

Abstract

The strategic nature of rare earth elements (REE) and the limitation of access to natural resources of these metals by the world's leading producer – China, have contributed in recent years to intensifying the search for alternative sources of their production.

The focus of attention was on raw materials, among which energetic waste plays an important role.

Although the total amount of REE in domestic ash is not high, ashes from domestic power plants are considered to be prospective sources of REE.

The dissertation presents several technological solutions for the recovery of REE from fly ash originating from combustion of hard coal.

On the basis of a literature analysis describing the current state of the art in the field of extraction REE from energy waste, technological and economic-technical criteria as well as own research and analysis.

As a raw material for extraction REE, energetic waste was used - fly ash from hard coal combustion in Łagisza Power Plant.

The developed physicochemical basis of hydrometallurgical ash leaching processes with the use of sulfuric acid and ashes subjected to thermal alkaline activation with sodium carbonate and sodium hydroxide and leaching with mineral acids were the basis of the developed innovative technology for extraction REE concentrates from energy waste.

As part of the dissertation laboratory tests were carried out regarding the possibility of using physical enrichment processes leading to the REE concentrates. Studies related to the separation of fly ash into various grain classes and ash enrichment in heavy liquids were carried out. In order to improve the efficiency of enrichment processes a two-stage method of obtaining REE concentrates through hydrometallurgical ash processing was used in the research. It included two stages: acid leaching REE from fly ash or fly ash after initial alkaline heat treatment and precipitation of REE concentrate.

The result of laboratory tests and the analysis of their results was the development of assumptions of innovative technologies for obtaining of REE concentrates from fly ash from hard coal combustion. The applied methods of multi-stage ash leaching with the use of sulfuric acid, alkaline activation with sodium carbonate or sodium hydroxide and acid leaching, and then precipitation of REE by precipitation methods, allowed to obtain a concentrate of REE with purity over 94%, calculated as hydroxides.

The residue remained after leaching of REE and was the subject of research on the possibility of its management.

The result of the dissertation was patent application for the invention entitled "Method of recovery of REE from fly ash" (P.423021).

The obtained results of experimental research were subjected to a wide analysis, giving possible directions of modification and improvement of the effectiveness of the proposed methods of obtaining REE concentrates from fly ash.

A preliminary economic analysis of obtain a concentrate of REE from selected energy waste for the process of multi-stage ash leaching with sulfuric acid and leaching acidic ash treated with the use of sodium carbonate or sodium hydroxide was also carried out.

On the basis of the obtained results of experimental research and their analysis, general conclusions were formulated, as well as concerning individual stages of comprehensive use of fly ash for obtaining concentrate of REE with simultaneous management of a waste product.