mg/kg, lead – 30 mg/kg, copper – 55 mg/kg, nickel – 85 mg/kg, zinc – 100 mg/kg. The limit values of mobile forms are 0.5 mg/kg for cadmium, copper – 3 mg/kg, nickel – 4 mg/kg, cobalt – 5 mg/kg, lead – 6 mg/kg, zinc – 23 mg/kg. According to the conducted research, it was found that the gross content and mobile forms of heavy metals in the analyzed soil samples does not exceed the maximum permissible concentrations.

Conclusion

In the course of the study, an ecological assessment of the soil of the industrial zones of Aksay, West Kazakhstan region, including the content of humus in the soil, pH level and gross content and mobile forms of heavy metals were studied. According to the results of the study, it was found that the level of soil contamination with heavy metals in the production area does not exceed the maximum permissible concentration, the most common type of heavy metal is zinc (Zn) and the least common is cadmium (Cd).

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