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SPECTROPHOTOMETRIC ANALYSIS OF THE WATERS OF THE SURKHANDARYA RIVER OF THE REPUBLIC OF UZBEKISTAN FOR DETERMINATION OF HEAVY TOXIC METALS

Abstract: The article presents the results of the quantitative determination of heavy toxic metals in the waters of the Surkhandarya River of the Republic of Uzbekistan. The content of heavy toxic metals has been established on average at the following level: mercury-zinc, $r = 0.601$; South Surkhan reservoir, mercury-chromium (III), $r = 0.654$, mercury-copper, $r = 0.695$; section Karatag, copper-zinc, $r = 0.672$ - 0.860 , copper-chromium, $r = 0.555$.

Key words: heavy toxic metals, Surkhandarya River, mercury.

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Introduction

In the world, large-scale scientific research is being carried out to develop methods for the preliminary concentration of TTM ions, which make it possible to isolate an element or a group of elements from the volume of a solution of a complex chemical composition, to reduce their detection limit, to eliminate or significantly reduce the influence of macro and micro components, which increases the accuracy and sensitivity of the analysis. When analyzing natural and wastewaters for the content of trace elements, the latter are preliminarily

concentrated and separated, most often using sorption methods. Therefore, the development of effective sorption-photometric and spectrophotometric methods for the determination of TTM ions is of great importance today [1; p.45].

Aquatic ecosystems are a natural aquatic environment in which its living and nonliving elements interact as a single functional whole and are interconnected by the exchange of substances and energy. This exchange is of a different nature, accompanied by the transformation of substances

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under the influence of physical, chemical and biological factors [2; p.78].

Currently, most aquatic ecosystems are involved in human economic activities. The annual total water withdrawal for all needs is almost 86 km³. Of these, 57.9% is spent on the needs of industry, household and drinking - 20.3%, irrigation - 13.7%, agricultural water supply - 2.1% and other needs - 6% [3; p.158].

The total volume of wastewater discharged into surface water bodies is more than 6×10^{10} m³, of which 2.2×10^{10} m³ is untreated and heavily contaminated. Thus, the chemical composition of surface waters is formed under the influence of a combination of natural and anthropogenic factors. Wastewater contains oil products, heavy metal ions, and many different compounds [4,5;p-34-56]

Experimental part.

The Surkhandarya River is saturated with snowy waters starting from the Gisar Mountains. The river is the main source of drinking water for the population of almost all districts of the Surkhandarya region and irrigation of agricultural crops [13, 56 b]. Therefore, the purity of these waters is a special factor in life, and research on the determination of toxic metals in these waters is considered a highly demanded task. Spectrophotometric determination of heavy metal ions in residual solutions after their sorption was carried out to determine the sorption characteristics (R, %; Q, mg / g; K; D) of sorbents (KFG-1 and TFG-1).

The determination of the residual concentrations of HM ions after sorption, as well as their

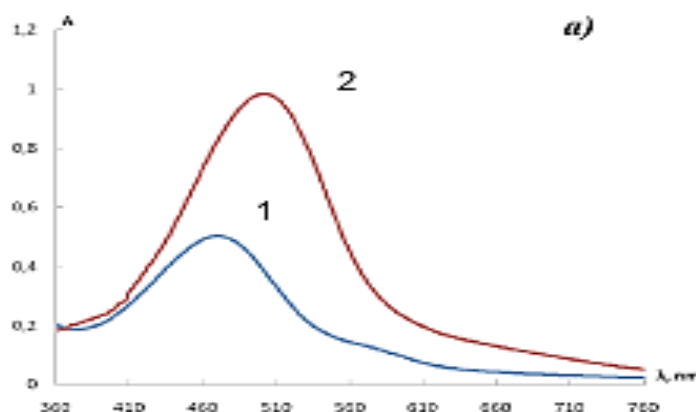
concentrations after desorption, was carried out for model solutions with the PAR reagent [6,7; p. 56-87].

To determine copper, lead, cadmium, zinc, mercury, and chromium in standard solutions using the reagents obtained, solutions containing the required amounts of the selected metal were first prepared in 100 cm³ flasks. Then a certain amount of a buffer mixture with an optimal pH value was added to them and the total volume of the mixture was brought to the mark with distilled water [8, 9, 10; p.45, 98, 12].

When establishing the content of the studied metals in drinking, waste and natural waters, as well as in model mixtures, standard samples of natural waters [4; p. 13-20; 118; p.18-24], the analyzed samples were prepared as follows: a buffer mixture with the optimal pH value for a given metal to be determined and the required amount of masking mixture were added to the water sample.

Dithizone (H₂Dz) is one of the most well-known and sensitive organic reagents used in the analytical chemistry of metals. In addition, the formation of dithizonates of the studied metals is realized in a wide range of pH (for example, for Cu (II) - 1-4, Pb (II) - 8-10) [11, 12 p. 42, 76].

The formation of lead (II) dithizonate was monitored spectrophotometrically by the absorption maxima of the initial reagent $\lambda = 470-480$ nm and its complex with lead $\lambda = 501-505$ nm, respectively. To select the optimal conditions, the concentration of lead ($1 \cdot 10^{-3} - 5 \cdot 10^{-5}$ mg / ml), dithizone ($1 \cdot 10^{-5} - 5 \cdot 10^{-5}$ M) and pH (3.5 - 10.5) were varied. ...



Pic. 1. Electronic absorption spectra of dithizone (1) and its complex with lead (2) ($c(\text{Pb}^{2+}) = 2.10 \cdot 10^{-5}$ mg / ml; $c(\text{HDz}) = 4.10 \cdot 10^{-5}$ M; $\text{pH} = 10.5$).

In fig. 1 shows the electronic absorption spectra of the system

Pb (II) - dithizone. At pH = 10.5, a complex of lead with dithizone is formed, which is characterized by an absorption maximum at 505 nm, in contrast to the initial dithizone with an absorption maximum at 475 nm.

4- (2-Pyridylazo) resorcinol (PAR) and 1- (2-pyridylazo) -2-naphthol (PAN). As is known [11],

depending on the acidity of the medium, the PAR reagent in solution can be in four forms: protonated at the nitrogen heteroatom (H₃R⁺), molecular neutral (H₂R), and two anionic (HR⁻ and R₂⁻), due to the dissociation of hydroxyl groups. PAN reagent - in three forms: HR, H₂R⁺, R⁻. Table 2.2 shows the pH values of the complexation of the studied metal ions with the reagents PAR and PN [6, p. 17].

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Table 1. PH values of complexation of metal ions with PAR, PAN, and dithizone

Organic reagents		Cd(II)	Cu(II)	Zn(II)	Hg(II)	Pb(II)	Cr(III)
ПАН	pH	-	4-10	8,5	7,5	8-10	4-7
	λ	555	-	540	560		
	ϵ	-	-	66000			
ПАР	pH	9,8-10,4	2-12	6-10	10-11	10	5-7
	λ	495	500	495	500	520	540
	ϵ	84000	71800	63400		40000	47000
Дитизон	pH					9-9,5 хлороформ	
538	λ			620		520 620	
5800 36400	ϵ			32000		72900 3900	

Table data. 2 made it possible to choose the optimal pH values for the CP extraction of the studied

metal ions: for PAN - pH = 9 (for Fe (III) - pH = 6), for PAR - pH = 10.

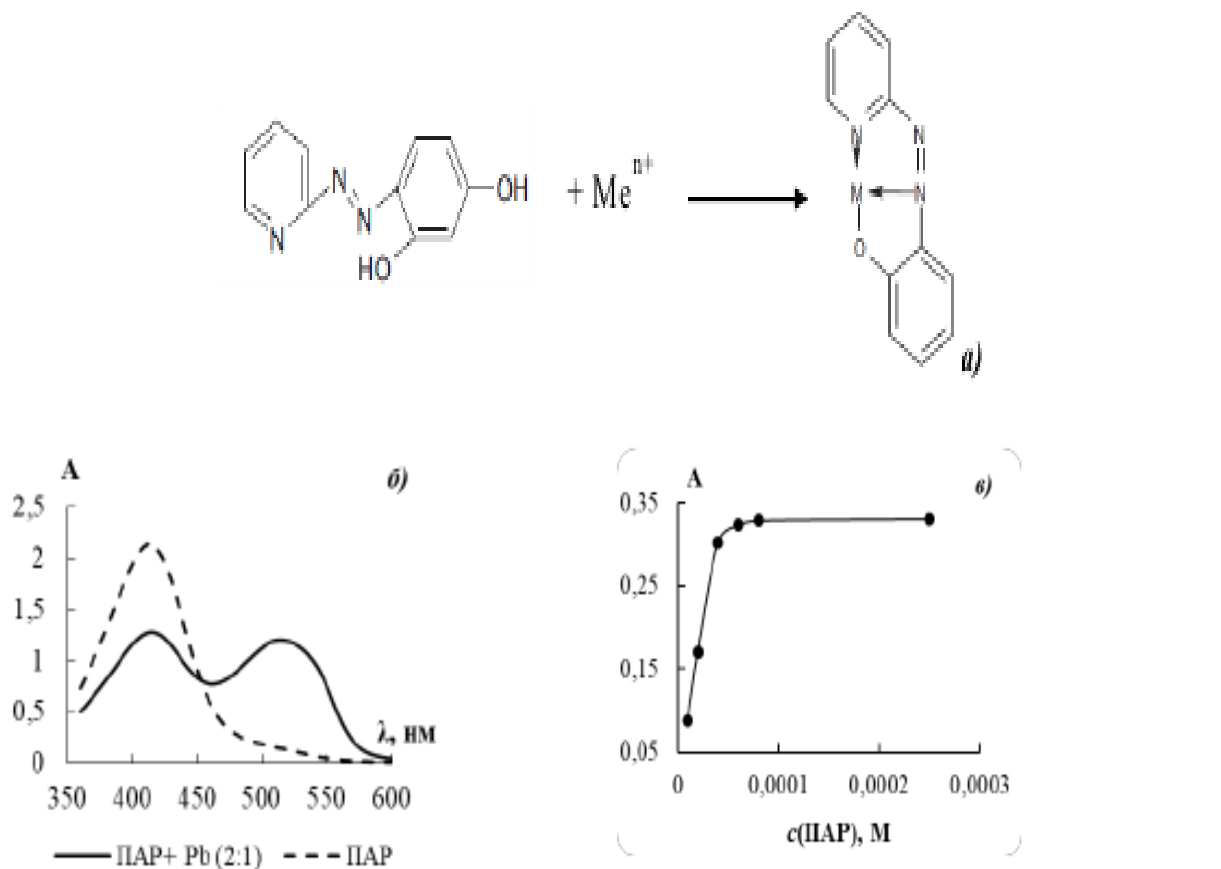


Fig. 2. a) Scheme of the reaction of PAR with metal ions. b) Electronic absorption spectra of the PAR reagent and its complex with Pb (II). c) Saturation curve for the Pb (II) - PAR system at various ligand concentrations. ($s(\text{Pb}^{2+}) = 2 \cdot 10^{-5} M$; $s(\text{PAR}) = (1 \cdot 10^{-5} - 2.5 \cdot 10^{-4} M$; pH = 10).

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At the selected optimal concentration of the PAR reagent ($8 \cdot 10^{-5}$ M), a calibration dependence for the determination of lead was built. For this, a series of solutions were prepared, according to the data in table.

2.2, and recorded electronic absorption spectra (Fig. 2.3.a) relative to water. The calibration dependence is shown in Fig. 2.3.b in coordinates A (525 nm) - c (Pb).

Table 2. Concentrations and aliquots of solutions of lead salt, PAR and a buffer system for constructing a calibration dependence

№	$c(\text{Pb}^{2+}), \text{M}$	$V(\text{Pb}^{2+}), \text{мл}$	$c, \text{M}; V(\text{ПАР}), \text{мл}$	buffer volume, ml pH = 10
1	$8 \cdot 10^{-6}$	0,08	8·10 ⁻⁵ ; 0,3	4,62
2	$1 \cdot 10^{-5}$	0,1		4,6
3	$2 \cdot 10^{-5}$	0,2		4,5
4	$3 \cdot 10^{-5}$	0,3		4,4
5	$4 \cdot 10^{-5}$	0,4		4,3
6	$5 \cdot 10^{-5}$	0,5		4,2

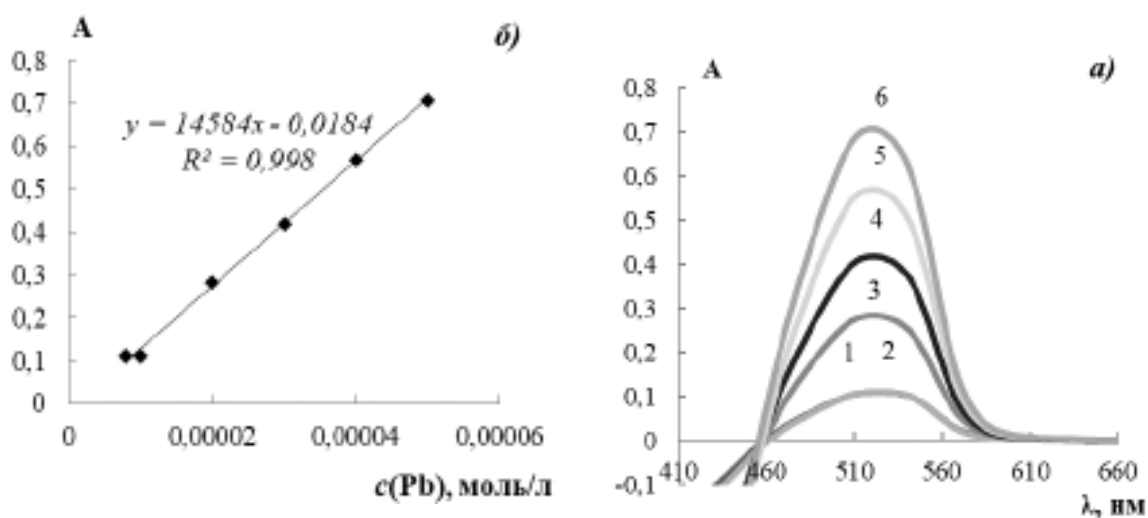


Fig. 3. a) Electronic absorption spectra of the Pb (II) - PAR system at various lead concentrations. b) Calibration dependence for the PAR-Pb (II) system. (s (Pb (II), M: 1 - $8 \cdot 10^{-6}$; 2 - $1 \cdot 10^{-5}$; 3 - $2 \cdot 10^{-5}$; 4 - $3 \cdot 10^{-5}$; 5 - $4 \cdot 10^{-5}$; 6 - $5 \cdot 10^{-5}$).

So, in the upper section of the Surkhandarya River, some TTM ions in the waters have correlations: the Sangardak section, mercury-zinc, $r = 0.601$; South

Surkhan reservoir, mercury-chromium (III), $r = 0.654$, mercury-copper, $r = 0.695$; section Karatag, copper-zinc, $r = 0.672-0.860$, copper-chromium, $r = 0.555$.

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