



SORPTION-SPECTROSCOPIC DETERMINATION OF RHENIUM ION IN INDUSTRIAL CAKE

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Article history:	Abstract:
Received: 14 th July 2022 Accepted: 14 th August 2022 Published: 26 th September 2022	Bismutol-II is used as an organic analytical reagent for rhenium (III) ion in industrial and environmental wastewater and zinc cake. Immobilization of bismutol-II organic reagent on various fibrous carriers and determination of rhenium metal ion, as well as an express method of determination, are shown. Analytical and metrological parameters of the method were evaluated, it was found that the limit of rhenium (III) ion quantification increases by 10 times in the immobilized state compared to the solution.
Keywords: Rhenium ion, bismutol-II, analytical reagent, immobilization, sorption-spectroscopic determination.	

I. INTRODUCTION

A characteristic feature of the Central Asian region (Uzbekistan, Kazakhstan, Mongolia) is the increasing amount of molybdenite compared to other countries of the world. In addition to molybdenite, some rhenium is reported to be associated with other sulphide minerals, accounting for 80% of the rhenium yield and 17% for molybdenite. Currently, for the ores of copper and molybdenum deposits in Uzbekistan, new rhenium minerals have been created for the first time by research of microzones, including: sulfide rhenium ReS_2 , disulfides CuFeReS_4 , CuZnReS_4 , etc., pyrite and magnetite concentrates can be an additional source of rhenium production at Almalyk KMK JSC. In addition to these average yields, 0.088–0.8 g/t of rhenium-bearing ores have been studied for beneficiation and metallurgical output. Copper mine of Uzbekistan (city of Almalyk) 4640.8 mln. containing tons of ore. These ores contain 371,268 tons of molybdenite with a molybdenum content of approximately 60 g/t, according to the books. The average content of rhenium and molybdenite is 1350 g/t. Thus, there are 495 tons of rhenium reserves in molybdenite. The price of 1 kg of rhenium is 1,500 dollars, its reserve value is 742,500 thousand dollars. It allows to expand the production of this precious metal in Uzbekistan [1].

In this work [2; 180 – 191 - b] It has been studied that in a number of mines of Western Uzbekistan, the content of rhenium in uranium ores ranges from 0.2 to 1-3 g/t, and that such mines in the Republic are considered very promising for rhenium. For these ores, a special technology of additional mining of Navoi underground minerals has been developed. According to the authors, there is no such technology in the world, and it can be concluded that the raw material base of rhenium in the Republic of Uzbekistan is not limited to the copper mines of the Almalik and Navoi ore areas, but also has an industrial concentration in unconventional types of mines: gold ore, uranium and shale mines.

[3; 32-36 - b] in the literature, the optimal conditions for the formation of a complex of rhenium 4 with tetraphenylarsazole were studied, according to which the formed complex formed a stable complex for 1 day at $\text{pH}=1$ and in 1M hydrochloric acid medium. An abundance of Mo(IV) , Ag(I) , Pd(II) , Au(III) ions interfered with the determination of rhenium. A method for the determination of rhenium (III) with nitron perhenate immobilized on a colorless polymethacrylate matrix was developed, and rhenium metal was determined from the solution using this method. Mo (II, IV) , Ni (II) , Co (II) , Pb (II) , Zn (II) , Cd (II) , Cu (II) ions in a ratio of 1:100 do not interfere with the determination of rhenium. It was studied that the detection concentration of rhenium at $\text{rN}=1$ is equal to 1 mg/l, $\text{Sr}=0.03-0.05$.

In the article [4; 39 - 40 - b] reaction of KReO_4 with BrF_3 to fluorine complex compounds resulting in oxoffluoride complex of rhenium Re^{6+} oxidation state $\text{K}_2\text{ReO}_2\text{F}_4$ and perhenate obtained from ReO_2F_4 anionic salts of

potassium, rubidium, cesium silver and barium, respectively, and Me_2ReF_8 for Re^{6+} oxidation state. Complexes containing MeReF_7 were studied.

The authors work [5; 289 – 296-b] anionic salt ReF_7 was prepared by reacting liquid ReF_6 with fluorides of active metals. This salt is yellowish in color, almost insoluble in water, and readily hydrolyzes to amber-colored MeReOF_5 , which decomposes to ReF_6 and MeF ($\text{Me}=\text{Cs}, \text{Rb}, \text{K}, \text{Na}$) when dissolved in HF . Conditions for the reaction of the MeReF_7 salt were studied.

[6; 28-29-b] in the literature, there are 3 types of rhenium sulfides: Re_2S_7 , ReS_2 , and ReS_3 , the first two of which are stable, and the heptasulfide compound cannot be synthesized directly. It is reported that it is usually obtained from perrhenic acid with hydrogen sulfide in an acidic medium ($2-6 \text{ n HCl}$).

II. GENERAL METHODOLOGY OF WORK

2.1. Method of carrying out the reaction:

A sample weighing 0.2-2 g contains 3-5 g of calcium oxide, 2 g of ammo Ni perrinate and 0.1-0.2 g of potassium permanganate were added and thoroughly mixed in a porcelain mortar, then another 2-3 g of calcium oxide was added and heated in a muffle furnace (SNOL with a temperature of 1000°C). After a certain period of time, the sample was cooled, then transferred to a crucible (small crucible 4 DTS 9147-80) and mixed with 40-60 ml of hot water in a 200 ml flask, boiled for 2 hours. After cooling, the solution was filtered through a double filter, the resulting the precipitate was dissolved with hydrochloric acid and filtered through a double filter.

The filter was washed 6-7 times with distilled water and cooled. The solution was transferred to a 200 ml volumetric flask and made up to the mark with distilled water.

In order to experimentally determine the rhenium (III) ion, the analysis was carried out using an atomic absorption spectrometer (Optima-8300), as a result of which analytical spectral lines were obtained for the rhenium (III) ion with the wavelengths shown in Table 2.1.

Table 2.1
The wavelength of the rhenium ion in solution

An identifying element	Wave length, nm
Reny	221,426

We will use this wavelength in the following experiments.

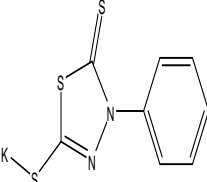
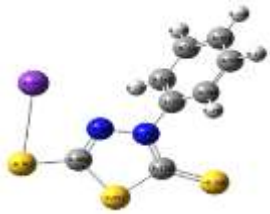
2.2. Selection of a new organic reagent for the determination of rhenium (III) ion

Organic reagents or as a result of their reactions were examined using the sorption-spectroscopic method for the determination of various metal ions.

As an organic reagent, we considered bismutol-2 reagent to be the most suitable for rhenium (III) ion, and most of the reagents used in the experiment were studied at the Department of Analytical Chemistry of UzMU. These reagents have been shown to exhibit good metrological properties, high sensitivity and selectivity.

Taking into account all the information on the use of bismutol-2 reagent in the analysis of the detected metal ion and their valuable chemical and analytical properties, bismutol-2 reagent allows us to accept it as a promising reagent for the determination of rhenium (III) ion. There are a number of methods for the detection of rhenium (III) ion, therefore, we considered the spectrophotometric capabilities of bismutol-2 reagents for its detection, and based on this, we studied the structure of the bismutol-2 reagent, and based on preliminary studies, it was selected for the given object. The result is presented in Table 2.2 .

Table 2.2
Structural formula and designation of the studied reagent.

You are suing the formularies		Total: 9.7342
Gross formula	$\text{C}_8\text{H}_5\text{S}_3\text{N}_2\text{K}$	Charges N 0.528 [N(1)] C 0.140 [C(2)] S 0.294 [S(3)] C 0.085 [C(4)] N -0.363 [N(5)] C 0.106 [C(6)] S -0.350 [S(7)] K 0.361 [K(8)] S -0.503 [S(9)] C -0.126 [C(10)] C -0.031 [C(11)]
Gaussian dasturida quantum-kymevium formulasy		
Systematic nomenclature on nomlanishi	5-mercapto-3-phenyl-1,3,4-thiadiazolthione-2 potassium	

2. Concluding from Table 2, we selected bismutol-2 organic reagent for its high ability to use in experiments as a reagent, taking into account its analytical properties.

III. PREPARATION OF WORKING SOLUTION OF ORGANIC REAGENT

3.1. Method of carrying out the reaction

1. To prepare a working solution of 0.01% bismutol-2 reagent, 0.01 g of bismutol-2 reagent was weighed on an analytical balance, placed in a 100 ml volumetric flask and brought to the mark with water. The prepared solution is diluted and used for experiments. To prepare a standard solution of rhenium (III) ion at 1 mg/ml, 0.732 g of ammonium perrhenate salt was taken into a 100 ml flask and made up to the mark with distilled water. This solution was used in subsequent work.

2. $1.0 \cdot 10^{-1}$ M hydrochloric acid solution is prepared for the experiment by diluting concentrated hydrochloric acid.

3. For a universal buffer solution with different rN (1-12) of buffer solutions, it is prepared by adding 0.04 M (H_3BO_3 , H_3PO_4 , CH_3COOH) 0.2 M NaOH solution.

3.2. Choosing the optimal carrier for an organic reagent

Summary of the fiber carrier: PPA-1 is an IR-spectroscopic structure of anionite obtained by modifying hydroxylamine-activated polyacrylonitrile (Nitron) fiber with polyethylenepolyamine

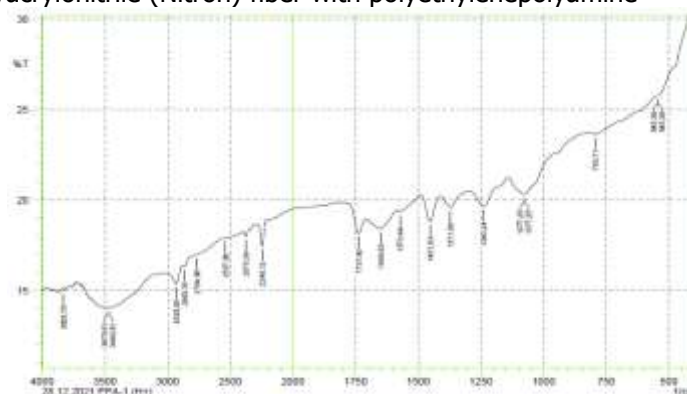


Figure 1. Experimental IR spectrum of PPA-1 fiber

3.3. Time dependence of bismutol-2 reagent immobilization on fibrous sorbent

The analysis was carried out at the optimum environment ($\text{pH} = 4-5$) at different time intervals and at a temperature of 25 ± 5 °C. Optical densities were studied at different time intervals by taking 5 ml of a 0.05% solution of the reagent and 5 ml of a universal buffer solution ($\text{rN} = 4-5$) from the PPM-1 fiber selected for the bismutol-2 reagent. The results are presented in Table 3.1, Figure 3.1.

Table 3.1

Time dependence of immobilization.
($I=1$, PPM-1, $25 \pm 50^\circ\text{C}$, $\text{IR}=360\text{nm}$)

No. time, min	10	20	30	40
Bismutol-2	0,12	0,18	0,22	0,26

It takes 40 minutes for the bismutol-2 reagent to completely immobilize the PPA-1 fiber. In order to study the effect of time on the formation of the complex, several solutions were prepared, each of these solutions was known to contain $10 \mu\text{g}$ of rhenium (III) ions, and when the rhenium (III) ion solution was added to the immobilized reagent, it was observed that the complex formed immediately. This indicates the sensitivity of the reagent to the rhenium ion at $\Delta\lambda=460 \text{ nm}$.

LIST OF USED LITERATURE

1. Law of the Republic of Uzbekistan "On radiation safety". //
2. August 31, 2000, No. 120-II.
3. Blokhin A. A., Mikhailenko M. A., Protsessy ionoobmennoy sorbtsii v hydrometallurgii reniya // 2019, No. 10, S. 180-191.
4. Melnikova I.A., Buynovsky A. S., //Opredelenie reniya v zolotorudnom syre covmestno s molybdenomi wolframom//,2016, Volume 2, #5. S. 32-36.
5. Boyarsky V. P., Bokach N. A., Stroenie i svoystva elementoorganicheskikh soedineniy perekhodnykh metallov i ix primenenie v homogennom metallokompleksnom katalize // Sankt-Peterburg 2020 S. 39-40.
6. Leszczynska-Sejda K., Benke G., Chmielarz A. at al. Synthesis of perrhenic acid using ion exchange method // Hydrometallurgy. 2017. Vol. 89. P. 289–296.
7. Borisova L.V., Ermakov A.N., Analyticheskaya khimiya reniya// Izdatelstvo nauka. Moscow 1974. p. 28-29.