Prospects for using a new phosphorus-containing extractant in uranium technology

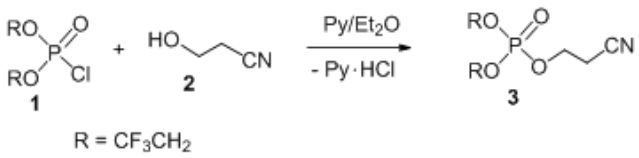
Arailym Nalibayeva[1], Gaukhar Bishimbayeva[1,2], Sabina Saidullayeva[2], Mariya Kopbaeva[2], SvetlanaVerkhoturova[3], Svetlana Arbuzova[3], Nina Gusarova[3], Uldana Kydyrbayeva[1]

[1]*D.V. Sokolsky Institute Institute of Fuel, Catalysis, and Electrochemistry, Almaty, Kazakhstan*
[2] *Institute of High Technology LLP of NAC Kazatomprom JSC, Almaty, Kazakhstan*
[3]*A.E. Favorsky Irkutsk Institute of Chemistry, Siberian Branch of the RAS, Irkutsk, Russia*

E-mail: *aray77@mail.ru, bigauhar@mail.ru*

Phosphorus-containing compounds are widely used in industrial hydrometallurgical processes as extragents and complexes of color, noble, rare-earth metals and transuranium elements [1]. The aim of this research was to study the optimal synthesis conditions for the previously unknown bis(2,2,2-trifluoroethyl)(2-cyanoethyl)phosphate, to study its extraction properties in the uranium extraction process from uranium-containing sulfuric and nitric acid solutions. Experiments have shown that bis(2,2,2-trifluoroethyl) chlorophosphate **1** reacts with 3-hydroxypropanonitrile **2** under mild conditions (20-22 °C, 8 h) in the pyridine (Py)/diethyl ether system to form the previously unknown bis(2, 2,2-trifluoroethyl)(2-cyanoethyl)phosphate 3 in 76 % yield (Scheme 1).

Scheme 1. Reaction of chlorophosphates **1** with 3-hydroxypropanonitrile **2** in the Py/Et_2O system



Bis(2,2,2-trifluoroethyl)(2-cyanoethyl) phosphate (I) was tested in parameters as close as possible to production. The results of the research showed that the use of this extractant (I) in the uranium extraction production process from uranium-containing nitric acid or sulfuric acid solutions was 20.7% and 18.7%; while the uranium content in the extractant (I) was 63.9 g / dm^3 and 49.7 g / dm^3.

Positive results were also obtained by studying the synergistic properties of the new extractant (I) and bis(2-ethylhexyl) phosphate. Using a mixture of these extractants (their weight ratio was 1:1.2) allows 57% of uranium to be recovered from the sulfuric acid uranium-containing solution. This is 9% more than in a similar process using only bis(2-ethylhexyl) phosphate as the extractant.

Acknowledgements

The research was completed within the framework of grant No.AP05134152 from the MES RK.

[1] FreeM.L. Hydrometallurgy: Fundamentals and Applications. New York: John Wiley & Sons, Inc, 2013. 444 p