

ABSTRACT

of dissertation of **Satimbekova Asem Bazarovna**
on the topic «Ecological situation improvement of the ISC «Kostanai
minerals» territory by means of chrysotile-asbestos waste with magnesium salts
production» for the degree of Doctor of Philosophy (PhD) in the specialty 6D073100
– «Life Safety and Environmental Protection».

Relevance of the research topic. It is known that the carcinogenic activity of chrysotile asbestos has been confirmed by experimental studies. However, the reasons underlying its biological and carcinogenic effects are still not well understood. Based on research, it has become known that the biological activity of fibers is closely related to factors such as the physicochemical and structural characteristics of their surface layers, as well as the surface charge. Currently, in many countries, in order to prevent environmental threats and protect the health of workers involved in this industry, research and development of alternative methods for reducing the risks associated with the production of chrysotile asbestos is actively underway. Some pathological diseases caused by asbestos-containing substances may affect not only workers in the mining industry, but also residents of settlements located near such enterprises. Research work on the recycling of chrysotile asbestos waste has so far mainly focused on the recovery of the magnesium component. However, the issues of neutralizing these dusty wastes and influencing their surface layer using acid treatment to achieve physicochemical changes have not been previously considered. This is probably due to the high content of magnesium (MgO - 40 wt.%) in asbestos-containing waste. In this regard, it is relevant to search for methods that simultaneously lead to the neutralization of industrial waste containing asbestos and the extraction of magnesium in the form of its important compounds, leading to the solution of problems of life safety and environmental protection, as well as the economic effects of their disposal technology.

Link to the research plan. The topic of the dissertation corresponds to the priority directions of scientific development. The dissertation work was completed at the department of “Life Safety and Environmental Protection” in accordance with the plan of state budgetary research work of the South Kazakhstan University named after M. Auezov. The work was carried out within the framework of the direction “Development of thermochemical processes for the production of environmentally friendly mineral fertilizers and salts using natural raw materials and various production wastes” - B-16-04-03.

Purpose of the study.

Development of technologies for environmentally hazardous dusty waste from the production of chrysotile asbestos with the simultaneous production of moles of magnesium to increase the economic efficiency of their disposal technologies through the use of acid processing methods.

Research objectives:

- analysis and synthesis of data on the main properties of chrysotile asbestos and its impact on life safety and environmental protection;
- assessment of the qualitative and quantitative composition of asbestos-containing dusty waste generated as a result of the enrichment of asbestos ores at Kostanay Minerals JSC;

- theoretically and experimentally study the physical and chemical properties of asbestos-containing dust waste, as well as develop acid treatment methods for their neutralization;

- to propose an environmentally and cost-effective acid treatment technology aimed at extracting magnesium salts, ensuring the reduction of dusty waste into an environmentally friendly state.

Objects of research. Dust-like waste containing 1.0% chrysotile asbestos generated during the enrichment of chrysotile asbestos raw materials from the Zhitigara deposit.

Scientific novelty of the research:

- for the first time, results and evidence of radiographic studies of the thermal decomposition of chrysotile asbestos in the temperature range of 650-750 °C were obtained;

- for the first time, scientific data on hazardous dusty waste from chrysotile-asbestos production of Kustanai Minerals JSC was presented from the point of view of life safety and environmental protection;

- for the first time, evidence was obtained of the neutralization of the harmful properties of asbestos-containing dusty waste from chrysotile-asbestos production by acid treatment, which was confirmed using IR spectroscopy and radiographic analyses.

- patterns of quantitative interaction of dusty waste with sulfuric acid were revealed for the first time;

- the optimal parameters of technological processes have been determined to ensure the extraction of 50% of the initial magnesium content in waste and its transformation into a safe state for the environment;

- methods have been developed that provide not only waste disinfection, but also the production of magnesium salts that meet the requirements of current regulatory documents in terms of quality indicators and economic efficiency.

Practical significance of the work:

New patterns of interaction of serpentinites with inorganic acids have been identified, which can be used to study the reactions of interaction of other magnesium hydrosilicate minerals with acids. The results of applied research on the disposal of environmentally hazardous waste from the production and enrichment of chrysotile asbestos have revealed the possibility of obtaining from them industrially important magnesium compounds, such as sulfate, chloride and nitrate, which have market value. They are of interest to asbestos enterprises from an environmental, production and economic point of view, since large volumes of environmentally hazardous asbestos-containing waste have been accumulated on their production areas. The proposed method for recycling accumulated and generated asbestos-containing waste allows not only to disinfect it, but also to diversify the range of products produced at enterprises. The quality of magnesium sulfate ($\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$), obtained according to the proposed acid treatment scheme for dusty waste, was tested at the Sapa testing center of the South Kazakhstan State University named after M. Auezov. The test results showed that the resulting magnesium sulfate in terms of main quality indicators is close to the values established by current regulatory documents (TU 2141-016-32496445-00, TU 400069905-043-2012).

The main provisions, results, conclusions and conclusion of the dissertation are presented in 11 published works: in 4 articles of International scientific

publications included in the Scopus database, in 3 articles in journals recommended by the Committee for Quality Assurance in Science and Higher Education of the Ministry of Education and Science of the Republic of Kazakhstan; in 3 articles in proceedings of international conferences. 1 patent of the Republic of Kazakhstan was received (No. 3570).

The accuracy and correctness of the scientific conclusions, conclusions and recommendations of the work are fully confirmed by the results of studies conducted in laboratory and production conditions.

Main provisions submitted for defense:

- results of a study of the physico-chemical properties of asbestos-containing dust waste;
- results of a study of the processes of interaction of asbestos-containing dusty waste with salt, sulfuric and nitric acids;
- results of IR spectroscopic and X-ray phase studies showing changes in the molecular structure of chrysotile asbestos during acid treatment;
- an acid treatment scheme that ensures the simultaneous extraction of magnesium compounds from them, as well as the disinfection of asbestos-containing dusty waste of high environmental hazard;
- assessment of the environmental and economic efficiency of developing a reduction in the harmful effects on the environment of processed asbestos-containing dust waste of Kustanai Minerals JSC and the simultaneous production of magnesium salts.

The doctoral candidate's personal contribution. The main results and hypotheses of the dissertation were presented and discussed at the following international and national scientific conferences: Scientific journal. Regional Bulletin of the East. Ust-Kamenogorsk, publishing house "Berel" EKSU named after S. Amanzholov, No. 1 (85), 2020; Publishing house "Internauka". Proceedings of the LXI International Multidisciplinary Conference "Recent Scientific Investigation". Primedia E-launch LLC. Shawnee, USA. 2024; Proceeding V International Conference "Industrial Technologies and Engineering" ICITE – 2018, V.1, M. Auezov South Kazakhstan State University, Shymkent, 2018; Scientific journal. Bulletin of the East Kazakhstan State Technical University named after D. Serikbaev, Ust - Kamenogorsk, No. 1 (83), 2019; Scientific journal. Bulletin of the East Kazakhstan State Technical University named after D. Serikbaev, Ust - Kamenogorsk, No. 1 (83), 2019; Republican magazine "Proceedings of the University". Karaganda State Technical University named after Buketov, Karaganda, No. 1 (74), 2019; International Research Publication House. International Journal of Engineering Research and Technology (IJERT) India, V. 13, NO 6, 2020; ARPN Journal of Engineering and Applied Sciences. 2006-2021 Asian Research Publishing Network (ARPN). All rights reserved, Pakistan, V. 16, NO.9, 2021; Green Processing and Synthesis – 2024; 13:20240034. ISSN: 2191-9550. №13. – 2024; Molecules journal. – 2024. – Volume 29. 4455. Issue 18 September – 2. 2024. During a scientific internship at the St. Petersburg State Technological Institute (Technical University), the work was carried out at the Department of Life Safety and Environmental Protection and received a positive assessment.

Publications on the Research Topic. The obtained scientific results of the dissertation work resulted in 11 scientific publications, including: 3 articles in publications included in the list recommended by the Committee for Quality

Assurance in Science and Higher Education of the Ministry of Education and Science of the Republic of Kazakhstan. 4 article in journals included in the international Scopus database. 3 articles in international and national conferences and collections of foreign conferences. 1 patent of the Republic of Kazakhstan was received (No. 3570).

Structure and Volume of the Dissertation

The dissertation consists of 110 pages and includes 46 figures, 11 tables. The list of references used includes 111 entries. The content of the dissertation consists of: introduction, literature review, materials and methods of research, research results, their discussion and a conclusion.