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Technogenic Transformations of the Aidar- Arnasay Lake System and their Geological Consequences

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Abstract: This article presents the results of studies of the Aydar-Arnasay lake system, one of the largest reservoirs in the territory of the Republic of Uzbekistan. The water and hydrochemical regime in the territory of this reservoir is not stable. The content of many elements is changing so rapidly that it is not possible to track their dynamics, even in the presence of cartographic and analytical materials. The monitoring of the ecological state of the reservoir was carried out using a stationary observation network, complex expeditionary studies using modern equipment and observation methods, which made it possible to assess the regularity of anthropogenic transformations of the environment and the problems of biological systems affecting toxic water pollution.
Keywords: Lake Aydar-Arnasay, monitoring, electrochemical methods of analysis, ecotoxicology, taxic substances, pollution.

INTRODUCTION

Humanity is faced with a number of large-scale anthropogenically induced phenomena on a regional and global scale. The rapid growth of the world's population, the extensive involvement in the exploitation of mineral resources and technological progress have dramatically affected the state of the environment, which has led to climate change, acid precipitation, enrichment of natural environments with metals with strong carcinogenic properties and, as a consequence, the emergence of new toxic synthesized substances. In many cases, violations of the laws of nature have become uncontrollable and irreversible.

Technogenic changes on the planet are occurring so rapidly that they are comparable to geological catastrophes. Despite all man's efforts to minimize the negative consequences of his life on the planet, man has changed, is changing and will continue to change the living environment to one degree or another.

Therefore, we have identified one of the urgent tasks - to resolve the contradictions between technical progress and the need to meet the growing needs of mankind with resources to preserve the life-supporting biosphere. Studying the ecological state of the waters of the Aydar-Arnasai lake, we set the main task of studying the pollution by heavy metals related to ecotoxicants. Ecotoxicology as a scientific direction is called upon to play a decisive role in providing science with key values that allow resolving the contradictions between the technological progress of mankind and the need to provide it with clean water, preserving the natural environment and its biodiversity in the future. The objective of ecotoxicology research is the study of the fate of pollutants (migration, transformation, sedimentation, interactions) in the surrounding (aquatic) environment and their impact on organisms, populations, communities and ecosystems. Some natural elements extracted from the subsoil, enriched in technological cycles and dispersed in the environment, have a toxic effect on living organisms.

Ecotoxicity properties of metals depend on:

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- chemical composition of natural waters;
- chemical properties of the ion of the metal itself and its ability to complex formation;
- degree of danger to the environment (ability to penetrate, bioaccumulation and destructive effect on organisms).

According to their ecotoxicity, the elements are subdivided into:

- essential (biophilic): Fe, Co, Cu, Cr, Mn, Zn, etc.
- non-essential (highly toxic): As, Cd, Hg, Pb.

Essential elements are functionally inherent in living organisms at certain concentrations, however, at high levels in the environment, they have a toxic effect on them, their accumulation in the body leads to a violation of a number of biochemical functions. Non-essential metals can be toxic even at very low levels in the environment. They are highly bioaccumulative in the trophic structure of aquatic ecosystems.

As you know, organisms have the ability to regulate metal concentrations and detoxify organic xenobiotics. At the same time, they can accumulate in large quantities in living organisms, which leads to disruption of the most important functions of the body. Bioaccumulation of organic xenobiotics and non-essential elements can underlie not only acute toxic effects, but also delayed chronic ones. All chemical toxic elements and compounds initially cause disturbances in the structure and functions of molecules, which leads to a change in their functioning in the cell and, in turn, affects the structure and functions of cellular organelles, which change the physiological status of the organism.

Understanding of the research results prompted us to form an idea of the patterns of anthropogenic changes in ecosystems in a single system: from environmental conditions to organisms, populations to communities.

The set of heavy metals largely coincides with the list of "trace elements" required for plant and animal organisms. However, exceeding some concentration thresholds turns them into potent poisons. One of these heavy metals is cobalt.

One of the existing available and express methods that solve the problem of environmental pollution is amperometry with the use of organic reagents, the use of which makes it possible to reduce the lower limits of the determined concentrations of elements and improve the metrological characteristics of the proposed methods.

Methods using organic reagents for the determination of heavy and toxic metals are being intensively developed. Their rapid development is caused by the simplicity of the hardware design, rapidity, and also the possibility of using them in amperometric titration of organic reagents in out-of-laboratory field conditions.

EXPERIMENTAL PART

Standard solutions of metals were prepared by dissolving crude metals in diluted (1:1) acids with subsequent dilution with distilled water. A series of buffer solutions was prepared from 1 M HCl, NaOH, NH_4OH. The influence of pH, metal concentration, composition of the buffer mixture, and the reagent content were studied at a rate of 5 ml / min.

From the results obtained in the course of experiments, it can be concluded that nitrosonaphthol

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interacts with many metals to form complexes; therefore, this reagent is one of the less selective reagents. However, to increase the selectivity, new reagents based on nitrosonaphthol were synthesized: 2-hydroxy-3-nitroso-1-naphthaldehyde, 4-bromo-2-nitroso-1-naphthol, 4-hydroxy-3-nitrosonaphthalene-1-sulfonic acid by introducing into the reagent molecule bromine atoms, sulfo groups and other functionally active groups For example, when passing from nitrosonaphthol to halogenated ones, for example 4-bromo-2-nitroso-1-naphthol), new reagents become more specific, their selectivity improves, since they acquire the ability to interact in more acidic media and with fewer ions.

The introduction of a sulfo group into the nitrosonaphthol molecule increases the solubility of the reagent in water. Thus, the reagent 4-hydroxy-3-nitrosonaphthalene-1-sulfonic acid was synthesized, which forms an intense blue soluble complex with cobalt (II) ions. Some cations form insoluble compounds with this reagent, since salt formation in them proceeds through the sulfo group.

An increase in selectivity when modifying the reagent is associated with a change in steric factors in the nitrosonaphthol molecule. At pH 4-5, nitrosonaphthol reacts with many elements, including ions of cobalt, nickel, iron, copper and zinc, while the 2-hydroxy-3-nitroso-1-naphthaldehyde synthesized by us does not interact with copper and zinc ... At the same time, the new reagent 2-nitroso-4-isoamyl naphthol-1 interacts with copper and zinc. The isoamyl group creates spatial barriers to the placement of the ion with a large radius in the chelate ring. At the same time, copper and zinc, which show a stronger affinity for nitrogen, react with 2-nitroso 4-isoamyl naphthol-1. The assumption that spatial obstacles play a role here, and not just the introduction of an isoamyl group, is confirmed by the study of the properties of 2-nitroso 4-isoamylnaphthol-1. This reagent reacts with metals like unsubstituted nitrosonaphthol, since the isoamyl group in this case is located rather far from the heterocyclic nitrogen.

Since the synthesized reagents are weak anions, the complexing ability of nitrosonaphthol strongly depends on the pH of the medium. This is very important for the selective titration of nitrosonaphthol complexes of cobalt, since the lower the stability constant of the complex, the higher the pH of the solution must be for its satisfactory titration. In addition, the selectivity that is achieved by adjusting the pH can be further increased by using suitable masking reagents. At low pH values (in an acidic environment), the cobalt (II) ions are in a hydrated form.

The results of the experiments showed that to achieve the maximum extraction of cobalt at the optimal pH value, it takes 10-15 minutes, regardless of the initial concentration of cobalt ions in the liquid phase. With a longer contact time, the recovery rate remains constant, which indicates the establishment of equilibrium.

We studied the effect of sodium chloride, sodium nitrate, sodium sulfate. The method for determining the distribution of cobalt in water samples was the same as in all 20 experiments. The results of the study showed that sodium chloride and sodium nitrate practically do not affect the titration of cobalt to a concentration of 7.5 mg / ml. For sodium sulfate, a decrease in the degree of titration of cobalt is observed already at concentrations of 4.5 mg / ml. This behavior can be explained by the possibility of the formation of anionic sulfate complexes by the cobalt ion in the sulfate medium.

Thus, a decrease in the detection limit is achieved by concentrating the metal to be determined from a relatively large volume of solution in the aqueous phase. Unlike extraction concentration, amperometric methods do not require the use of organic solvents, and therefore are safe for health. The metal complexes of cobalt with organic reagents themselves are non-toxic, which makes the analysis more rapid.

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CONCLUSIONS

The significance of the trajectory of ecosystem pollution in the context of an increase and decrease in anthropogenic pollution will make it possible to predict future changes and correctly direct practical efforts to limit and reduce to a practical minimum anthropogenic impacts and accelerate ecosystem restoration processes, which in turn will develop mechanisms that, on the one hand, provide environmental requirements for preservation of the habitat, and on the other - the economic provision of sustainable and diverse development of society.

Maintaining a favorable water quality in sufficient quantities is a prerequisite for preserving the health of the population, biodiversity, self-renewable fish, natural and industrial products, aesthetic and recreational potential of nature.

Thus, the development of new options for effective and perfect methods of amperometric titration of metal ions with both one and two indicator electrodes in nonaqueous and mixed media using analytically active organic reagents as titrants significantly expands the scope and possibilities of using electrochemical research methods in the analysis of waters of Aydar-Arnasay lake system.

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