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THE INFLUENCE OF TOXIC AND ECOLOGICALLY HARMFUL COMPONENTS ON THE ENVIRONMENT

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ABSTRACT

This work presents the optimization of conditions for titration of lead, mercury and tungsten ions with two indicator electrodes, solutions of DDTK (diethyldithiocarbamic acid) Na and (DDTK) 2Pb. The influence of the following factors on the course and results of titration was studied: the magnitude of the external voltage applied to the indicator electrodes, the nature and concentration of the background electrolyte, the addition of an inert solvent, various foreign cations, interfering anions, a number of complexing compounds and other factors.

KEYWORDS: *ecotoxicants, heavy toxic metals, amperometric titration, industrial waste.*

IMPORTANCE OF THE PROBLEM

In recent years, in the century of scientific and technological progress, one of the most important problems humanity faced has become the protection of the environment, especially flora and fauna [1]. I, the role of the natural sciences is important, especially chemistry and ecology, since they also have the function of protecting the environmental objects. Therefore, it is urgent and necessary to improve and develop the existing and new analytical methods and approaches that provide control and subsequent quantitative determination of toxic and environmentally harmful components (impurities) with higher accuracy, selectivity and rapidity in wide ranges of their concentrations.

There is a danger of excessive accumulation of heavy toxic metals in soil and water, which ultimately can lead to environmental degradation, consequently, it is urgent and necessary to improve existing and develop new analytical methods and approaches that provide control and subsequent quantitative determination of toxic and environmentally harmful components (impurities)

with higher accuracy, selectivity and rapidity, in wide ranges of their concentrations.

The increased interest in the problem of determining heavy toxic metals in environmental objects is caused by their significant prevalence in nature, their relatively high toxicity [2], the ability to migrate and bioconcentrate. The main part of heavy toxic metals entering our environment is of a technogenic nature of anthropogenic origin as it is associated with their use in agriculture, organic synthesis, radio electronics and other fields of science and also technology and industry.

The problems of global monitoring of environmental objects provide for monitoring the levels of pollution not only in industrial, but also relatively ecologically clean areas to identify the natural background.

Urban wastewater sludge containing (mg / kg) 52–1170 copper and 10–5300 nickel can be used as organomineral fertilizers, however, with their prolonged use, there is a risk of excessive accumulation of heavy toxic metals in the soil, which ultimately can lead to deterioration in the quality of agricultural products.



It is known that due to the buffer properties of the soil, some of the introduced compounds of heavy toxic metals can be transformed into forms inaccessible to plants and, conversely, previously inaccessible compounds can pass into a mobile state. In this regard, it is important to control the content of their mobile forms of heavy toxic metals, which mainly form the flow of ions in the plant.

To assess the concentration level of mobile forms of heavy toxic metals, amperometric methods occupy one of the first and priority places, which, unlike other methods, provide the simultaneous selective determination of several elements in various extracts without preliminary separation and concentration. As a rule, the concentration of these metals in the atmosphere ranges from 0.005 to 500 ng / m³, in waters from 2 ng to 50 mkg / l. In uncontaminated rocks, sand and soil, the content of heavy toxic metals averages 0.1–0.2 mg / kg. Such low levels of metal content require the use of extremely sensitive methods of analytical control; amperometric methods of analysis and research meet all these important and necessary criteria.

It is known that minimum amounts of heavy toxic metals enter the body of humans and animals in different ways: with food, drinking water, air and etc. At present, the degree of toxic effects of various metals on all living-beings, and, in particular, on the human and animal organism, is obvious.

When analyzing (monitoring) natural objects, waters, food products and industrial effluents, amperometry, due to the high sensitivity of accuracy, the comparative cheapness of equipment and convenience in terms of automation and computerization, has gained great popularity and has found wide application in production field.

THE METHODS OF EXPERIMENT

We carried out amperometric titration of metal ions of mercury, lead, tungsten with solutions of sodium diethyldithiocarbamate (DDTK Na) and lead diethyldithiocarbamate ((DDTK)₂Pb) [3].

Amperometric titration with two platinum indicator electrodes, as follows from the volt-ampere characteristics of DDTK Na and (DDTK)₂Pb, must be carried out at voltages below 0.3 V on acetate, 0.4 V - nitrate and 0.5 V - perchlorate backgrounds, so that simultaneously the processes of oxidation of titrants at the anode and reduction of oxygen at the cathode could proceed [4-5]. If the voltage is too high and is used as a titrant (DDTK)₂Pb current can also arise due to the oxidation of lead, mercury, tungsten ions formed during the reaction at the anode and oxygen reduction at the cathode.

In order to optimize the conditions for titration of the ions of the above metals with two indicator electrodes with solutions of DDTK Na and (DDTK)₂Pb, the influence of the following factors on the course and results of titration has been studied: the magnitude of the external voltage applied to the indicator electrodes, the nature and concentration of the background electrolyte, additives of an inert solvent, various foreign cations, interfering anions, a number of complexing compounds and other factors.

THE RESULTS AND DISCUSSION

The experimental results during optimizing the conditions for titration of ions of various metals in their individual solutions served as the basis for these metals in their binary and more complex combinations.

Table 1
Amperometric titration results
ions of various metals with a solution of DDTK Na

Composition of the analyzed mixture, mkg	found Me, mkg (P=0,95; $\bar{x} \pm \Delta X$)	n	S	S _r
Bi (17,59) + Cd (45,53)	(Bi) 17,41 ± 0,66	5	0,53	0,030
Hg (21,34) + Co (92,31)	(Hg) 21,20 ± 2,31	3	0,93	0,044
Cu (9,81) + Pb (130,12)	(Cu) 9,73 ± 0,36	5	0,29	0,030
Pb (15,66) + Zn (13,00)	(Pb) 15,51 ± 0,16	4	0,10	0,006
Ni (29,34) + Ca (203,50)	(Ni) 29,46 ± 0,81	4	0,51	0,017
Ag (26,10) + Cd (102,30)	(Ag) 26,50 ± 1,29	5	1,04	0,041
W (4,97) + Mo (7,32)	(W) 4,79 ± 0,96	4	0,60	0,011



Table 2
Results of amperometric titration of ions of various metals with DDTK Na solutions in ternary and more complex mixtures ($\Delta E=0,65B$)

Mixture composition, mkg	found Me, mkg ($P=0,95; \bar{x} \pm \Delta X$)	n	S	S_r
Bi(17,59) + Al(5,03) + Ni(4,07)	(Bi) 17,63 \pm 1,03	4	0,69	0,032
Hg(21,34) + In(3,05) + Tl(1,97) + Al(214,0)	(Hg) 21,15 \pm 1,03	4	0,75	0,031
Cu(9,81) + Ni(1,02) + Cd(20,01)	(Cu) 9,88 \pm 0,47	6	0,45	0,046
Pb(15,66) + Os(95,10) + Fe(53,31) + Cd(221,1)	(Pb) 15,55 \pm 0,76	5	0,81	0,089
W(54,97) + Ni(37,58) + Au(55,48)	(W) 55,68 \pm 0,88	5	0,31	0,013

By the difference between the values of the titrant consumption in two or more metals, the content of all components in the mixture is found.

CONCLUSION

Based the studies carried out and the results obtained, it can be concluded that amperometric titration of metal ions with solutions of DDTK Na and (DDTK)₂Pb is quite possible as during the time of optimizing the titration conditions, high metrological characteristics was achieved and it was found that for effective increasing the selectivity of the developed amperometric method, it is possible to successfully use the variation not only of the acidity of the medium under study (background electrolytes), but also of the nature of the applied protolytic and inert solvents of the used reagents, as well as of the complexing compounds and anions.

In accordance with the data in Tables 1 and 2, the amperometric titration method allows obtaining fairly correct results with high reproducibility and small errors. Testing against $t_{0,95}$ statistics did not reject in any case the hypothesis of insignificance between the certified and found values.

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