Editorial

COMPLEX AND DEEP PROCESSING OF MINERAL RAW MATERIALS OF NATURAL AND TECHNOGENIC ORIGIN: STATE AND PROSPECTS

According to the Strategy for Development of the Mineral and Raw Material Base of the Russian Federation until 2035, various economic and technological factors, caused by the current world situation, may hinder the increase in the rates of reproduction and processing of solid minerals. The peculiarity of the current historical stage of development of the national economy, which is within the global context of change of technical and economic modes of the Russian Federation, is the implementation of the strategy of reproduction of the mineral resource base and processing of solid minerals in conditions of import substitution. To achieve technological sovereignty and provide high-tech industries of Russia with strategic metals and other resources, it is necessary to concentrate scientific research of leading institutions in the field of mineral raw processing on justification and development of innovative processes of extraction of valuable components from natural and anthropogenic raw materials. In the course of implementation of the Strategy, it is foreseen to solve one of the key problems, which is enhancement of efficiency of enrichment and deep processing of strategic mineral raw materials of natural and technogenic origin on the basis of physicochemical and energy effect with maximum extraction of valuable components and obtaining finished products with required characteristics.

In the special issue of the Journal of Mining Institute we collected articles considering the problems of Russian and world science in the field of complex and deep processing of mineral raw materials of natural and anthropogenic origin, development of theory and methods of intensification of selective disintegration of finely dispersed mineral clusters, and leaching of noble metals and rare-earth elements from resistant ores and unconventional raw materials and concentrates, improvement of basic and auxiliary processes of concentration and their digitalization.

In the paper by RAS academician *Valentin A.Chanturiya* (DOI: 10.31897/PMI.2022.31), the scientific substantiation of innovative processes of zirconium and rare-earth elements (REEs) extraction during deep and complex processing of eudialyte concentrate is given. The mechanism and optimal conditions and specific features of eudialyte and rock minerals destruction, zirconium and REEs extraction under the influence of various acids, powerful nanosecond pulses, dielectric barrier discharge, electrochemical treatment, mechanochemical activation and ultrasound were revealed. The mechanism of formation and optimum conditions of silica gel dispersion depending on methods and parameters of energy influences are theoretically and experimentally substantiated.

The issues of complex study of material, mineralogical and physical-technological properties of mineral raw materials for optimization of ore dressing processes are considered. *Tatiana N. Aleksandrova* with co-authors (DOI: 10.31897/PMI.2022.58) present the results of comprehensive study of mineralogical and technological features and regularities in crushing of ferruginous quartzites from Mikhailovskoye deposit, which allowed to substantiate the possibility of selective disintegration at the stages of sequential destruction. The paper by *Asiya M. Duryagina* and colleagues (DOI: 10.31897/PMI.2022.76) is devoted to research of application of selective disintegration, which provides results of optical-microscopic and *X*-ray-microtomographic studies with identification of quantitative characteristics of morphological parameters by the example of ores of Norilsk type from Oktyabrsky deposit. *Alexander P. Gospodarikov* and colleagues (DOI: 10.31897/PMI.2022.87) performed surveys to estimate deformation characteristics of brittle rocks beyond the strength limit. As a result of these studies of samples of rich sulfide ore, it was found that during fracture, the elasticity and strain moduli decrease by about 1.5-2 times and in the zone of residual strength by 5-7 times.

Several articles are devoted to the development of the theory and practice of flotation. The article by *Sergey A. Kondratev* and *Tatyana A. Khamzina* (DOI: 10.31897/PMI.2022.52) stated one of the new approaches to the evaluation of the flotation of reagents' collecting ability by the example of flotation of light coking coal slime. A new concept of the function performed by the physically sorbed collector in the elementary flotation act and the criterion of flotation activity of reagents are proposed and criterion of flotation activity of reagents used in coal-slime enrichment. The collector used in coal flotation, in addition to hydrophobizing the surface of the extracted particles, should reduce the induction time and remove the kinetic limitation of flotation agent formation.

The problem of flotation separation of titanite concentrate from apatite-nepheline-titanite ores in the anomalous zones of the Khibiny deposits is the subject of the article by *Galina V. Mitrofanova* et al.

(DOI: 10.31897/PMI.2022.81). It is shown that flotation separation of titanite concentrate is preferable to the chemical method based on sulfuric acid leaching.

Sergey I. Evdokimov and *Tatyana E. Gerasimenko* (DOI: 10.31897/PMI.2022.62) developed flotation schemes for apatite-nepheline ores, which provide a significant increase in extractable component content in the main flotation operation with a simultaneous increase in material enrichment capacity.

Aleksey E. Pelevin (DOI: 10.31897/PMI.2022.61) has critically analyzed the existing iron ore beneficiation technologies in Russia and considered variants of increasing their efficiency. It was suggested to use combined technologies of fine screening, high-gradient magnetic separation, gravitation, flotation, and electric beneficiation methods to increase iron ores processing complexity and electrical methods of enrichment.

The article of *Alexandr S. Opalev* and *Svetlana A. Alekseeva* (DOI: 10.31897/PMI.2022.80) considers the issues of increasing the quality of iron-ore concentrates in processing of iron ores. On the basis of the carried out investigations, the technology of concentrate staging was proposed, which can be replicated for other objects. *Darya N. Shibaeva* and co-authors (DOI: 10.31897/PMI.2022.79) on the basis of the analysis of video-fixation data of physical modeling, implemented on the laboratory drum magnetic separator of SMBS-L series and in the VSDC Video Editor, and simulation modeling of dry magnetic separation on its virtual prototype in the program complex Rocky DEM, suggested carrying out dry magnetic separation of ferruginous quartzite of a –80+0 mm size class without preliminary preparation using a vibration-picker as a feeder for ore mass into the zone of separation.

Andrey I. Matveev and his colleagues (DOI: 10.31897/PMI.2022.90) presented the results of research on the creation of technologies and equipment in the field of ore dressing and pneumatic dry enrichment of mineral raw materials. The use of dry enrichment technologies will reduce the capital costs for the construction of stationary enrichment plants, completely or partially abandon the use of process water, the construction of water supply systems, traditional tailings storage, etc.

A number of articles are devoted to the issues of increasing the complexity of the use of minerals and involving in the processing of low-quality, hard-to-enrich and technogenic mineral resources. In the article by *Igor Yu. Rasskazov* with co-authors (DOI: 10.31897/PMI.2022.60), the method of underground development of complex deposits of uranium and molybdenum ores using activation leaching and various combinations of modified reagents is proposed, which will increase the extraction of valuable components. Development of the methodological approach to mineralogical study of titanium ores (by the example of Pizhemskoe deposit) within the limits of mineralogical support of their complex evaluation taking into account transformation of mineral phases as a result of extreme influences and physical and chemical properties as agents-modifiers at synthesis of industrial products is presented in the article of *Olga B. Kotova* and colleagues (DOI: 10.31897/PMI.2022.78). *Victoria V. Maksimova* with co-authors (DOI: 10.31897/PMI.2022.88) studied composition and properties of loparite tailings (as a potential source of rare metals) for the substantiation of necessity to develop complex technology of their processing. *Andrey G. Syrkov* and *Lyudmila A. Yachmenova* (DOI: 10.31897/PMI.2022.25) have presented the results of experimental and theoretical studies to substantiate the preparation modes of initial solid-phase raw materials and gas media to obtain metal products by solid hydride synthesis.

A number of articles address the application of digital technologies at different stages of mineral processing and beneficiation. *Jinzhan Huang* et al. (DOI: 10.31897/PMI.2022.89) proposed a model for coal ash content prediction based on neural networks and improved optimization algorithms. The model has a good prediction accuracy with high values of Pearson correlation coefficient and allowed to establish that potassium content is the most important factor influencing the ash content in the products. In paper by *Artem O. Romashev* et al. (DOI: 10.31897/PMI.2022.77), the authors proposed an adaptive approach enabling, by using machine-vision technology, to fix the dynamics of changing the level of contact of different pulp phases. The conducted research proves that the proposed solution is able to capture data even at high sedimentation rate of suspensions without a clear boundary of separation. The results of a comprehensive numerical simulation to improve the energy efficiency of the mill are given in the paper by *Yuriy L. Zhukovskiy* and colleagues (DOI: 10.31897/PMI.2022.91). The developed method can be used to determine a more efficient mode of operation when changing the volumetric filling of the mill by measuring the resultant torque on the shaft.

Responsible editor of the volume is Corresponding Member of the RAS
Tatiana N. Aleksandrova, Doctor of Engineering Sciences