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# EXTRACTION OF RARE-EARTH METALS FROM SECONDARY AND TECHNOGENIC RAW MATERIALS

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Technologies used for recovery of earth rare metals from various types of secondary and technogenic raw materials are considered, namely: flotation, leaching, chemical deposition, electrolysis, extraction, sorption and biosorption, ion exchange.

Keywords: rare earth metals, secondary and technogenic raw materials, recovery technologies

The review of scientific and technical literature showed that by the most priority technologies for extraction of ERM from used fluorescent lamps there is a method of the chemical processing of used products and extraction of ERM from solutions by deposition or liquid extraction. Three directions of the use of scrap of fluorescence lamps are considered in work [1]: direct application of phosphoric luminiforous mixture, dividing of them into component and extraction of ERM from mixture, thus the last shift prevails in European technologies.

Scrap of computer monitors on the first stage of its processing [2] lixiviate by the concentrated sulphuric acid, transferring oxisulfides europium and yttrium in sulfates. The aquatic washing follows after autoclave sulfuric acid decomposition of scrap. The got solution contains a 17 g/ℓ of yttrium (*Y*) 0.7 g/ℓ of europium (*Eu*), extraction of europium – 96 %, yttrium – 98 %.

The method of extraction of cerium from used iron-potassium catalysts includes their pre-treatment and subsequent dissolution in the concentrated muriatic acid. The got solution with the self-weighted particles of $CeO_2$ it is heated to boiling, maintain at this temperature 30-120 minutes and during 3-12 hours in the chilled solution with the making of sediment which. wash on a filter and dry to permanent mass of dioxide of cerium [3].

Method of selective extraction of gadolinium and gallium from wastes of production of gallium-gadolinium garnets [4] foresees treatment of wastes by one or by mixture of a few strong acids ($HNO_3$, $H_2SO_4$, *HCl*, $H_3PO_4$) at the temperature of boiling and subsequent extraction of metals from sour solutions by means of cationic or anionic extractants. As a result of processing $Gd_2O_3$ got by a cleanness more than 5 *N*.

Process of extraction of lanthanum, yttrium and gallium [5] from used optical glasses includes: converting of oxides of ERM into hydroxides at treatment of *NaOH* wastes, lixiviating by *HCl*, cleaning of solutions selective deposition and division of chlorides by method of liquid extraction.

There is offered [6] method of extraction of ERM from solutions, containing iron (III) and aluminium, with the use of sorbent as which it used an ampholyte. Solution was preliminary neutralized or acidified to pH = 4-5 with further inclusion of ampholyte to the got mash without the separation of hard part. A persorption was carried out at correlation of ampholyte: pulp, equal 1:(50-150) in presence a repairer.

Tests, executed on OAJ «*PhosAgroCherepovets*» (Russian Federation), showed possibility of realization of process of extraction of ERM from extraction phosphoric acid (EPA) in the conditions of operating production on processing of apatite.

A company «*Sol'vey*» has possibilities to construct and produce the special molecules for lixiviating of elements, based on the structure of phosphines and amines [7].

From solutions of phosphoric acid extraction of lanthanum, ytterbium and yttrium in work [8] it is suggested to conduct by the method of ionic exchange with the use of cationite of KU-2.

For extraction of ERM from phosphogyrsum there are investigated a few technologies: agitation lixiviating by sulphuric acid solutions by the concentration ≤ of 4 mass %; selection of ERM from sulfuric acid solutions of lixiviating, including, spontaneous crystallization of concentrate on the basis of double sulfates of ERM and sodium from solutions of lixiviating of phosphogyrsum, containing 22-30 mass. % $H_2SO_4$; persorption of ERM and admixtures from low concentrated solutions of lixiviating of phosphogyrsum; processing of stripping with the making of unradio-active carbonate concentrates of ERM; and method of processing of such concentrate in an unradio-active carbonate concentrate.

Sorbtographic technology of extraction of ERM from sulfuric acid solutions of the percolating lixiviating of phosphogyrsum is worked out in work [9]. There are certain the conditions of realization persorptions, providing achievement in the sorbent of maximal content of ERM at minimum content of thorium and calcium.

Process of flotation extraction of cerium from sewages of enchant separations of steel-rolling enterprises, specialized on producing of welding wire, alloyed by a cerium, was studied in work [10]. The conducted researches showed that at the optimal conditions of conduct of flotation process a cerium is extracted from solutions on 95 %.

*Conclusion.* Technologies of extraction of rare-earth metals are considered from the different types of secondary and technogenic raw material.

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