ISSN 2518-1483 (Online),
ISSN 2224-5227 (Print)

2019 • 1

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫНЫҢ

БАЯНДАМАЛАРЫ

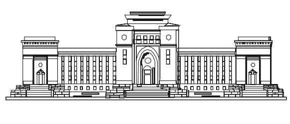
ДОКЛАДЫ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН

REPORTS

OF THE NATIONAL ACADEMY OF SCIENCES
OF THE REPUBLIC OF KAZAKHSTAN

PUBLISHED SINCE 1944



ALMATY, NAS RK

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫНЫҢ
БАЯНДАМАЛАРЫ **2019 • 1**

«Қазақстан Республикасы Ұлттық ғылым академиясының баяндамалары»
ISSN 2518-1483 (Online),
ISSN 2224-5227 (Print)

Меншіктенуші: «Қазақстан Республикасының Ұлттық ғылым академиясы» Республикалық қоғамдық бірлестігі (Алматы қ.)
Қазақстан республикасының Мәдениет пен ақпарат министрлігінің Ақпарат және мұрағат комитетінде 01.06.2006 ж. берілген **№5540-Ж** мерзімдік басылым тіркеуіне қойылу туралы куәлік

Мерзімділігі: жылына 6 рет.
Тиражы: 500 дана.

Редакцияның мекенжайы: 050010, Алматы қ., Шевченко көш., 28, 219 бөл., 220, тел.: 272-13-19, 272-13-18,
http://reports-science.kz/index.php/en/archive

Типографияның мекенжайы: «Аруна» ЖК, Алматы қ., Муратбаева көш., 75.

Доклады Национальной академии наук Республики Казахстан»
ISSN 2518-1483 (Online),
ISSN 2224-5227 (Print)

Собственник: Республиканское общественное объединение «Национальная академия наук Республики Казахстан» (г. Алматы)
Свидетельство о постановке на учет периодического печатного издания в Комитете информации и архивов Министерства культуры и информации Республики Казахстан **№5540-Ж**, выданное 01.06.2006 г.

Периодичность: 6 раз в год.
Тираж: 500 экземпляров

Адрес редакции: 050010, г.Алматы, ул.Шевченко, 28, ком.218-220, тел. 272-13-19, 272-13-18
http://reports-science.kz/index.php/en/archive

Адрес типографии: ИП «Аруна», г.Алматы, ул.Муратбаева, 75

REPORTS **2019 • 1**
OF NATIONAL ACADEMY OF SCIENCES OF THE
REPUBLIC OF KAZAKHSTAN

Reports of the National Academy of Sciences of the Republic of Kazakhstan.
ISSN 2224-5227
ISSN 2518-1483 (Online),
ISSN 2224-5227 (Print)

Owner: RPA "National Academy of Sciences of the Republic of Kazakhstan" (Almaty)
The certificate of registration of a periodic printed publication in the Committee of Information and Archives of the Ministry of Culture and Information of the Republic of Kazakhstan N 5540-Ж, issued 01.06.2006

Periodicity: 6 times a year
Circulation: 500 copies

Editorial address: 28, Shevchenko str., of.219-220, Almaty, 050010, tel. 272-13-19, 272-13-18,
http://reports-science.kz/index.php/en/archive

Address of printing house: ST "Aruna", 75, Muratbayev str, Almaty

REPORTS OF THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN
ISSN 2224-5227 **https://doi.org/10.32014/2019.2518-1483.2**
Volume 1, Number 323 (2019), 11 – 17

B.R. Rakishev

K.I. Satpayev Kazakh National Research Technical University, Almaty, Kazakhstan
e-mail:b.rakishev@mail.ru

MINING AND METALLURGICAL COMPLEX IN INDUSTRIAL AND POSTINDUSTRIAL DEVELOPMENT OF SOCIETY

Abstract. Development of the human society is directly related to the use of natural materials. Depending on the processing degree of the used material from mineral raw materials as the tools of labor, theStone, Bronze andIron Ages are distinguished. Subsequently, in the period of industrial development of society, articles made of high-quality metals and alloys were used as means of production, and in the period of post-industrial development, items made of high-tech metals and alloys were used. By the name of these materials, new stages in the development of civilization are called the “age” of high-quality metals and alloys and the “age” of high-tech metals and alloys, respectively. The main characteristics of the stages of the human society development are given.

Keywords: Stone, Bronze andIron Ages,“age” of high-quality metals and alloys, “age” of high-tech metals and alloys.

Major stages of society development

The thinkers of past eras had being determined the level of human society development by the type of material, laying in the basis of the means of production. In this connection, still in the antic world the idea of three ages arose: Stone Age, Bronze Age and Iron Age [1].

The Stone Age is the cultural and historical period in the mankind development, when the basic tools of labor and weapon were made mainly of stone; wood and bone were also used. There was still no metal treatment.

The Stone Age coincides with most of the era of the primitive communal system and covers the time, beginning with the allocation of a man from the animal state (about 1 million 800 thousand years ago) and ending with the era of the spreading of the first metals (about 8 thousand years ago in the ancient East and about 6-7 thousand years ago in the Europe). The Stone Age is divided into ancient (Paleolithic) and new (Neolithic) stone ages [2].

The Bronze Age is a historical and cultural period characterized by the spreading at the advanced cultural centers of metallurgy of bronze and turning it into a leading material for the production of tools of labor and weapons. Approximate chronological framework of the Bronze Age: the end of the 4th and the beginning of the 1st millennium BC. The tribes inhabiting both Asia and Western Europe developed within the framework of the primitive society [3].

The Iron Age is an epoch in the primitive and early class history of mankind, characterized by the spread of metallurgy of iron and making tools of production from it. The period of the initial distribution of the iron industry was experienced by all countries at different times. Usually only the cultures of primitive tribes that inhabited outside the territories of ancient slave-owning civilizations that originated in the era of the Neolithic and Bronze are referred to the Iron Age [1].

The Iron Age in comparison with the previous archaeological epochs (the Stone and Bronze Ages) is very short. Its chronological boundaries: from 9th-7th centuries BC, when many primitive tribes of Europe and Asia had developed their own metallurgy of iron, and before the time of the emergence of the class society and the state at these tribes [1].

The technical revolution, caused by the widespread use of iron and steel, greatly expanded power of man over nature. By the beginning of our era, all the main types of handicraft and agricultural hand tools, used in the Middle Ages and in new times, were made of iron and its derivatives. Development of the productive forces associated with the spread of iron, led to the transformation of the whole social life.

Further development of civilization is associated with the mass use of a whole number of high-quality metals for the creation of means of production-machines for various purposes. The process of formation of the large-scale machine production in all sectors of the economy, especially in industry, created the conditions for the production of a large range of previously unknown industrial products, the transformation of an agrarian or agrarian-industrial country into an industrial-agrarian or industrial one [4-6]. On the basis of heavy industry (mining, metallurgy, machine-tool construction, machine building), all branches of the economy developed, including construction, energy, agrarian, light, foodindustries, etc.

This stage of the civilization development, which coincides with the wide use of various high-quality metals and their derivatives can be called the Age of High-Quality Metals and Alloys by analogy with the above periods of human society development (by the name of the base material used) [6]. It characterizes the period of industrialization, which begins in the middle of the XVIII century and lasts until the middle of the XX century. On the basis of complex mechanization, pipelining and automation of production processes in the leading industries, the mass production of various products was mastered [6]. The main characteristics of the stages of society development, compiled by us with taking into account the data [4-9], are given in Table 1.

Within the framework of the Age of High-Quality Metals and Alloys, new industrial revolutions unfolded. The first industrial revolution occurred when the mankind learned to use the energy of steam and water to mechanize production[4-9]. At the end of the XVIII and the beginning of the XIX century, the water and steam engines, internal combustion engines were widely applied in the advanced countries of the world, the rail, sea, and motor transport developed [4-6]. Compared with the previous periods of society development, the shape of civilization has changed radically.

The use of electrical energy with the appropriate technical support led to the second technological breakthrough, the second industrial revolution. In the second half of XIX and at the beginning of the XX century, due to the widespread use of high-quality metals and alloys, conveyor production was mastered, mass production was adjusted. Aviation, telephone, telegraph communication were developing. Life has become more comfortable and high quality.

From the middle of the XX century, a modern scientific and technological revolution began, which had a strong influence on the further course of industrial development. The conditions appeared for the transition to the use of high technology and the corresponding technical means. Usually to the high technologies the most knowledge-intensive industries are referred. These are electronics, robotics, aircraft construction, rocket engineering, space engineering, software, nanotechnologies, nuclear, solar and hydrogen energy, biotechnology, genetic engineering and environmentally friendly technologies in all sectors of the economy[10,11]. They have unrecognizably changed the culture and structure of production, repeatedly raising the productivity of labor. These technologies are based on the use of various alloys of ferrous, nonferrous, noble, rare, rare-earth metals (REM).

In accordance with [1-3] the considered stage in the civilization development by type of the applied base material can be called an Age of High-Tech Metals and Alloys [6]. The beginning of this Age coincides with the middle of the XX century, when humanity mastered atomic energy; the space engineering and cybernetics were developing. In the leading industries and management, computers and information technologies were widely applied, which have become the symbol of the scientific and technological revolution. They changed fundamentally the position and role of the man in the process of production management.

Within the framework of this Age a third industrial revolution took place. Integrated mechanization and automation of production processes, intensive use of digital, information technologies in the management of these processes were being introduced. The role of fundamental science in transforming the production base has sharply increased; the newest high-tech industries have been formed. Science has become a real productive force.

Table 1- Main characteristics of the stages of the society development

Stage name	Stage duration	Production
Stone Age	Start: 1 million 800 thousand years ago End: 8-6 thousand years ago	Weapon, tools of labor, stone products
Bronze Age	Start: the end of the 4th and beginning of the 1st millennium BC End: 11-10 centuries BC	Weapon, toolsoflabor, bronzeproducts, extended agriculture
Iron Age	Start: 9-7 centuries BC End: 1-4 centuries of our era	Weapon, ironproducts, toolsoflabor from iron and steel, improvement of irrigation facilities
Age of High-Quality Metals and Alloys	Start: middle of the 18th century End: middle of the 20th century	Energyofsteamandwater Large-scale machine production based on high-quality metals and alloys (I Industrial Revolution) Electric Energy Conveyor production based on high-quality metals and alloys (II Industrial Revolution)
Age of High-Tech Metals and Alloys	Start:middle of the 20th century Action: present time	High technologies (electronics, robotics, space technology, nuclear power, information technologies, nanotechnology, etc.), based on high-tech metals and alloys (III Industrial Revolution). Integration of advanced technologies, fusion of physical, digital, biological fields, artificial intelligence, big data processing, based on high-tech metals and alloys (IV Industrial Revolution or Industry 4.0)

As a result of self-development, self-improvement, at the beginning of the XXI century the third industrial revolution smoothly passed into the fourth industrial revolution, which provides the deeper quantitative and qualitative changes in the sphere of science and production. The Fourth Industrial Revolution, or Industry 4.0, is characterized by integration of the advanced technologies and fusion of the physical, digital and biological spheres. In addition, almost every physical object involved in the production process is equipped with a lot of sensors, which will generate a huge flow of information every second. Processing and analyzing large amounts of data (Big Data) is becoming one of the main elements ensuring the operation of Industry 4.0 [7,9,10].

The place mining and metallurgy in development of civilizations

As seen, mankind in its development had experienced a Stone, Bronze and Iron Ages, is experiencingthe Age of High-Quality Metals and Alloys, and has entered the Age of High-Tech Metals and Alloys. At the same time, according to the historically established tradition, the brand of the society was determined by the type of material obtained from mineral raw materials, which underwent various degrees of processing and formed the basis of means of production.These materials are stone, bronze, iron, high-quality metals (various grades of steel, aluminum, copper, etc.) and their alloys (a large variety), high-tech metals (various for various industries) and their alloys (a large variety). The mining and metallurgical complex served as the material and technical basis for the development of civilization. No branch of the economy, no production technology could and can do without the use of products of the mining and metallurgical industry(MMC). This is an axiom.

Thus, MMC is a natural material and technical basis of scientific and technological progress and of the society development as a whole, and scientific and technical progress, in turn, is a driver of innovation in all sectors of the economy, including the mining and metallurgical industry. All high-tech, high technologies in one way or another use the components consisting of the high-tech metals and alloys, made from various combinations of many traditional metals and rare, rare-earth elements. Materials with rare earth elements have excellent properties, the importance of which is recognized throughout the world [8-14]. All innovative solutions in the field of space and rocket engineering, nuclear and hydrogen energy, nanotechnologies, medicine, biotechnologies, communications, etc. are based on the use of high-tech alloys with the desired characteristics. In the world of innovative and high technologies, the following expensive REMs are widely used: indium, scandium, platinum, rhenium, palladium, osmium, lutetium, zirconium, selenium, tellurium, cobalt, cadmium, etc. [10-15].

Most of them are contained in ores of ferrous, non-ferrous, noble metals, in uranium, in coal, in oil and others. Removing them from basic raw materials to meet the needs of new technologies for high-tech metals and alloys even more actualizes the problem of complex and full use of minerals. The effective solution of this dual problem becomes the main priority of the mining and metallurgical industry. We consider its solution on the example of mining and metallurgical enterprises in Kazakhstan.

Kazakhstan in the global production of rare and rare earth metals

In the present territory of Kazakhstan, in the Bronze Age copper was smelted, in the Iron Age iron metallurgy was originated, and gold and silver were produced [1-3]. As the President of the Republic of Kazakhstan, Nazarbayev N.A., notes, «even in deep ancient times, on the lands of Kazakhstan, the centers of mining and ore production and smelting of bronze, copper, iron, silver and goldappeared, and the manufacture of sheet metal arose. Our ancestors constantly developed the production of new, more durable metals, which opened them up the possibility to accelerate the technological process» [16].

The mining and metallurgical industry had developed rapidly during the Soviet era. The largest enterprises of the ferrous metallurgy “Sokolovsky-Sarbay mining production association”, JSC "Kazchrome", "Karaganda Metallurgical Plant", flagships of the non-ferrous metallurgy –Dzhezkazgan and Balkhash mining and metallurgical plants, Ust-Kamenogorsk lead-zinc and titanium-magnesiumplants, Zyryanovsk and Leninogorskmining and metallurgical plants, Achisaipolymetallicplant, Chimkent lead plant, Pavlodar aluminum plant provided the country with the necessary volume and required nomenclature of the ferrous, non-ferrous, noble and rare metals. The production and output of the high-quality metals and alloys were mastered. Thus, the material and technical base for the creation of large-scale machine and conveyor production was prepared, which determines the contribution of Kazakhstan to the scientific and technological progress in the XX century.

In the middle of the XX century, as a result of the strong influence of the fundamental science on the production of various new products, innovative industries began to form. They were based on the use of high-tech metals and alloys with the necessary physical-chemical and physical-technical properties. Depending on the specific requirements, these structural materials were obtained from a given combination of traditional and rare and rare-earth metals. As a rule, the latter throughout the world are extracted from the composition of the core mineral raw materials. In this matter, Kazakhstan is no exception.

The main feature of Kazakhstan's mineral deposits is their multicomponent nature. For example, the deposits of non-ferrous metals contain up to 20 of the most important noble and rare metals (gold, silver, bismuth, platinum, palladium, cobalt, selenium, tellurium, cadmium, rhenium, indium, osmium, tallium, etc.). The Republic has successfully mastered the technologies of extracting many of them from copper, lead, zinc and other concentrates, as well as from as well as uranium ore, coal and oil[17]. However, these technologies require the fundamental improvement.

Currently, our republic is the largest producer of rhenium (second place), beryllium (second place), titanium sponge (second place), tantalum, niobium, osmium, gallium, technical thallium, arsenic (third place), uranium (first place), vanadium (fifth place), bismuth (sixth place), gold, silver (eighth place).

In spite of the achieved success, at the majority of the middle mining and metallurgical enterprises in Kazakhstan, the precious useful components (platinum, gold, palladium, rhenium, osmium, thallium, and others), accompanying profile metals, are often not extracted from the raw materials and go to the waste of the processing and metallurgical production. At those enterprises where they are produced, their extraction coefficient from ore raw materials is very low (about 0.4) [17]. Such a paradox is connected with the fact that byapprovingthe reserves of deposits, the associated useful components are often not evaluated and are not put on the balance. There are no requirements for the subsoil users to extract the useful components found in the ores during the deposit exploitation.

At the same time, the advanced experience of the large enterprises of the MMC of Kazakhstan [17,18] shows that due to the development and implementation of innovative technologies and technical means, the current level of extraction of precious and rare metals can be raised by 2-2.5 times, and for profile metals - by 1.5 times. In the adduced conditions [17], the total revenues from realization of the concomitant noble and rare metals exceed incomes from the core metals (copper, molybdenum) by 9.33 times. The current amount of income from sales of Kazakhstan MMC productionwith the integrated use of ores may be providedby their volume at least 8.0-10.0 times less than at present. In other words, the existing resource potential of mineral deposits can be raised by an order of magnitude.

For large-scale implementation of measures to increase the complexability of the use of mineral raw materials at the legislative, state level, it is necessary to resolve the issue of the need to extract all the related, especially high-value, useful components from ore raw materials, the demand for which increases many times due to the needs of the high technologies. This will ensure the production of rare and rare-earth metals in the quantities sufficient for Kazakhstan to be able to occupy a worthy place in the global market for rare-earth metals, a fundamental component of high technology.

Conclusions

1. The thinkers of past eras had being determined the level of human society development by the type of material, laying in the basis of the means of production. In this connection, still in the antic world the idea of three ages arose: Stone Age, Bronze Age and Iron Age.

2. Further development of civilization is associated with the mass use of a number of high-quality metals for the creation of means of production-machines for various purposes. By analogy with the above systematization of the human society development, it can be called an Age of High-Quality Metals and Alloys.

3. From the middle of the XX century the conditions appeared for the transition to the use of high technology and the corresponding technical means. These technologies are based on the use of various alloys of nonferrous, noble, rare, rare-earth metals. This stage in the civilization development can be called an Age of High-Tech Metals and Alloys.

4. The mining and metallurgical complex, producing high-quality and high-tech metals, is a natural material and technical basis of scientific and technological progress and of the society development as a whole. In turn, scientific and technical progress is a driver of innovation in all sectors of the economy, including the mining and metallurgical industry.

5.Traditional mineral deposits together with the technogeneones are the main sources of industrial production of noble, rare and rare earth metals.

6.Technical facilities and technologies, adapted to the natural and technological properties of mineral raw, provide a high level of extraction of core, noble, rare and rare-earth metals.These results represent the contribution of the MMC to the further development of scientific and technological progress.

Б.Р.Рақышев

К.И.Сәтбаев атындағы Қазақ ұлттық техникалық зерттеу университеті, Алматы, Қазақстан

ҚОҒАМНЫҢ ИНДУСТРИАЛЫҚ ЖӘНЕ ПОСТИНДУСТРИАЛЫҚ ДАМУ КЕЗІНДЕГІ ТАУ-КЕН КЕШЕНІ

Аннотация. Қоғамның дамуы табиғи заттарды пайдаланумен тікелей байланысты. Шикі заттарды өңдеп қолданудың деңгейіне байланысты атам заманнан тас,қола, темір ғасыры деген ұғым қалыптасқан. Бертін келе қоғамның индустриялық даму кезінде негізгі жабдықтар шығаруда жоғарғы сапалы металлдармен қорытпаларды, ал постиндустриялық даму кезінде жоғарғы технологияға сай металлдармен қорытпаларды пайдаланған. Осыған орай бұрыннан қалыптасқан ұғымдарға сай осы жаңа кезеңдер жоғарғы сапалы металлдармен қорытпалардың «ғасыры», жоғары технологиялық металлдармен қорытпалардың «ғасыры»деп атау ұсынылған.

Жоғары сапалы және жоғарғы техноллгиялық металлдармен қорытпаларды өндіретін тау-кен кешені ғылыми-техникалық прогресстің, одан әр қоғамды өркендетуінің табиғи негізі. Ал ғылыми техниалық прогресс өндірістің әр саласы, оның ішінде тау-кен саласының дамуының себепкері. Асыл және сирек кездесетін металлдардың негізгі көзі – көп тараған пайдалы қазбалар мен қайтадан құралған қосындылардың орны. Адам қоғамының негізігі кезеңдерінің қасиеттері келтірілген.

Түйін сөздер. Тас, қола, темір ғасырлары, жоғарғы сапалы металлдармен қорытпалардың «ғасыры», жоғары технологиялық металлдармен қорытпалардың «ғасыры».

Б.Р. Ракишев

Казахский национальный исследовательский технический университет имени К.И.Сатпаева, Алматы, Казахстан

ГОРНО-МЕТАЛЛУРГИЧЕСКИЙ КОМПЛЕКС В ИНДУСТРИАЛЬНОМ И ПОСТИНДУСТРИАЛЬНОМ РАЗВИТИИ ОБЩЕСТВА

Аннотация. Развитие человеческого общества непосрдественно связано с использованием природных материалов. В зависимости от степени обработки используемого материала из минерального сырья в качестве орудия труда различают каменный, бронзовый, железный века. В дальнейшем в период индустриального развития общества в качестве средств производства использовались предметы, изготовленные из высококачественных металлов и сплавов, а в период постиндустриального развития-предметы, изготовленные из высокотехнологичных металлов и сплавов.По наименованию этих материалов новые этапы развития цивилизации названы соответственно«веком» высококачественных металлов и сплавов и «веком» высокотехнологических металлов и сплавов.

Горно-металлургический комплекс, производящий высококачественные и высокотехнологичные металлы и сплавы, составляет естественную материально-техническую базу научно-технического прогресса и развития обществ в целом. В свою очередь научно-технический прогресс является драйвером инноваций во всех отраслях экономики, включая ГМК.Традиционные месторождения полезных ископаемых совместно с техногенными являются основными источниками промышленного производства благородных, редких и редкоземельных металлов. Приведены основные характеристики этапов развития человеческого общества.

Ключевые слова: каменный, бронзовый, железный века, «век» высококачественных металлов и сплавов, «век» высокотехнологических металлов и сплавов.

Informationaboutauthors :

Rakishev Bayan - doctor of Technical Sciences, academician of the National Academy of Sciences of Kazakhstan, professor of the department of the Kazakh National Research University named after K.I.Satpayev, b.rakishev@mail.ru. https://orcid.org/0000-0001-5445-070X

REFERENCES

[1] Great Soviet Encyclopedia. T.9, M.: «Soviet Encyclopedia», **1971**, pp. 142-144.

[2] Great Soviet Encyclopedia. T.11, M.: «Soviet Encyclopedia», **1973**, pp. 261-263.

[3] Great Soviet Encyclopedia. T.4, M.: «Soviet Encyclopedia», **1971**, pp. 51-53.

[4] Palamarchuk O.T. Science and technological revolutions. // Economica. Pravo.Vestnik KSEI. **2013**. №4(60). pp.81-88 (in Russian).

[5] Rao J.S.Industrial Revolution. In: History of Rotating Machinery Dynamics. History of Mechanism and Machine Science, vol. 20. Springer, Dordrecht, **2011**. pp. 31-34.

[6] Rakishev B.R.Mining industry is the foundation of scientific and technical progress. // 25th World Mining Congress. Astana, **2018**. pp.161-169.

[7] IndustrialInternetofThings. https://iotas.ru/files/.../wg/Индустриальный_промышленный_ИнтернетВещей.pdf.

[8] ShvedianiA.E., GorovoiA.A.The Fourth Industrial Revolution as the basis for the transition to the sixth technical structure // In the collection: Actual problems of economics and management, Proceedings of the II International Scientific Practical Conference. 2017. - pp.55-59(in Russian).

[9] Clark G.Industrial Revolution. In: Macmillan Publishers Ltd (eds) The New Palgrave Dictionary of Economics. Palgrave Macmillan, London, **2018**, pp. 67-70.

[10] Kablov E.N., Ospenshova O.G., Vershkov A.V. Rare metals and rare-earth elements are the materials of the modern and high technologies of the future. M., Trudy VIAM, №2, **2013** (in Russian).

[11] SidorovV.V., TimofeevaO.B., KalitsevV.A., GoryunovA.V. Effect of microelementation of rare-earth metals on the properties and structural-phase transformations in the VKNA-25-VI intermetallic alloy // Aviation materials and technologies. **2012.** №4. pp. 3-8(in Russian).

[12] S.C. Santos, O.Rodrigues Jr, L.L. Campos EPR response of yttrium micro rods activated by europium. // Journal of Alloys and Compounds, Volume 764, 5 October 2018, pp. 136-141.

[13] Samuel Leleu, Bertrand Rives, Jerome Bour, Nicolas Causse, NadinePebere. On the stability of the oxides film formed on a magnesium alloy containing rare-earth elements, ElectrochimicaActa, Volume 290, 10 November 2018, pp. 586-594.

[14] Peng Wang, Wen Li, Sami Kara.Dynamic life cycle quantification of metallic elements and their circularity, efficiency, and leakages // Journal of Cleaner Production, Volume 174, 10 February 2018, pp. 1492-1502.

[15] TanushreeDutta, Ki-Hyun Kim, MinoriUchimiya, Eilhann E. Kwon, Byong-Hun Jeon, Akash Deep, Seong-Taek Yun.Global demand for rare earth resources and strategies for green mining, Environmental Research, Volume 150, October **2016**. pp. 182-190.

[16] NazarbayevN.A. Seven facets of the Great Steppe.KazakhstanskayaPravda, №223, November 21, **2018** (in Russian).

[17] Rakishev B.R. Diversification of the mining and metallurgical complex in Kazakhstan. // 24^{th}world mining congress proceedings, Rio de Janeiro, Brazil, **2016**. pp.126-134.

[18] Rakishev B.R. Technological resources for improving the quality and completeness of use of the mineral raw materials. // Series of geology and technical sciences,№2, **2017**. pp. 116-125.

Publication Ethics and Publication Malpractice in the journals of the National Academy of Sciences of the Republic of Kazakhstan

For information on Ethics in publishing and Ethical guidelines for journal publication see http://www.elsevier.com/publishingethics and http://www.elsevier.com/journal-authors/ethics.

Submission of an article to the National Academy of Sciences of the Republic of Kazakhstan implies that the work described has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis or as an electronic preprint, see http://www.elsevier.com/postingpolicy), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder. In particular, translations into English of papers already published in another language are not accepted.

No other forms of scientific misconduct are allowed, such as plagiarism, falsification, fraudulent data, incorrect interpretation of other works, incorrect citations, etc. The National Academy of Sciences of the Republic of Kazakhstan follows the Code of Conduct of the Committee on Publication Ethics (COPE), and follows the COPE Flowcharts for Resolving Cases of Suspected Misconduct (http://publicationethics.org/files/u2/New_Code.pdf). To verify originality, your article may be checked by the originality detection service Cross Check http://www.elsevier.com/editors/plagdetect.

The authors are obliged to participate in peer review process and be ready to provide corrections, clarifications, retractions and apologies when needed. All authors of a paper should have significantly contributed to the research.

The reviewers should provide objective judgments and should point out relevant published works which are not yet cited. Reviewed articles should be treated confidentially. The reviewers will be chosen in such a way that there is no conflict of interests with respect to the research, the authors and/or the research funders.

The editors have complete responsibility and authority to reject or accept a paper, and they will only accept a paper when reasonably certain. They will preserve anonymity of reviewers and promote publication of corrections, clarifications, retractions and apologies when needed. The acceptance of a paper automatically implies the copyright transfer to the National Academy of sciences of the Republic of Kazakhstan.

The Editorial Board of the National Academy of sciences of the Republic of Kazakhstan will monitor and safeguard publishing ethics.

Правила оформления статьи для публикации в журнале смотреть на сайте:

www:nauka-nanrk.kz

ISSN 2518-1483 (Online), ISSN 2224-5227 (Print)

http://reports-science.kz/index.php/en/archive

Редакторы *М. С. Ахметова, Т.А. Апендиев, Д.С. Аленов*
Верстка на компьютере *А.М. Кульгинбаевой*

Подписано в печать 07.02.2019.
Формат 60х881/8. Бумага офсетная. Печать – ризограф.
10,5 п.л. Тираж 500. Заказ 1.

Национальная академия наук РК
050010, Алматы, ул. Шевченко, 28, т. 272-13-18, 272-13-19