

ABSTRACT

of **Tileuberdi Ayaulym Nurlankyzy's** dissertation work on the topic «Research of environmentally friendly technologies for the extraction of heavy metals from dump slags», submitted for the degree of Doctor of Philosophy (PhD) in the education program 8D05210 – «Ecology»

The relevance of the topic under study. The Development Program of Kazakhstan and the Message of the President to the People of the Republic of Kazakhstan focuses on saving mineral resources by attracting secondary materials and waste into production, which negatively affect the environment.

Great attention is paid to the creation of energy- and resource-saving technologies for processing mineral and secondary raw materials, ensuring the most appropriate extraction of valuable components of industrial environmental importance to solve the tasks set in the subordinate enterprises of construction products, metallurgical and chemical industries,

In this regard, our proposed environmentally safe waste-free technology for processing metallurgical waste with the release of chlorides of heavy and non-ferrous metals while producing expanded clay is effective in terms of saving mineral resources and solving environmental pollution problems with toxic harmful metal components.

Research purpose: solving the region's environmental problems through integrated safe processing of metallurgical waste.

The following scientific **objectives** were solved to achieve the purpose:

- analytical review of information sources and legislative materials on the impact of metallurgical waste on the environment and living organisms;
- physico-chemical features of metallurgical wastes and study of their impact on environmental components;
- theoretical and practical studies of creation of ecologically clean technology of metallurgical waste processing;
- study of thermodynamic and kinetic regularities of ecologically safe technologies of lead slag processing;
- mathematical modeling of the impact of metallurgical waste on the environment;
- calculation of ecological and economic indicators of ecologically clean technology of metallurgical slag processing.

Research objects: Dump slags of lead production, Lenger refractory clay.

Research methods. The reliability of the experimental results was ensured by the use of modern technical means of physico-chemical analysis - JEOL scanning electron microscope (SEM), SPECORD75 spectrophotometer, Shimadzuirprestige-21 infrared Fourier spectrometer, DRON-3 X-ray phase analyzer, differential thermal analysis (DTA).

Thermodynamic studies were performed using the HSC-10 Chemistry software package developed by Outokumpu Research Oy.

The mathematical planning of the experiments was performed using the method of rotatable planning of second-order experiments according to the Student's criterion and with a Fischer adequacy check.

Kinetic studies of complex environmentally safe processing of metallurgical waste were carried out on the basis of experimental data on the dependence of the degrees of metal extraction on temperature, duration and composition with the processing of the results by the Rotinyan-Drozdov equation.

The classification of the waste hazard was carried out according to the Environmental Code of the Republic of Kazakhstan dated January 2, 2021.

Connection with the plan of scientific research works.

The dissertation work was carried out in accordance with the scientific directions of the M.Auezov South Kazakhstan University within the framework of the state budget theme of the Department "Ecology" for 2021-2025 years GB Research -21-03-04 "Sustainable development and green technologies of the southern region of Kazakhstan" and the Department of "Chemical Technology of inorganic substances" GB Research-21-03-02 "Development of new promising technologies and improvement of traditional technologies for the production of inorganic products, environmentally friendly fertilizers and plant growth stimulants based on mineral raw materials and man-made waste".

Scientific novelty of the research:

1. The study of thermodynamic and kinetic regularities of complex environmentally safe processing of metallurgical wastes with simultaneous separation of metals and obtaining a useful product was carried out for the first time.

2. The constant and variable factors providing maximum obtaining of useful metals were determined for the first time by the method of mathematical modeling of the process of complex safe processing of metallurgical wastes.

3. The scientifically based assessment of the environmental impact of the residual composition of non-ferrous and heavy metals for the Shymkent region for the first time.

The main provisions for the dissertation defense:

1. Literature review of the current state of processing of waste-dust slag from lead production.

2. Physico-chemical characteristics of the used initial raw materials and the obtained products.

3. Thermodynamic and kinetic study of the possibility of chlorination reactions of residual metals with the participation of mineral components of slags and galvanic sludge.

4. Results of mathematical modeling of the process of complex environmentally safe processing of metallurgical wastes and constant and variable factors that provide maximum release of useful metals.

5. Results of ecological and economic assessment of the impact of metallurgical waste on the environment.

Practical significance of research:

1. Patent of the Republic of Kazakhstan for utility model «Method of lead-containing waste processing» (Patent for UM RK №7894 bull. №12 from 24.03.2023).

2. The results of research of thermodynamic and kinetic regularities of collective extraction of chloride subions from metallurgical wastes at ecologically waste-free processing are generalized.

3. The technological parameters of the process were determined, ensuring a high degree of metal extraction with simultaneous production of high-strength expanded clay by the method of mathematical planning of experiment the technological parameters of the process.

4. Pilot tests of ecologically clean technology of extraction of heavy metals from slag waste have been carried out (Test Act No. 20 from 15.11.2023 y.).

The degree of reliability and approbation of the results.

The reliability of the new scientific data obtained is ensured by the results of chemical and physico-chemical analyses of raw materials and finished products, using instrumental research and analysis methods and modern analytical instruments for research. The proposed technology for processing metallurgical waste has been tested in the process of laboratory tests in the Regional Laboratory of Engineering profile "Structural and Biochemical Materials" at the South Kazakhstan University named after M. Auezov, which showed reproducibility of experimental scientific data. The developed technological scheme of processing, the conditions ensuring maximum metal extraction with simultaneous production of high-quality expanded clay are determined based on the established optimal production parameters. The results of the study were reported at international scientific and practical conferences.

The proposed environmentally friendly technology was evaluated by the results of industrial tests (Test Act No. 20 from 15.11.2023 y.).

The personal contribution of the doctoral candidate it consists in the analysis of literary information, patent search on the topic of the dissertation, in setting research goals and objectives, in selecting research methods and analyses, in conducting theoretical and experimental research, in generalizing their results and developing new technological solutions, in experimental approbation of the development and generalization of the results obtained, in the preparation and publication of scientific publications on dissertation work, in the design of test certificates for the implementation of the results of the dissertation work in the educational process.

Publications on the dissertation theme. The main provisions of the completed dissertation research are reflected in 10 scientific publications, including 3 in international scientific journals included in the Scopus database, 6 in the materials of international scientific and practical conferences. According to the research results, 1 patent for a utility model of the Republic of Kazakhstan was obtained.

The dissertation structure and volume. The dissertation work is presented on 118 pages of typewritten text, contains 21 tables, 48 figures. The work consists

of an introduction, 5 sections, a conclusion, a list of used sources from 165 titles and 4 appendices.