ISSN 2091-5527
№ 4/2024

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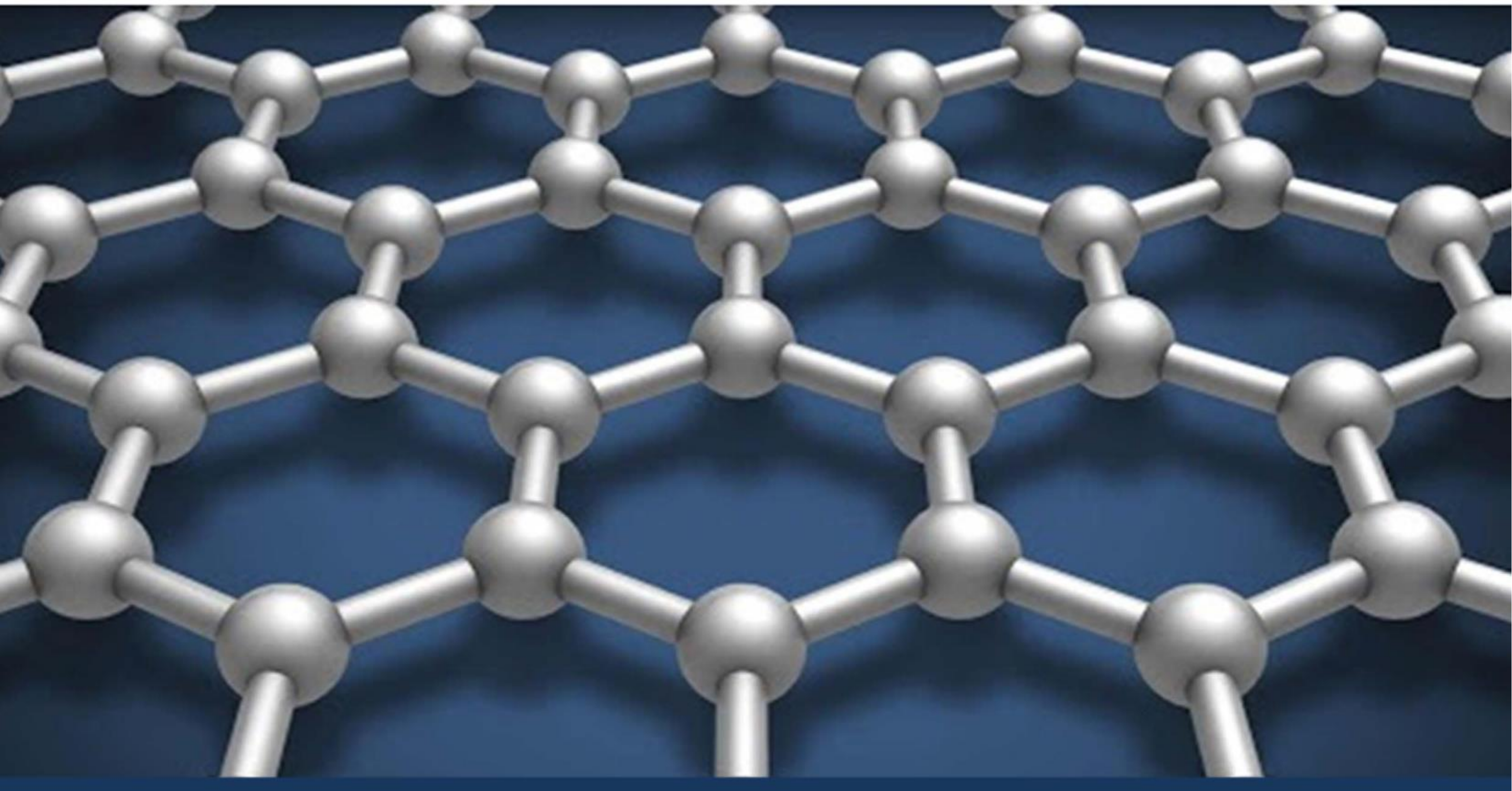

Узбекский научно-технический и производственный журнал

Композиционные материалы

INVESTIGATION OF COBALT RECOVERY FROM MOTHER LIQUOR

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Annotation. The main trend of the current stage of development of scientific and technological progress is the transition from an extensive path of management to an intensive one. The intensification of economic activity is carried out through the development and development of new highly productive, economical and environmentally friendly technologies. The need for savings is particularly acute in developing countries. There are no cobalt deposits in Uzbekistan, so extracting it from secondary raw materials is an urgent task. At the same time, significant amounts of cobalt are contained in industrial waste, the processing of which we still lag behind many developed countries. This work is also partially aimed at solving environmental problems related to industrial wastewater treatment.

Keywords: hard alloy, electrolysis, cobalt, ion exchange process, cationite, extraction, sorption capacity

Introduction. In almost all areas of industry, waste and scrap of rare and non-ferrous metals and alloys are generated, which are secondary raw materials. The main suppliers of such waste are ferrous and non-ferrous metallurgy, aerospace engineering, oil refining, radio engineering and electronic industries [1,2].

Waste of molybdenum, tungsten, cobalt and rhenium, formed during the production of alloys and finished products, as well as during the operation of tools containing these metals, can be conditionally divided:

• waste of steels in the form of scale, edge scraps after rolling, chips, dust from sharpening steel tools. In the production of metal cutting tools made of steel, 20-40% of the base material goes to waste in the form of chips;

• lumpy waste of hard alloys, which include industrial defects, unused parts of tool plates, fragments, waste from welding tungsten electrodes coated with 2% thorium. A significant part of the waste is from• pulverized waste from sharpening a carbide tool. About half of the tungsten and cobalt supplied to the production of hard alloy tools can be regenerated from these wastes during centralized sharpening and dust collection at large metal processing plants [4];

• waste of metallic molybdenum, tungsten, cobalt and rhenium, including ingots, rods, wire, plates, powders formed during the production of products made of metallic molybdenum, tungsten [5];

• waste of spent catalysts;

• oxide waste from metallurgical processing of ore raw materials, autoclave soda leaching cakes of scheelite raw materials, cakes of hydro-processing of tungsten raw materials, tungsten slag of tin production. Oxide wastes differ in chemical and material composition depending on the quality and type of feedstock and the processing technology of raw materials [6].

Literature Review. Currently, cobalt, which is of strategic importance, has found wide application in various fields of industry [7, 8]. Cobalt metal is mainly used for the production of special alloys and steels: stellite, vitalium, alnico [9]. Alloys in which cobalt predominates or makes up a significant part are used as heat-resistant materials, in the manufacture of permanent magnets, as materials with high corrosion resistance, as well as for the manufacture of cutting tools [10,11].

Catalysts for organic synthesis, drying of varnishes and paints (siccatives) have been obtained on the basis of cobalt. Cobalt compounds are used for the production of enamels and paints of high durability [12]. In recent years, the radioactive isotope Co60 has found wide application in medicine ("cobalt cannon") [13]. Cobalt is also used in agriculture as micronutrients [14]. A significant increase in cobalt consumption has recently been associated with the use of

Research Methodology. The mathematical method of experiment planning was used to describe the influence of factors (temperature, current density, current frequency) and to reduce the number of experiments in the study of electrochemical dissolution of metal waste and in studies of electrical conductivity of solutions [16].

The mass spectrometric analysis method was used to determine the composition of the gas phase formed during the electrochemical oxidation of solid alloy waste of the VK8 brand. The research was carried out on a gas analytical complex based on the mass spectrometer EMG-20-1 (St. Petersburg, ME'GEK).

The method of atomic absorption spectrophotometry was used to determine the content of non-ferrous metals in samples [17]. The atomic absorption of metals was measured using an atomic absorption spectrophotometer AAS-1N in an acetylene torch flame using radiation from lamps with a hollow cathode of the LPK-1 type.

Analyses and Results. The results of the analyses showed that the cobalt content in the mother liquor after oxalate deposition is 570 mg/l, which raised the question of the expediency of additional Co^{+2}extraction from mother liquor.In hydrometallurgy, sorption processes are widely used to selectively extract metal from a poor solution and obtain a more concentrated metal solution [18].Cation exchange resins of the "KU" brands were used as sorbents-2-8- A" and "KU-2-8-B" (Pirolit). The studied cationites differed in their graduation composition: CU-2-8- A has a smaller granule size than CU-2-8- B. If we denote by R a framework with fixed ions, then the cation exchange reaction can be expressed by the equation:

$$2RH + Co^{+2} + R_2Co + 2H^+ \quad (1)$$

Previously, search experiments on these cationites were carried out in static mode. The series of experiments consisted of 5 experiments for each brand of sorbent, during which the solid ratio was varied: liquid (T:F) 1:80, 1:40,1:8, 1:4, 1:2. The results of the experiment are shown in Table 1.

Table 1

Effect solid: liquid for the degree of cobalt sorption from the mother liquor (duration of each experiment is 24 hours, pH = 2.0, T = 295K)

S.L	KU Cationite-2-8- A		KU Cationite-2-8- B	
	Residual concentration of Co, г/л	Extraction, %	Residual concentration of Co, g/l	Extraction, %
1:80	0,016	90	0,093	70
1:40	0,037	98,5	0,17	85
1:8	0,0034	97	0,017	97,3
1:4	0,0018	98,2	0,0059	96,8
1:2	0,0025	100	0,0027	100

From the presented results of Table 1, it can be seen that with a ratio of T:W = 1:2, maximum cobalt extraction is achieved. The influence of the size of ionite granules on the sorption process has also been established.

The next stage of the research was to determine the effect of the pH of the system on the process of cobalt sorption. As can be seen from Figure 1, the maximum Cr.

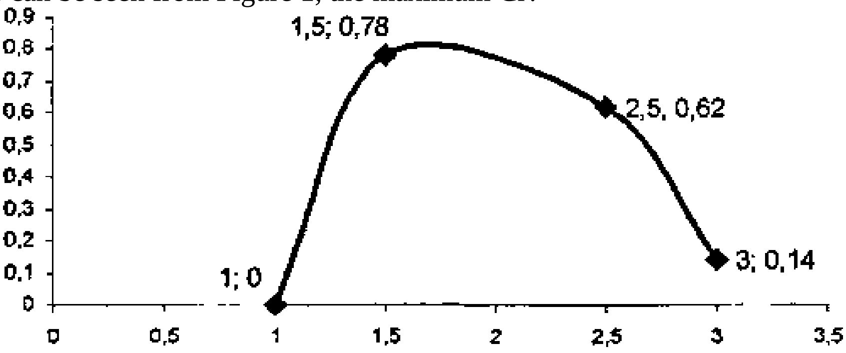

Fig. 1. Dependence of the distribution constant (Kr) on pH at 295K.

Cobalt extraction is achieved at pH = 1.5 - 2.5. To determine the capacity of the sorbent, an additional series of experiments were conducted, but using a model solution containing 30 g/l of cobalt. In the preparation of the model solution, $CoCl_2$ (grade H.H.) was used, which was diluted in a solution of nitric acid with a concentration of 400 g / l, correction to pH = 1.5 was performed with ammonia under heating and continuous stirring. Since the salt used is a fairly pure product, additional purification from iron was not required (<0.005 g/l). The results of the experiment are shown in Table 2.

Table 2.

Determination of the sorption capacity of cobalt cationites (Duration of the experiment - 24 hours, pH = 1.0, T = 295K)

S.L	Cobalt content		Cobalt content	
	c.smg/l	KU-2-8- A,mg/g	c.s mg/l	KU-2-8-B, mg/g
1:80	13000,0	160	13000,0	150
1:40	10000,0	160	10000,0	150
1:20	8000,0	74,5	8000,0	100
1:8	6000,0	60	6000,0	50

The data obtained (Table2) indicate that the sorption capacity (COE) of both grades of cobalt resins is about 160 mg/g.

The final stage of the work was the study of the kinetic features of sorption extraction of cobalt with KU cationite-2-8- A." For this purpose, a model solution from $CoCl_2$ containing 2000 mg/l of Co was used. The prepared solution was diluted 10 times, and the acidity of the diluted solution was adjusted to pH = 2-3 with ammonia. In a series of 6 experiments each experiment was carried out for a fixed time with constant mixing.

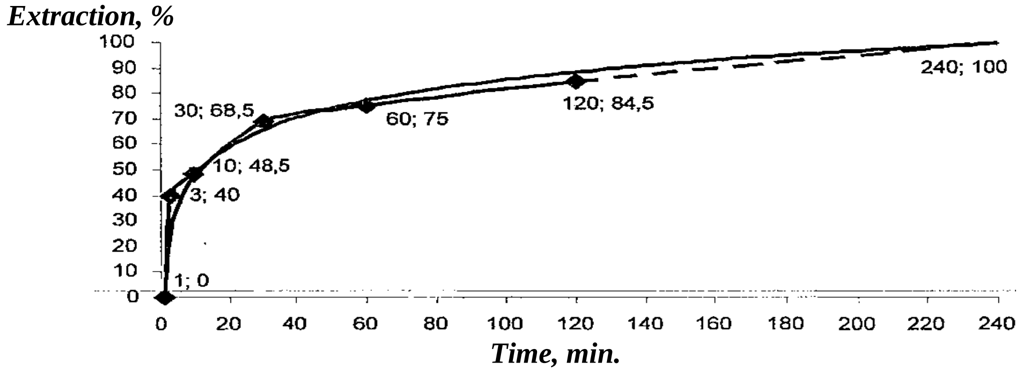

Fig. 2. Dependence of the degree of extraction on time. Temperature 295K, S.L= 1:20.

The results obtained indicate that in 60 minutes, the extraction of cobalt in this mode is more than 70%. By approximating the experimental data obtained, the time to achieve equilibrium in the studied sorption system was determined, which was 240 minutes.

Conclusions. As a result of the study, it was found that cationites of the "KU" brands-2-8- A" and "KU-2-8- B" are quite effective cobalt sorbents and can be recommended for the sorption recovery of cobalt from mother liquor precipitation of cobalt oxalates.

It was found that in the pH range from 1.5 to 2.0, the sorption process occurs most maximally. This is proof of the subordination of the studied process to the laws of chemisorption.

The COE content of the cobalt of the studied cationites was determined, which reaches 160 mg/g. It was also found that 120 minutes is sufficient for maximum extraction of cobalt by the studied cationites.

REFERENCES:

1. Коровин С.С., Букин В.И., Федоров П.И., резник А.М. Редкие и рассеянные элементы. Химия и технология. М.: МИСиС.-Т.3.- 2003.440С.

2. Шоназарова Ш.И., Пармонов С.Т., Самадов А.У., Каримов М.М. Современное состояние добычи вольфрама и повторной регенерации его отодов в Узбекистане. Цифровые тенологии в промышленности. 2024. №1. –С. 61-68.

3. Sharipov K.A., Sanakulov K.S., Samadov A.U., Karimov M.M., Parmonov S.T., ShonazarovaSh. I., Kuchkarova N.X., Hakimov F.Y., Mirzavaliyev D.B., Nosirov N.I. Volframyokititanyokitantalkarbid-kobaltasosliqattiqqotishmachiqindila-riniqaytaishlabolishningusuli. Foydalimodelpatent. №UZ FAP 2558. 13.08.2024.

4. ЗеликманА.Н., КоршуновБ.Г. Металлургия редких металлов. М., «Металлургия», 1991, 432 С.

5. Лейтман В.С. Тугоплавкие металлы: состояние рынка и перспективы применения в России // Сталь. 2008. №3. -С. 47-50.

6. Наумов А.Р. Большая инновационная экономика и малые металлы // Национальная металлургия. 2008. №2. -С.43-53.

7. Гедгагов Э.И., Бессер А.Д. Современное состояние и перспективы развития вольфрамово-молибденовой подотрасли в странах СНГ // Цветные металлы. 1998. №3. -С.49-56.

8. Худяков И.Ф., Дорошкевич А.П., Карелов С.В. Комплексноеисполь-зование сырья при переработке лома и отходов тяжелых цветных металлов.- М.: Металлургия, 2005.160С.

9. Naik S.V., Basn S.A new salt bath technique for recovery and extraction of tungsten from scraps and other secondaiy sources// Adv. Hard Mater. Prod. Metal powder Rept. Conf., London, 11-13 Apr. 2008.

10. Троценко И.Г., СвистуновН.В. Способпереработкикусковыхотходовтвердыхсплавов. Пат.РФ. №20041348678/02. 2006.

11. GulishÍja Z., Odanovic Z., Gulishija R. Investigations of a technical method for the reclamation of hard metal scrap.// Sei. Sinter. 2015.- 27, №3.- C.211- 217.

12. Liu X., Xu S., Wang K. Переработкаотходов WC-Co-сплавов. YousejinshuNonferrous Metals. 2003. 55, №3, -С.59-61.

6. Проблемные обзоры