Qo‘qon DPI

ILMIY XABARLAR

ISSN: 3030-3958

№ 1/2025

Qo‘qon DPI.

Ilmiy xabarlar

Кокандский ГПИ.

Научный вестник

№1/2025

УЎК 5/9(08)
КБК 72я5
Қ 99

MUASSIS:
Qo‘qon davlat pedagogika instituti

Qo‘qon DPI.
ILMIY XABARLAR-
НАУЧНЫЙ ВЕСТНИК.
Кокандский ГПИ.
Jurnal bir yilda o‘n ikki marta chop etiladi.

O‘zbekiston Respublikasi Prezidenti Administratsiyasi huzuridagi Axborot va ommaviy kommunikatsiya agentligida 2020-yil 9-iyulda 1085 raqam bilan ro‘yxatga olingan.

Jurnaldan maqola ko‘chirib bosilganda, manba ko‘rsatilishi shart.

“**Qo‘qon DPI.Ilmiy xabarlar**" ilmiy jurnali OAK Rayosatining 2021-yil 31- martdagi qarori bilan OAK ilmiy nashrlar ro‘yxatiga kimyo, biologiya, filologiya, tarix, 2023-yil 5-maydagi №337/6 sonli Rayosat qarori bilan Pedagogika hamda 2024-yil 8-maydagi 5/7-sonli OAK tartib qoida komissiyasi qarori bilan Jismoniy madaniyat, psixologiya va san’atshunoslik fan tarmoqlari bo‘yicha milliy nashrlar sifatida kiritilgan.

Tahririyat manzili:
150700, Qo‘qon shahar, Turon ko‘chasi, 23-uy.
Tel.: (0373) 542-38-38.
Сайт: www.kspi.uz
journal.kspi.uz
ISBN: 978-9943-7182-7-2
“CLASSIC” nashriyoti
2025

QO‘QON DAVLAT PEDAGOGIKA INSTITUTI ILMIY XABARLARI
(2025-yil 1-son)

TABIIY FANLAR

NATURAL SCIENCES

UDK 543.251:541.25:541.13:541.8

DETERMINATION OF HEAVY AND TOXIC METAL IONS FROM INDUSTRIAL WASTEWATER COMPOSITION BY INVERSION-VOLTAMPEROMETRIC METHOD

[1]Maxsuda Nazarova, [2]Gulnoza Saydullayeva
[1,2]Tashkent medical academy, Tashkent, Uzbekistan
[1]maxsudaqaxramonovna@gmail.com,
Phone:+998-90-984-81-06.

Abstract. One of the modern electrochemical methods of analysis, the inversion-voltammetric analysis method provides the possibility to determine the concentration of substances in a wide range (from 1 to $1 \cdot 10^{-9}$ mol/l), is easily automated, and is widely used in food quality control. is used. Inversion-voltammetric methods of analysis are used in industry for analytical control of the concentration of saline solutions, salt content of ground and underground waters, control of water quality and treatment, assessment of wastewater pollution. In our research work, the presence of copper(II) and zinc(II) ions in the composition of the industrial wastewater leaking from the gold mining “Kuchbulok mine” belonging to the Angren mining department of the Almalyk mining and metallurgical combine was studied through qualitative reactions of the corresponding ions. The pH environment of the water was determined. Based on qualitative reactions, inversion-voltammetric and X-ray-fluorescence quantitative analyzes were carried out.

Key words: trace element, waste water, metal ions, Cu(II), Zn(II), background electrolyte, buffer mixture, inversion voltammetry.

OG‘IR VA ZAHARLI METAL IONLARINI SANOAT CHIQINDI SUVLARI TARKIBIDAN INVERSION-VOLTAMPEROMETRIK USULDA ANIQLASH

Abstrakt. Zamonaviy elektrokimyoviy tahlil usullaridan biri bo‘lgan inversion-voltamperometrik tahlil usuli moddalarning konsentratsiyasini keng diapazonda (1 dan $1 \cdot 10^{-9}$ mol/l gacha) aniqlash imkonini beradi, oson avtomatlashtiriladi va oziq-ovqat sifatini nazorat qilishda keng qo‘llaniladi. Inversion-voltamperometrik tahlil usullari sanoatda tuzli eritmalar konsentratsiyasini, er osti va er usti suvlarining tuz tarkibini analitik tahlil qilish, suv sifati va tozalashni nazorat qilish, oqava suvlarning ifloslanishini baholash uchun qo‘llaniladi. Ilmiy tadqiqot ishimizda Olmaliq kon-metallurgiya kombinati Angren kon boshqarmasiga qarashli

“Kuchbulok koni” oltin konidan sizib chiqayotgan sanoat chiqindi suvlari tarkibida mis (II) va rux (II) ionlari mavjudligi tegishli ionlarning sifat reaksiyalari orqali tahlil qilindi. Suvning pH muhiti aniqlandi. Inversion-voltamperometrik va rentgen-fluoressens miqdoriy tahlillari o‘tkazildi.

Kalit so‘zlar: mikroelement, chiqindi suv, metall ionlari, Cu(II), Zn(II), fon elektrolitlar, bufer aralashma, inversion-voltamperometriya.

ИНВЕРСИОННО-ВОЛЬТАМПЕРОМЕТРИЧЕСКОЕ ОПРЕДЕЛЕНИЕ ИОНОВ ТЯЖЕЛЫХ И ТОКСИЧНЫХ МЕТАЛЛОВ ИЗ СОСТАВА ПРОМЫШЛЕННЫХ СТОЧНЫХ ВОД

Абстракт. Один из современных методов электрохимического анализа – инверсионно-вольтамперометрический метод анализа – позволяет определять концентрацию веществ в широком диапазоне (от 1 до $1 \cdot 10^{-9}$ моль/л), легко автоматизируется и широко применяется при контроле качества пищевых продуктов. Методы инверсионно-вольтамперометрического анализа применяются в промышленности для аналитического анализа концентрации солевых растворов, содержания солей в подземных и поверхностных водах, контроля качества и очистки воды, оценки загрязнения сточных вод. В нашей исследовательской работе изучено наличие ионов меди(II) и цинка(II) в составе промышленных сточных вод, вытекающих из золотодобывающего предприятия «Кучбулокский рудник», принадлежащего Ангренскому горнорудному управлению Алмалыкского горно-металлургического комбината, посредством качественные реакции соответствующих ионов. Определяли pH среды воды. На основании качественных реакций проведены инверсионно-вольтамперометрический и рентгенофлуоресцентный количественный анализы.

Ключевые слова: микроэлемент, сточные воды, ионы металлов, Cu(II), Zn(II), фоновый электролит, буферная смесь, инверсионная вольтамперометрия.

Water is a source of life and an important source for humans. However, due to human activities, water pollution is becoming more and more severe. The consequences of this pollution are very serious and cause environmental problems, and also negatively affect human health. Toxic chemicals, heavy metals and other waste emitted by factories and factories pollute water bodies. The use of water pollution can lead to various diseases, including diarrhea, intestinal infections, liver diseases and cancer. The analysis of aqueous toxic metals plays an important role in the protection of the environment and human health. This analysis will help determine the level of pollution of water bodies and reduce the negative impact of harmful substances. Depending on the results of the analysis, it is possible to determine whether the concentration of toxic metals in water is higher or lower than normal. If the concentration is higher than normal, measures should be taken to clean water bodies and eliminate sources of

pollution. The analysis of toxic metals in water is of the following importance: the Prevention of diseases caused by drinking contaminated water; the control of the level of pollution of water bodies and the protection of ecosystems; the Prevention of the consequences of toxic metals and the protection of people from danger, etc. Analysis of toxic metals in water is an important step in maintaining water bodies and protecting human health.

The conflict between the growing demand and the current supply has a huge impact on the healthy development of the industry. Studying the main influencing factors of changes in water use in industry is of great practical importance in water resources management. Industrial development is the largest contributor to changes in industrial water use and has a positive effect over the analysis period. Technological progress plays a major role in reducing industrial water use, but the negative impact changes periodically over time. Environmental protection also has a positive effect during early analysis and a negative effect later over time. The results of this research can help the relevant authorities to plan industrial development and formulate water conservation policies and rationally control industrial water demand [1,5,]. Natural resources are the basis of all material benefits of special importance for human life and development. Therefore, sustainable management of natural resources is of great importance for modern society. The concentration of heavy metals (Cu, Fe, Cd, Mn, Pb and Zn) in the soil has a negative effect on crop pollution. Human activity should be developed based on the principles of ecological sustainability. In order to improve the environment polluted by human activities, economic and social welfare and environmental protection, preservation and restoration of natural resources are necessary. In addition, managing the well-being of the environment and maintaining the cleanliness of the environment in the future will enable the production of safe food products. Maintaining good quality water resources creates security and soil quality. In recent times, there has been a significant increase in awareness of natural resources, especially water quality, soil conservation, and their importance to our lives. The research included various methodologies, qualitative, quantitative and statistical analysis [2,4].

One of the most important branches of Uzbekistan's non-ferrous metallurgy is the gold industry. The Kuchbulok gold mine from Shujumla is a mine on the northern slope of the Kurama ridge, 15 km south of Angren. Found in 1959. It has been used since 1966. The ores contain more quartz and less carbonate, besides sericites, there are various sulfides and to a lesser extent sulfa salts, tellurides, oxides, and native elements. Different ore bodies have different amounts of ore minerals. The gold-sulphide-telluride association is the main gold product in the mine. According to drilling data, the extent of mineralization reaches a depth of 1500 meters. The mine is currently being used on a large scale. Deep horizons and marginal parts are not well studied.

The waste water leaking from the Kuchbulok mine, a gold mine belonging to the Almalyk Mining and Metallurgical Combine, the Angren Mining Department, leaks from a depth of 200 meters. Leaking wastewater is pumped to the top with special pumps, and the water is

discharged to the treatment plant. Turbid wastewater is deposited in slaked lime ponds. The treated wastewater is discharged into the stream. 600,000 tons of water leaks out in 1 month.

In our research work, the pH environment of the wastewater leaking from the mine was studied using the Swiss-made pH meter pH/Mv/TEMP m FiveEasy F20 and magnetic stirrer MS-H280-Pro. Technical water was found to be acidic, i.e. pH 1.12 [13,14,15].

The results of the analysis were recorded using a graphite-based electrochemical sensor, a reference electrode with saturated potassium chloride, and an electrolyzer made of an auxiliary graphite electrode with a large surface area, equipped with a computer ABC-1.1 device. [3,9,12].

The research work began with the preparation of the wastewater sample for analysis. For this, 10 ml of the sample was taken, evaporated and filtered in the presence of the background solution, and measurements were made. We used several background electrolytes of different amounts and natures as the background electrolyte.

Table 1.

Effects of background electrolytes and buffer mixtures on the determination of Cu(II) and Zn(II) ions. (t.k.=2,5 mkA; t= 120 s; C_{Cu}= 10 mkg/dm^3; C_{Zn}= 10 mkg/dm^3)

№	E_m	Cu(II)		Zn(II)	
		E	I_d	E_m	I_d
1	,	-	2,6	-	3,2
2	,	-190	2,7	-430	3,3
3	,	-180	2,5	-440	1,4
4	,	-	-	-450	3,5
5	0,2 M KJ	240	2,7	460	3,7
6	,	-160	2,6	-440	3,6
7	,	-170	2,4	-470	3,6
8	,	-160	2,6	-460	3,6
9	**Universal buffer**	**-180**	**3,0**	**-480**	**4,2**
10	Britten-Robinson buffer	-220	2,6	-	-

These solutions, which are used as background electrolytes, were prepared by dissolving the appropriate salts in bidistilled water and using analytical chemistry as a buffer solution [4,11]. The obtained results are presented in Tables 1, 2 and 1-picture.

Table 2.

Effect of different pH values of universal buffer on the analytical signal of

2,5 mkA; t= 120 s; C_{Cu} = 10 mkg/dm^3; C_{Zn}= 10 mkg/dm^3)

Cu(II), Zn(II) (P=0,95; n=3)			
№	**pH**	**I**	**I**
	1,85	4,04	3,20
	2,65	4,58	3,00
	3,56	5,03	3,15
	4,25	5,90	3,30
	4,75	**6,20**	3,55
	5,45	5,80	**3,75**
	5,90	4,75	3,50
	8,40	4,50	3,40
9	9,45	3,80	3,00
10	11,02	2,90	2,20

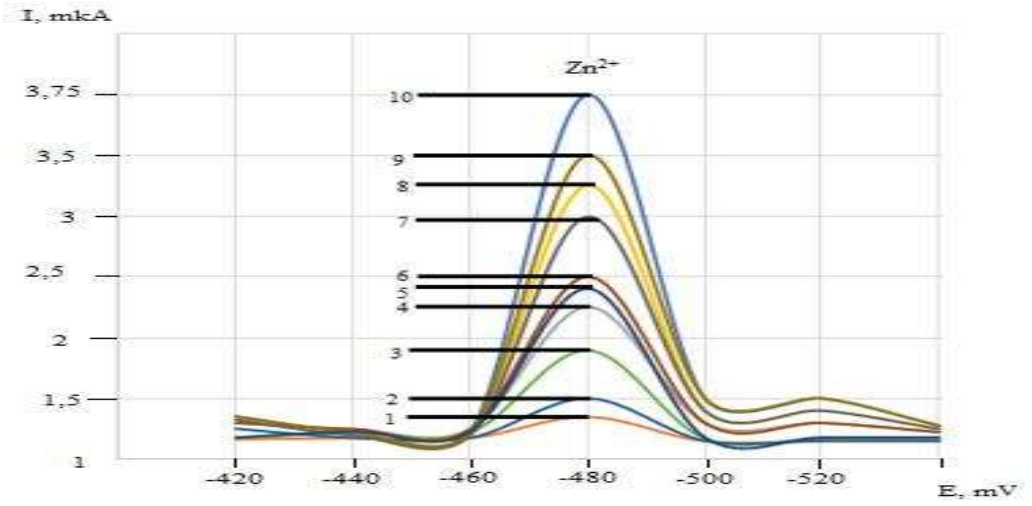


Fig. 1. **Effect of different pH values of universal buffer on the analytical signal of**

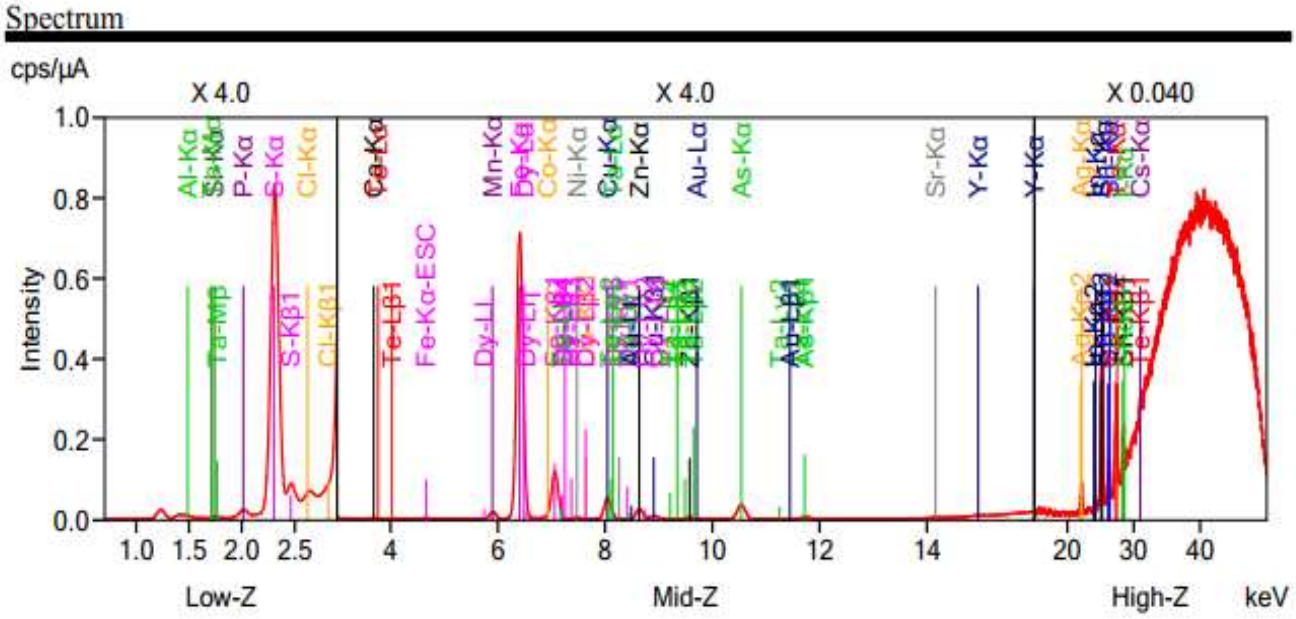
1- pH 11,02; 2- pH 9,45; 3- pH 2,65; 4- pH 3,56; 5- pH 1,85; 6- pH 4,25; 7- pH 8,40; 8- pH 5,90;

9- pH 4,75; 10- pH 5,45.

The obtained results show that the most optimal background electrolyte for the determination of Cu(II) and Zn(II) ions is the universal buffer mixture. In our further work, we used a universal buffer mixture background electrolyte with values in the range of pH 4-6. Table 3 shows the results of inversion voltammetric analysis of copper(II) and zinc(II) ions from industrial wastewater [16,17,18].

Table 3.

Results of inversion-voltammetric analysis of Cu(II) and Zn(II) ions from the industrial wastewater leaking from the gold mining "Kuchbulok mine" belonging to the Almalyk Mining and Metallurgical Combine Angren Mining Department



lement	%	mg/sm^3
Cu(II)	4,15	36,72
Zn(II)	1,42	12,56

Analyzed result(FP method)

No.	Component	Result	Unit	Element line	Intensity(cps/μA)
1	Total	885	mg/cm2		
2	Mg	ND	mass%		
3	Al	7.28	mass%	L:Al-Kα	0.14474
4	Si	0.971	mass%	L:Si-Kα	0.08101
5	P	1.14	mass%	L:P-Kα	0.39476
6	S	28.1	mass%	L:S-Kα	21.78805
7	Cl	0.150	mass%	L:Cl-Kα	0.17315
8	K	ND	mass%		
9	Ca	1.11	mass%	M:Ca-Kα	0.05281
10	V	ND	mass%		
11	Cr	ND	mass%		
12	Mn	1.85	mass%	M:Mn-Kα	0.65457
13	Fe	51.2	mass%	M:Fe-Kα	27.65806
14	Ni	0.445	mass%	M:Ni-Kα	0.18477
15	Cu	4.15	mass%	M:Cu-Kα	2.28860
16	Zn	1.42	mass%	M:Zn-Kα	1.12252
17	As	1.10	mass%	M:As-Kα	1.79278
18	Br	ND	mass%		
19	Mo	ND	mass%		
20	Pd	ND	mass%		
21	Ag	0.0508	mass%	H:Ag-Kα	0.04929
22	Cd	ND	mass%		
23	Sn	0.454	mass%	H:Sn-Kα	0.48931
24	Sb	0.0357	mass%	H:Sb-Kα	0.03800
25	Ba	ND	mass%		
26	La	ND	mass%		
27	Ce	ND	mass%		
28	Pr	ND	mass%		
29	Nd	ND	mass%		
30	Pt	ND	mass%		
31	Au	ND	mass%	M:Au-Lα	0.00000
32	Hg	ND	mass%		
33	Pb	ND	mass%		
34	Th	ND	mass%		
35	U	ND	mass%		
36	Ti	ND	mass%		
37	Co	0.181	mass%	M:Co-Kα	0.13673
38	Ga	ND	mass%		
39	Ge	ND	mass%		
40	Se	ND	mass%		
41	Rb	ND	mass%		

NEX DE Rigaku

Fig. 2. **The results of X-ray fluorescence analysis of the composition of the industrial wastewater leaking from the gold mining "Kuchbulok mine" belonging to the Angren mining department of the Almalyk mining and metallurgical combine.**

Due to the continuous improvement and development of X-ray fluorescence spectrometers, they are widely used in many departments and industries, such as metallurgy, geology, minerals, petroleum, chemistry, biology, medicine, forensics, archeology, etc. Not only has it become an important analytical tool for testing chemical elements, physical phases, chemical stereo structures, physical evidence materials, non-destructive testing of product and material quality, medical examination of the human body, microcircuit photolithography examination, etc. Currently, it is an important analytical method of analysis. Taking this into account, the results of X-ray fluorescence analysis of the composition of the industrial wastewater leaking from the gold mining "Kuchbulok mine" belonging to the Angren mining department of the Almalyk mining and metallurgical combine were obtained and the results are presented in Figure 2.

X-ray fluorescence analysis is used as an elemental analysis, and it is one of the methods of X-ray spectrum analysis based on the interaction of X-rays with the analyzed substance.

The advantages of the inversion-voltamperometry method we have developed include: high sensitivity is able to detect very low concentration metals (at ppb or even ppt levels); selective exposure is a method that allows you to analyze a particular metal in addition to other metals; a relatively simple method: the hardware is relatively simple and inexpensive and easy to install in the laboratory. widely used analysis method, it is used in the following areas. Inversion-voltamperometry can determine the amount of metals in drinking water, wastewater, seawater and other water bodies, determine the amount of metals in food, determine the amount of metals in blood, urine and other biological samples, determine the degree of contamination of air, soil and water. According to the results of the analysis, the presence of 36.72 mg/sm^3 of copper and 12.56 mg/sm^3 of zinc ions in the industrial wastewater leaking from the gold mining "Kuchbulok mine" belonging to the Angren Mining Department of the Almalyk Mining and Metallurgical Combine was confirmed.

REFERENCES:

1. Bingxuan Wang., Xiaojun Wang., Xu Zhang. (2019). An Empirical Research on Influence Factors of Industrial Water Use. Water, 11(11), 2267. DOI: https://doi.org/10.3390/w11112267

2. Adem Dreshaj., Albona Shala., Mimoza Hyseni., Bedri Millaku., Arian Gashi.(2022). Analysis of the Impact of Industrial Waste on River Water Quality Towards Using the Dynamics of Land Quality. J.Ecol.Eng, 23(4), 191-196. DOI: https://doi.org/10.12911/22998993/146676

3. Nazarova M.Q., Ziyayev D.A., Sayfiyev M.N., Mamajanov M.M. (2022). Qo‘rg‘oshin va mis(II) ionlarini inversion-voltamperometrik usulda kosmetik vositalar tarkibidan aniqlash. O‘zMU xabarlari, № 3/2/1, 418-421.

4. Ю.Ю.Люре. (1989). Справочник по аналитической химии. Химия, 446.

5. Ziyayev D.A., Sayfiyev M.N., Xo‘jaqulov D.A., Nazarova M.Q. (2021). Разработка инверсионно-вольтамперометрических определение меди с использованием графитсодержашим модифицированными электродами. O‘zMU xabarlari, № 3/2/1, 221-225.

6. Nazarova M.Q., Sayfiyev M.H., Ziyayev D.A. (2023). Og‘ir va zaharli metall ionlarini kosmetik vositalar tarkibidan inversion-voltamperometrik usulda aniqlashning ahamiyati. O‘zMU, “Analitik kimyoning dolzarb muammolari”, Toshkent, 11-12-may, 131-132.

7. Nazarova M.Q.(2024). Kosmetik vositalar tarikibidan qo‘rg‘oshin(II) va kadmiy(II) ionlarini aniqlash. INTER EDUCATION & GLOBAL STUDY. ISSN 2992-9024 (online) Buxoro, №2, 53-61. DOI:10.24412/2992-9024-2024-2-53-61

8. Sayfiyev M.H., Nazarova M.Q., Boqiyev Q.S., Gofurov A.A., Ziyayev D.A. (2024). Determination of Zinc Ion by Inversion Voltammetric Method from the Composition of Wastewater Using an Electrochemical Sensor. International Journal of Materials and Chemistry, 14(2), 19-23. DOI:10.5923/j.ijmc.20241402.02

9. Nazarova M.Q., Sayfiyev M. N., Boqiyev Q.S., Rustamov E.M., Ziyayev D.A. (2023). Kadmiy ionini inversion voltamperometrik usulda oqava suvlar tarkibidan elektrokimyoviy sensor yordamida aniqlash. O‘zMU. Funksional polimerlarning fundamental va amaliy jihatlari. Toshkent, 17-18-mart, 937-940.

10. Назарова М.Қ., Сайфиев М.Н., Боқиев Қ.С., Мамажанов М., Зияев Д.А. (2023). Мис ионини қўрғошин ва рух ионлари билан биргаликда оқава сувлар таркибидан инверсион-вольтамперометрик усулда аниқлашнинг аҳамияти. O‘zMU. “Analitik kimyoning dolzarb muammolari”, Toshkent, 11-12-may, 101-102.

11. Atanasova T., Gochev V., Nenov N., Djurkov T., Girova T., Merdzhanov P., Stoyanova A. (2016). Lavender extract with tetraflouroethane - chemical composition, antimicrobial activity and application in cosmetics. International scientific and practical conference world science. №1, 10-15.

12. Кузубова Л.И., Шуваева О.В., Аношин Г.Н. (2000). Элементы-экотоксиканты в пищевых продуктах. Гигиенические характеристики, нормативы содержания в пищевых продуктах, методы определения. Экология. Серия аналитических обзоров мировой литературы, №58, 1 - 67.

13. Чистяков В.П. (2017). Определение концентрации тяжелых металлов в продуктах питания методом инверсионной волтамперометрии. Безопасност и качество селскохозяйственного сыря и продуктов питания, 301- 303.

14. Стас И.Е., Шипунов Б.П., Букина А.А. (1999). Инверсионно-волтамперометрическое определение тяжелых металлов в жидкой фазе снеговых проб с применением ультрафиолетового облучения. Известия алтайского государственного университета, Т.13, № 3, 17 - 22.

15. Черноусова К.А. (2020). О составе декоративной косметики. Сибирская академическая книга, №20-5, 24-27

16. Синкевич Е.В., Бабей Е.С.(2019). Влияние исползования декоративной косметики как фактор риска ухудшения состояния здоровя женщин активного репродуктивного возраста. Современные проблемы гигиены, радиационной и экологической медицины, №8, 116-122.