EXTRACTION OF GALLIUM, VANADIUM AND ALUMINUM FROM THE ORGANIC PHASE BY REEXTRACTION

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Abstract: *in this article, we study the re-recovery and purification of typical laboratory solutions obtained in the production of aluminum from an extractant solution of the organic phase with an acid solution H_2SO_4.*
If the volume of the organic phase increases with the aqueous phase, the re-extraction rate decreases and the number of stages must be increased to increase the yield. Purification of the organic phase after the aqueous phase can be carried out using activated carbon. The extraction of gallium and vanadium from solution occurs in two stages. In the first stage, the extraction is carried out at pH-2, and in the second stage with stripping.
Keywords: *D2EHFA, gallium (III), vanadium (IV), aluminum (III), stripping.*

ИЗВЛЕЧЕНИЕ ГАЛЛИЯ, ВАНАДИЯ И АЛЮМИНИЯ ИЗ ОРГАНИЧЕСКОЙ ФАЗЫ ПУТЁМ РЕЭКСТРАКЦИИ

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Аннотация: *в этой статье мы изучаем повторное извлечение и очистку типичных лабораторных растворов, полученных при производстве алюминия из раствора экстрагента органической фазы с раствором кислоты H_2SO_4.*
Если объем органической фазы увеличивается вместе с водной фазой, скорость повторной экстракции уменьшается и количество стадий должно быть увеличено для увеличения выхода. Очистку органической фазы после водной фазы можно проводить с помощью активированного угля. Извлечение галлия и ванадия из раствора происходит в две стадии. На первой стадии экстракция проводится при pH-2, а на второй стадии с реэкстракции.
Ключевые слова: *D2EHFA, галлий (III), ванадий (IV), алюминий (III), реэкстракция.*

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INTRODUCTION

In addition to the separation of valuable components from the aqueous phase, the practical use of the extractant is to some extent associated with the rapid and selective re-extraction of one or another component of the extractant with inexpensive available reagents. Let's find out how D2EHFA, which is widely used in the extraction of rare metals, will meet these requirements for Ga and V. The literature [1, 2] investigated the use of HNO_3, HCl və H_2SO_4 in the extraction of gallium from the organic phase from D2EHFA, as well as in the work [3, 4]. The re-extraction of Al with the indicated reagent has been studied in the literature [5, 6]. Since all three elements are studied for selective separation from synthetic products, the conditions for their re-recovery differ significantly from each other.

In this section, we study the re-recovery and purification of typical laboratory solutions obtained in the production of aluminum from an extractant solution of the organic phase with an acid solution H_2SO_4.

EXPERIMENTAL PART

Despite the high degree of extraction of hydrochloric and nitric acids, in our studies, preference was given to a solution of sulfuric acid. The high selling prices of HCl and HNO_3, rapid corrosion of equipment, and the difficulty of disposing of spent acids make research with these acids profitable.

It was determined that the extraction of gallium from sulfate solutions has an equilibrium pH of 1.8, and the extraction of vanadium - 2.5. Since these ions are in the cationic form ($Ga^{(3+)}$, $VO^{(2+)}$, $Al^{(3+)}$), their extraction occurs in a weakly acidic medium at pH <4 and at high pH (pH>6) ions in anionic form (GaO_2^{-1}, AlO_2^{-1}, $H_2VO_4^-, HVO_4^{2-}, H_2V_2O_7^{2-}$). It should be noted that if the extraction of Ga (III), Al (III), V (IV) ions occurs in a

weakly acidic medium, then the separation (repeated extraction) from the organic phase can be carried out in strongly acidic solutions. These items can be categorized according to the speed of re-extraction.

Studies have shown that the transition of complex compounds from the organic phase to the aqueous phase depends on the initial concentration of sulfuric acid, the duration of repeated extraction, and the volume ratio of the organic and aqueous phases. In fig. 1 shows the results of the influence of the concentration of sulfuric acid on the degree of separation of Ga (III), V (IV) and Al (III) from the organic phase to the aqueous phase. The experiments were carried out for 30 minutes at a ratio of organic phase: aqueous phase = 4: 1. As you can see, the re-extraction of V (IV) occurs gradually from 0.25 to 1.0 mol/l of the concentration of H_2SO_4 with a slight increase in the concentration range of 1.0-3.0 mol /l. On the contrary, the displacement of Al (III) from the organic phase occurs weakly, below 1.0 mol /l and rapidly increases above 1.0 mol /l. The transition of gallium to the aqueous phase is 51.1% at 0.25 mol /l, 72% at 1 mol /l and 97.2% at 3 mol /l.

RESULTS AND DISCUSSION

The results show that the degree of separation of vanadium from the organic phase varies from 84.0% to 98.6% (3 mol /l H_2SO_4), aluminum from 11% to 65% at an acid concentration of 0.5 mol /l. At an acid concentration of 1 mol / l, the transition of vanadium to the aqueous phase is 95.4%, and aluminum - 20.1%. Vanadium emission rate is 81.9%. The concentration of 3.0 mol/l increases the release of elements into the aqueous phase.

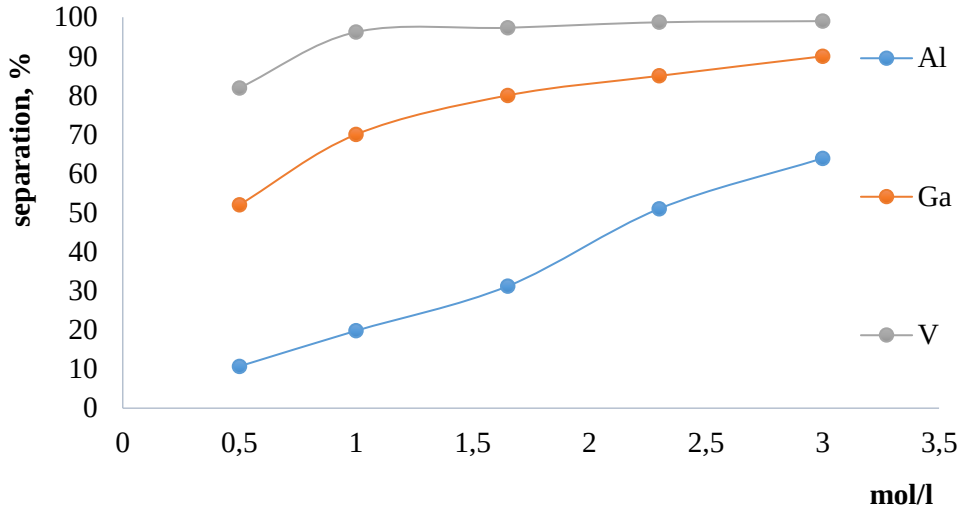

Fig. 1. Influence of sulfuric acid concentration on re-extraction of Ga (III), V (IV) and Al (III) ions. ($V_{(org.)}$: $V_{(water)}$ = 4: 1, time 30 min., T = 21°C, , $C_{Al(III)}$ - 2,4 g /l, $C_{V(IV)}$ - 0,222 g /l, $C_{Ga(III)}$ – 0,054 g /l)

In fig. 1 shows the percentage of Ga (III), Al (III) and V (IV) in the organic phase during the extraction. The transition of Ga (III) and V (IV) to the aqueous phase occurs quickly, in 30 minutes. 13.8% separation of Al into the aqueous phase occurs in 10 minutes, and 29% in 50 minutes.

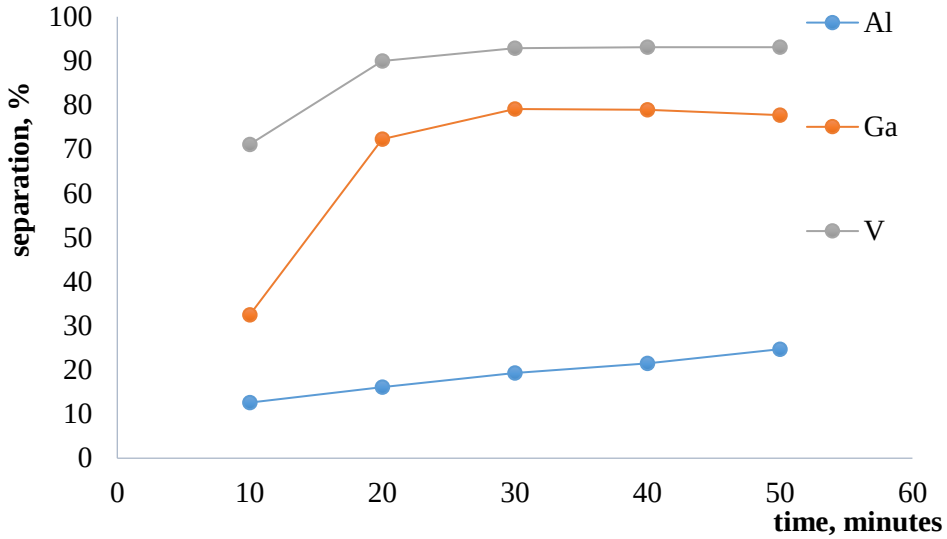

Fig. 2. Influence of the re-extraction time on the release of Ga (III), V (IV) and Al (III) ions into the aqueous phase ($V_{(org.)}$: $V_{(wat.)}$ = 4: 1, t = 21°C, $C_{H_2SO_4}$ = 1 mol / l)

Fig. 2 shows that the ratio of organic to aqueous phases also has a strong effect on re-extraction. As the organic phase: the ratio of the aqueous phase increases, the extraction of vanadium and gallium into the aqueous phase decreases rapidly. 95.4% vanadium, 79% gallium and 20.2% aluminum are recovered in a 4: 1 ratio.

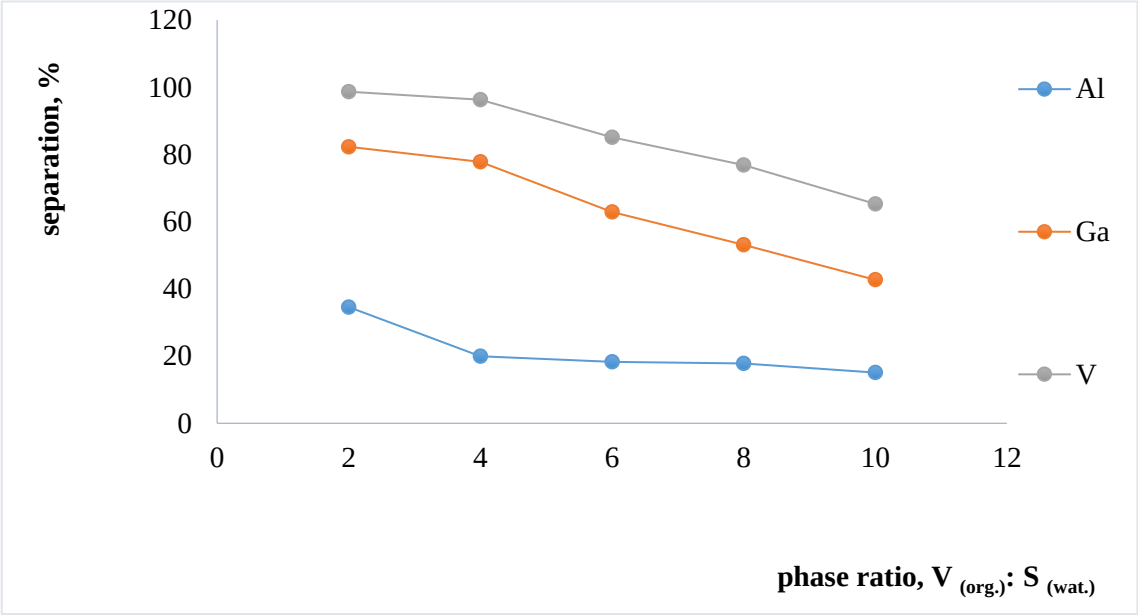

Fig. 3. Influence of the ratio of organic and aqueous phases on the separation of the aqueous phase of Ga (III), V (IV) and Al (III) ions (time 30 min, t = 21°C, $C_{H_2SO_4}$ =1mol / l)

As can be seen from Fig. 3 If the volume of the organic phase increases with the aqueous phase, the re-extraction rate decreases and the number of steps must be increased to increase the yield. Purification of the organic phase after the aqueous phase can be carried out using activated carbon.

CONCLUSIONS

From the above, we can conclude that the transition of Ga (III) and V (IV) to the aqueous phase occurs quickly, in 30 minutes. 13.8% separation of Al into the aqueous phase occurs in 10 minutes, and 29% in 50 minutes.

It was also studied that the extraction of gallium and vanadium from solution occurs in two stages:

1-during extraction in the first stage at pH-2

2-in the second stage with stripping.

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