

ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫ
Satbayev University

Х А Б А Р Л А Р Ы

ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН
Satbayev University

N E W S

OF THE ACADEMY OF SCIENCES
OF THE REPUBLIC OF KAZAKHSTAN
Satbayev University

**SERIES
OF GEOLOGY AND TECHNICAL SCIENCES**

6 (450)

NOVEMBER – DECEMBER 2021

THE JOURNAL WAS FOUNDED IN 1940

PUBLISHED 6 TIMES A YEAR

ALMATY, NAS RK

NAS RK is pleased to announce that News of NAS RK. Series of geology and technical sciences scientific journal has been accepted for indexing in the Emerging Sources Citation Index, a new edition of Web of Science. Content in this index is under consideration by Clarivate Analytics to be accepted in the Science Citation Index Expanded, the Social Sciences Citation Index, and the Arts & Humanities Citation Index. The quality and depth of content Web of Science offers to researchers, authors, publishers, and institutions sets it apart from other research databases. The inclusion of News of NAS RK. Series of geology and technical sciences in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential content of geology and engineering sciences to our community.

Қазақстан Республикасы Ұлттық ғылым академиясы «ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы» ғылыми журналының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруда. Web of Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді геология және техникалық ғылымдар бойынша контентке адалдығымызды білдіреді.

НАН РК сообщает, что научный журнал «Известия НАН РК. Серия геологии и технических наук» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Известия НАН РК. Серия геологии и технических наук в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по геологии и техническим наукам для нашего сообщества.

Бас редактор

ЖҰРЫНОВ Мұрат Жұрынұлы, химия ғылымдарының докторы, профессор, ҚР ҰҒА академигі, Қазақстан Республикасы Ұлттық Ғылым академиясының президенті, АҚ «Д.В. Сокольский атындағы отын, катализ және электрохимия институтының» бас директоры (Алматы, Қазақстан) Н = 4

Редакциялық алқа:

ӘБСАМЕТОВ Мәліс Құдысұлы (бас редактордың орынбасары), геология-минералогия ғылымдарының докторы, профессор, ҚР ҰҒА академигі, «У.М. Ахмедсафина атындағы гидрогеология және геоэкология институтының» директоры (Алматы, Қазақстан) Н = 2

ЖОЛТАЕВ Герой Жолтайұлы (бас редактордың орынбасары), геология-минералогия ғылымдарының докторы, профессор, Қ.И. Сатпаев атындағы геология ғылымдары институтының директоры (Алматы, Қазақстан) Н=2

СНОУ Дэниел, Ph.D, қауымдастырылған профессор, Небраска университетінің Су ғылымдары зертханасының директоры (Небраска штаты, АҚШ) Н = 32

ЗЕЛЬТМАН Реймар, Ph.D, табиғи тарих мұражайының Жер туралы ғылымдар бөлімінде петрология және пайдалы қазбалар кен орындары саласындағы зерттеулердің жетекшісі (Лондон, Англия) Н = 37

ПАНФИЛОВ Михаил Борисович, техника ғылымдарының докторы, Нанси университетінің профессоры (Нанси, Франция) Н=15

ШЕН Пин, Ph.D, Қытай геологиялық қоғамының тау геологиясы комитеті директорының орынбасары, Американдық экономикалық геологтар қауымдастығының мүшесі (Пекин, Қытай) Н = 25

ФИШЕР Аксель, Ph.D, Дрезден техникалық университетінің қауымдастырылған профессоры (Дрезден, Берлин) Н = 6

КОНТОРОВИЧ Алексей Эмильевич, геология-минералогия ғылымдарының докторы, профессор, РФА академигі, А.А. Трофимука атындағы мұнай-газ геологиясы және геофизика институты (Новосибирск, Ресей) Н = 19

АБСАДЫКОВ Бахыт Нарикбайұлы, техника ғылымдарының докторы, профессор, ҚР ҰҒА корреспондент-мүшесі, А.Б. Бектұров атындағы химия ғылымдары институты (Алматы, Қазақстан) Н = 5

АГАБЕКОВ Владимир Енокович, химия ғылымдарының докторы, Беларусь ҰҒА академигі, Жаңа материалдар химиясы институтының құрметті директоры (Минск, Беларусь) Н = 13

КАТАЛИН Стефан, Ph.D, Дрезден техникалық университетінің қауымдастырылған профессоры (Дрезден, Берлин) Н = 20

СЕЙТМҰРАТОВА Элеонора Юсуповна, геология-минералогия ғылымдарының докторы, профессор, ҚР ҰҒА корреспондент-мүшесі, Қ.И. Сатпаев атындағы Геология ғылымдары институты зертханасының меңгерушісі (Алматы, Қазақстан) Н=11

САҒЫНТАЕВ Жанай, Ph.D, қауымдастырылған профессор, Назарбаев университеті (Нұр-Сұлтан, Қазақстан) Н = 11

ФРАТТИНИ Паоло, Ph.D, Бикокк Милан университеті қауымдастырылған профессоры (Милан, Италия) Н = 28

«ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы».

ISSN 2518-170X (Online),

ISSN 2224-5278 (Print)

Меншіктеуші: «Қазақстан Республикасының Ұлттық ғылым академиясы» РҚБ (Алматы қ.).

Қазақстан Республикасының Ақпарат және қоғамдық даму министрлігінің Ақпарат комитетінде 29.07.2020 ж. берілген № **KZ39VPY00025420** мерзімдік басылым тіркеуіне қойылу туралы куәлік.

Тақырыптық бағыты: геология, мұнай және газды өңдеудің химиялық технологиялары, мұнай химиясы, металдарды алу және олардың қосындыларының технологиясы.

Мерзімділігі: жылына 6 рет.

Тиражы: 300 дана.

Редакцияның мекен-жайы: 050010, Алматы қ., Шевченко көш., 28, 219 бөл., тел.: 272-13-19

<http://www.geolog-technical.kz/index.php/en/>

© Қазақстан Республикасының Ұлттық ғылым академиясы, 2021

Типографияның мекен-жайы: «Аруна» ЖК, Алматы қ., Мұратбаев көш., 75.

Главный редактор

ЖУРИНОВ Мурат Журинович, доктор химических наук, профессор, академик НАН РК, президент Национальной академии наук Республики Казахстан, генеральный директор АО «Институт топлива, катализа и электрохимии им. Д.В. Сокольского» (Алматы, Казахстан) Н = 4

Редакционная коллегия:

АБСАМЕТОВ Малис Кудысович, (заместитель главного редактора), доктор геолого-минералогических наук, профессор, академик НАН РК, директор Института гидрогеологии и геоэкологии им. У.М. Ахмедсафина (Алматы, Казахстан) Н = 2

ЖОЛТАЕВ Герой Жолтаевич, (заместитель главного редактора), доктор геолого-минералогических наук, профессор, директор Института геологических наук им. К.И.Сатпаева (Алматы, Казахстан) Н=2

СНОУ Дэниел, Ph.D, ассоциированный профессор, директор Лаборатории водных наук университета Небраски (штат Небраска, США) Н = 32

ЗЕЛЬТМАН Реймар, Ph.D, руководитель исследований в области петрологии и месторождений полезных ископаемых в Отделе наук о Земле Музея естественной истории (Лондон, Англия) Н = 37

ПАНФИЛОВ Михаил Борисович, доктор технических наук, профессор Университета Нанси (Нанси, Франция) Н=15

ШЕН Пин, Ph.D, заместитель директора Комитета по горной геологии Китайского геологического общества, член Американской ассоциации экономических геологов (Пекин, Китай) Н = 25

ФИШЕР Аксель, ассоциированный профессор, Ph.D, технический университет Дрезден (Дрезден, Берлин) Н = 6

КОНТОРОВИЧ Алексей Эмильевич, доктор геолого-минералогических наук, профессор, академик РАН, Институт нефтегазовой геологии и геофизики им. А.А. Трофимука СО РАН (Новосибирск, Россия) Н = 19

АБСАДЫКОВ Бахыт Нарикбаевич, доктор технических наук, профессор, член-корреспондент НАН РК, Институт химических наук им. А.Б. Бектурова (Алматы, Казахстан) Н = 5

АГАБЕКОВ Владимир Енокович, доктор химических наук, академик НАН Беларуси, почетный директор Института химии новых материалов (Минск, Беларусь) Н = 13

КАТАЛИН Стефан, Ph.D, ассоциированный профессор, Технический университет (Дрезден, Берлин) Н = 20

СЕЙТМУРАТОВА Элеонора Юсуповна, доктор геолого-минералогических наук, профессор, член-корреспондент НАН РК, заведующая лабораторией Института геологических наук им. К.И. Сатпаева (Алматы, Казахстан) Н=11

САГИНТАЕВ Жанай, Ph.D, ассоциированный профессор, Назарбаев университет (Нурсултан, Казахстан) Н = 11

ФРАТТИНИ Паоло, Ph.D, ассоциированный профессор, Миланский университет Бикокк (Милан, Италия) Н = 28

«Известия НАН РК. Серия геологии и технических наук».

ISSN 2518-170X (Online),

ISSN 2224-5278 (Print)

Собственник: Республиканское общественное объединение «Национальная академия наук Республики Казахстан» (г. Алматы).

Свидетельство о постановке на учет периодического печатного издания в Комитете информации Министерства информации и общественного развития Республики Казахстан № KZ39VPY00025420, выданное 29.07.2020 г.

Тематическая направленность: геология, химические технологии переработки нефти и газа, нефтехимия, технологии извлечения металлов и их соединений.

Периодичность: 6 раз в год.

Тираж: 300 экземпляров.

Адрес редакции: 050010, г. Алматы, ул. Шевченко, 28, оф. 219, тел.: 272-13-19

<http://www.geolog-technical.kz/index.php/en/>

© Национальная академия наук Республики Казахстан, 2021

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

Editor in chief

ZHURINOV Murat Zhurinovich, doctor of chemistry, professor, academician of NAS RK, president of the National Academy of Sciences of the Republic of Kazakhstan, general director of JSC “Institute of fuel, catalysis and electrochemistry named after D.V. Sokolsky» (Almaty, Kazakhstan) H = 4

Editorial board:

ABSAMETOV Malis Kudysovich, (deputy editor-in-chief), doctor of geological and mineralogical sciences, professor, academician of NAS RK, director of the Akhmedsafin Institute of hydrogeology and hydrophysics (Almaty, Kazakhstan) H = 2

ZHOLTAEV Geroy Zholtaevich, (deputy editor-in-chief), doctor of geological and mineralogical sciences, professor, director of the institute of geological sciences named after K.I. Satpayev (Almaty, Kazakhstan) H=2

SNOW Daniel, Ph.D, associate professor, director of the laboratory of water sciences, Nebraska University (Nebraska, USA) H = 32

Zeltman Reymar, Ph.D, head of research department in petrology and mineral deposits in the Earth sciences section of the museum of natural history (London, England) H = 37

PANFILOV Mikhail Borisovich, doctor of technical sciences, professor at the Nancy University (Nancy, France) H=15

SHEN Ping, Ph.D, deputy director of the Committee for Mining geology of the China geological Society, Fellow of the American association of economic geologists (Beijing, China) H = 25

FISCHER Axel, Ph.D, associate professor, Dresden University of technology (Dresden, Germany) H = 6

KONTOROVICH Aleksey Emilievich, doctor of geological and mineralogical sciences, professor, academician of RAS, Trofimuk Institute of petroleum geology and geophysics SB RAS (Novosibirsk, Russia) H = 19

ABSADYKOV Bakhyt Narikbaevich, doctor of technical sciences, professor, corresponding member of NAS RK, Bekturov Institute of chemical sciences (Almaty, Kazakhstan) H = 5

AGABEKOV Vladimir Enokovich, doctor of chemistry, academician of NAS of Belarus, honorary director of the Institute of chemistry of new materials (Minsk, Belarus) H = 13

KATALIN Stephan, Ph.D, associate professor, Technical university (Dresden, Berlin) H = 20

SEITMURATOVA Eleonora Yusupovna, doctor of geological and mineralogical sciences, professor, corresponding member of NAS RK, head of the laboratory of the Institute of geological sciences named after K.I. Satpayev (Almaty, Kazakhstan) H=11

SAGINTAYEV Zhanay, Ph.D, associate professor, Nazarbayev University (Nursultan, Kazakhstan) H = 11

FRATTINI Paolo, Ph.D, associate professor, university of Milano-Bicocca (Milan, Italy) H = 28

News of the National Academy of Sciences of the Republic of Kazakhstan. Series of geology and technology sciences.

ISSN 2518-170X (Online),

ISSN 2224-5278 (Print)

Owner: RPA «National Academy of Sciences of the Republic of Kazakhstan» (Almaty).

The certificate of registration of a periodical printed publication in the Committee of information of the Ministry of Information and Social Development of the Republic of Kazakhstan **No. KZ39VPY00025420**, issued 29.07.2020.

Thematic scope: geology, chemical technologies for oil and gas processing, petrochemistry, technologies for extracting metals and their connections.

Periodicity: 6 times a year.

Circulation: 300 copies.

Editorial address: 28, Shevchenko str., of. 219, Almaty, 050010, tel. 272-13-19

<http://www.geolog-technical.kz/index.php/en/>

© National Academy of Sciences of the Republic of Kazakhstan, 2021

Address of printing house: ST «Aruna», 75, Muratbayev str, Almaty.

NEWS

OF THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN

SERIES OF GEOLOGY AND TECHNICAL SCIENCES

ISSN 2224-5278

Volume 6, Number 450 (2021), 30-36

<https://doi.org/10.32014/2021.2518-170X.116>

UDC 629.3.03

Abishev K.K.*, Kassenov A.Zh., Mukanov R.B., Sembaev N.S., Suleimenov A.D.

Toraighyrov university, Pavlodar, Republic of Kazakhstan.

E-mail: a.kairatolla@mail.ru

RESEARCH ON THE OPERATIONAL QUALITIES OF A MINING MACHINE FOR THE DEVELOPMENT OF MINERAL DEPOSITS

Abstract. Mining machines of different types and designs with different technical characteristics have been created for geological exploration. The fleet of mining and transport vehicles engaged in mining production is constantly growing. However, the quantitative growth of the park alone is not enough for a rapid increase in labor productivity. Qualitative changes are needed due to the creation and introduction of fundamentally new means of labor that surpass the best domestic and foreign models of equipment in their technical and economic indicators.

The modern development of mining machines is characterized by an increase in their power, traction qualities, cross-country ability, increased reliability and others. These trends in the development of machines can be solved by creating new models of machines or upgrading existing designs of individual components and aggregates of machines. The modernization of mining machines is due to an increase in the energy saturation of the power plant, which leads to an increase in the mass of the mining machines, without significant improvements in the design of the running system. This leads to a more intense impact of the movers of the machines on the ground, to the destruction of its structure.

Therefore, it is necessary to improve the performance of the running systems of the machines, which characterize the interaction of the propulsion with the support base. To do this, it is necessary to conduct a study of the influence of the design parameters of the machine on its operational qualities.

Experimental studies of the influence of the design parameters of a mining machine on its operational qualities require large expenditures of resources, time and money.

In order to reduce the material, time and resource costs of conducting experimental studies and obtaining data for mathematical modeling of the interaction of the propulsor with the ground, physical modeling methods are used.

Testing on models makes it possible, as well as on real machines, to identify the qualitative side of even such complex processes as the interaction of propellers with the support surface. A number of general patterns can be established on the model more strictly than on a real machine, since it is easier to exclude the influence of random factors here.

The results of the conducted research make it possible to reduce the cost of time and material resources in the creation and operation of running systems of mining machines.

Key words: mining machines, mineral deposits, undercarriage system, physical modeling, ground, operational properties, model of a undercarriage of a vehicle, traction and drag properties.

Introduction. Mining machines of various types and designs with different technical characteristics have been created for operation in various conditions. The type and purpose of the machine determine the design of its undercarriage system. Tractive and transportation vehicles are widely used in agriculture, in the construction of highways and railways, in the laying of gas and oil pipelines, in the mining industry and in the exploration of minerals [1, 2, 3].

As part of the research work, a team of authors has developed designs for the undercarriage systems of tractive and transportation vehicles, the peculiarity of which is that they are equipped with rubber-reinforced tracks [4].

In the paper [5], a mathematical model of the interaction of a rubber track with a support base was developed. To obtain confirmation of the results of theoretical studies, experimental studies were carried out.

Materials and research methods. Experimental studies of the influence of the design parameters of a mining machine on its performance require a lot of resources, time and money [6, 7]. Therefore, in order to reduce material, time and resource costs for conducting experimental research and obtaining data for mathematical modeling of the interaction of a tracked propulsive device with the ground, it is proposed to use physical modeling methods [8, 9]. In physical modeling, the soil remains natural, while the machine is vehicle with a model that simulates the effect of a full-scale vehicle on the soil. In this case, a change in scale occurs, however the nature of the phenomenon remains unchanged. Qualitative and quantitative connections of such phenomena are established in the form of criterial relationships.

To carry out experimental studies, the method of speed-up and coasting of the undercarriage system model on a horizontal surface was used, which provides comparative data for hard and soft soils [10]. This method provides the accuracy of measurements and the ability to compare different versions of the models in the same parameters of mass and base.

To carry out experiments at the Department of Transport Equipment and Logistics of Toraihyrov University NJSC, a stand was designed and made for studying various types of undercarriage systems on a universal non-self-propelled model of the undercarriage system of a tractive and transportation vehicle.

The essence of the method lies in conveying a precisely defined amount of energy to the model, that ensures the acceleration of the model to speed v . Then this speed gets put out due to losses in the propulsion device during coasting (run-out).

In practice, the creation of a certain amount of energy can be carried out using the potential energy of the lifted load. The scheme of the experiment is shown in Figure 1.

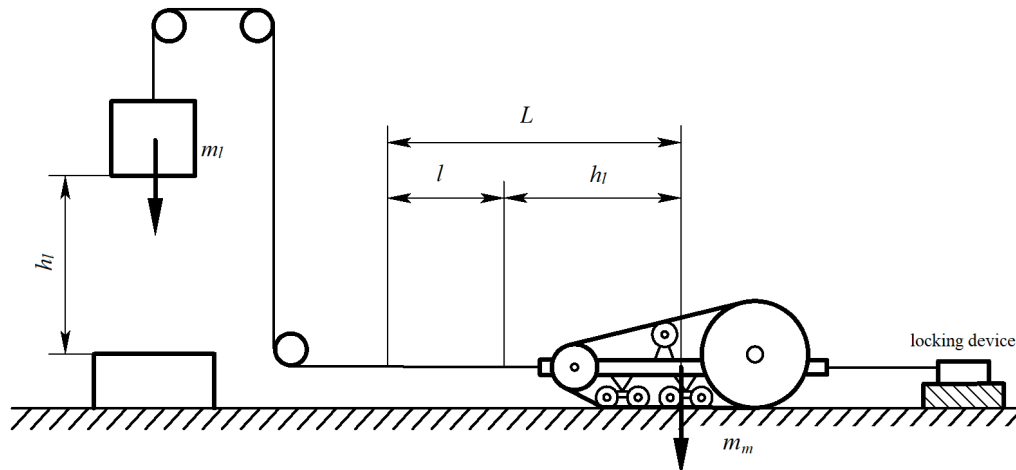


Figure 1 – The scheme of the experiment by the speed-up and coasting method.

Load of the mass m_1 is raised to the height h_1 and gets connected by a cable through a system of blocks with the model that is held in its original position by a locking device. When the model is unlocked under the action of the load m_1 it is accelerated in a section corresponding to the drop height h_1 of the load followed by a run-out to the length l .

Potential energy $m_1 \cdot h_1$ of the load m_1 gets spent on:

- overcoming the forces of resistance to movement on the section h_1 ;
- acceleration of the model to speed v ;
- acceleration of the load to speed v ;
- losses in the blocks.

$$m_1 \cdot h_1 \cdot \eta_b = F_f \cdot h_1 + E_m + E_l \quad (1)$$

where η_b is the block system efficiency, $\eta_b=0.98$;

F_f is the rolling resistance force;

E_m is the kinetic energy of the model;

E_l is the kinetic energy of the load.

As the load stops, its energy is spent on impact, and the model moves further due to the kinetic energy it has acquired.

Taking into account that at equal speeds the energy is proportional to the masses, we get

$$\frac{E_m}{E_l} = \frac{m_m}{m_l}, \quad (2)$$

where m_m is the mass of the model.

At the moment the load touches m_l the base surface, the kinetic energy of the load – model system, on the one hand, is equal to the sum of the kinetic energy of the model and the load, and on the other hand, the difference between the potential energy of the load and the work spent on overcoming the rolling resistance of the model in the section h_l

$$E = E_m + E_l; \quad (3)$$

$$E = m_l \cdot h_l \cdot \eta_b - F_f \cdot h_l. \quad (4)$$

From equations (2) and (3) we infer

$$E_m = E \cdot \frac{m_m}{m_l + m_m}. \quad (5)$$

By putting E from equation (4) in equation (5) we obtain

$$E_m = (m_l \cdot h_l \cdot \eta_b - F_f \cdot h_l) \cdot \frac{m_m}{m_l + m_m}. \quad (6)$$

The kinetic energy of the model is spent on overcoming the rolling resistance forces of the model F_f in the run-out section l

$$E_m = F_f \cdot l. \quad (7)$$

By putting E_m from equation (7) in equation (6) we obtain

$$F_f \cdot l = (m_l \cdot h_l \cdot \eta_b - F_f \cdot h_l) \cdot \frac{m_m}{m_l + m_m}.$$

Therefore

$$F_f = \frac{m_l \cdot h_l \cdot \eta_b}{h_l + \frac{m_l + m_m}{m_l} \cdot l}. \quad (8)$$

In this formula, the value $m_l \cdot \eta_b$ corresponds to the pulling force F_p . Replacing the ratio $\frac{m_l + m_m}{m_l}$ with

k , where k is the run-out coefficient, we obtain the formula which is convenient for experimental calculations

$$F_f = \frac{m_l \cdot h_l \cdot \eta_b}{h_l + k \cdot l}. \quad (9)$$

The value F_f represents the average rolling resistance of the model.

The speed at the end of the acceleration can be determined from the equality of the energy acquired by the model during the acceleration period and its consumption for run-out

$$F_f \cdot l = \frac{m_l \cdot v^2}{2g},$$

therefore

$$v = \sqrt{\frac{2g \cdot F_f \cdot l}{m_l}}. \quad (10)$$

Calculation formula (10) is valid at constant force F_f . With variable force, the results obtained are sufficient for comparative experiments.

The purity of the experiments is achieved by conducting experiments on soil with uniform physical and mechanical properties in its depth.

Results and discussion. The study was carried out on a universal non-self-propelled model of the undercarriage system of a tracked vehicle with an elastic balanced suspension. The longitudinal base of the model is 380 mm. The experiments were carried out on sand, wet loam and flat concrete.

The main characteristics of soils:

a) sand – volume weight 16 kN/m³, humidity 5%, density 1.6 g/m³, structural composition: 2.0 mm sized particles 4%; 1.0 mm sized particles 6%; 0.5 mm sized particles 17%; 0.25 mm sized particles 73%.

b) loam – volume weight 20 kN/m³, humidity 15%, density 1.5 g/m³. Loam is clay with a significant admixture of sand and dust particles. Structural composition: clay 15%, sand 35%, dust particles 50%.

c) concrete track – straight platform without any slope. During the experiments, cement concrete with a density of 2.0 g/m³ was used.

In order to determine the effect of the mass of the vehicle on its traction and drag properties, models with weights of 48 kg, 64 kg and 80 kg were made, which, in terms of a natural vehicles corresponds to weights

of 30 kN, 40 kN and 50 kN. In addition, each model was loaded with ballast weights, thereby providing intermediate values of the model mass.

The change in the mass of the model was carried out with constant parameters of the undercarriage system, therefore, it was accompanied by a corresponding change in the specific pressure.

Experimental data on the effect of the mass of the vehicle on its traction and drag properties have shown that, with constant parameters of the undercarriage system, each type of soil has its own certain value of the optimal mass.

The analysis of the research results shown in Figure 2 demonstrated that on a concrete slab the rolling resistance coefficient is almost constant and slightly increases only with a minimum weight of the vehicle. This is due to an increase in losses in the tracked propulsive device, which depend little on the mass.

On sand, rolling resistance decreases as the mass of the tractive and transportation vehicle increases. This is due to the fact that the bulk of the resistance is made up of forces that are little dependent on mass. On sand, these are the friction forces in the details of the tracked propulsive device.

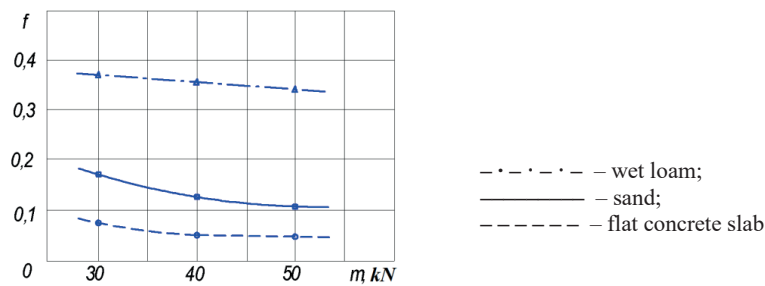


Figure 2 – The dependence of the rolling resistance on the mass of the vehicle.

On wet loam, the rolling resistance coefficient decreases smoothly, in proportion to the increase in the weight of the vehicle. This is due to the fact that the loss due to pressing of the support base depends little on the mass.

Also, studies were carried out on the effect of the mass of the vehicle on the rolling resistance at various values of the speed of movement, which showed that with an increase in the speed of movement, the nature of the dependence of the coefficient of rolling resistance on the weight of the machine practically does not change.

On cohesive soil, wet loam in particular, the adhesion coefficient increases with a decrease in mass according to a law close to hyperbolic, which corresponds to the presence of a component of the adhesion force that does not depend on the mass

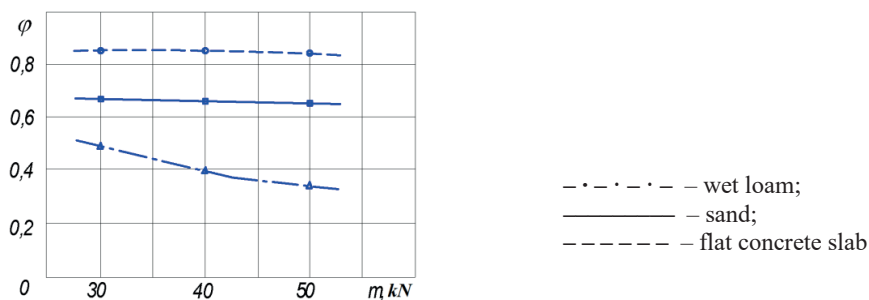


Figure 3 – The dependence of the coefficient of adhesion on the mass of the vehicle.

Studies have been carried out on the effect of the mass of the vehicle on the coefficient of adhesion at different values of the coefficient of slipping, which showed that with an increase in the mass of the vehicle, the value of the coefficient of adhesion decreases. At the same time, the mass of the tractive and transportation vehicle does not affect the slipping.

From the graph shown in Figure 4, it can be seen that on sand, the efficiency of the undercarriage system decreases with an increase in the mass of the vehicle, which is explained by an increase in power losses for soil deformation due to an increase in pressure on it.

On a flat concrete surface, the efficiency of the undercarriage increases with increasing mass of the vehicle. This is due to the fact that soil deformation losses are small.

On wet loam, the highest efficiency of the undercarriage occurs with a machine weight of 40 kN. A decrease in mass leads to a decrease in efficiency due to an increase in the rolling resistance coefficient, and an increase in mass reduces efficiency due to an increase in rolling resistance and slipping due to soil deformation.

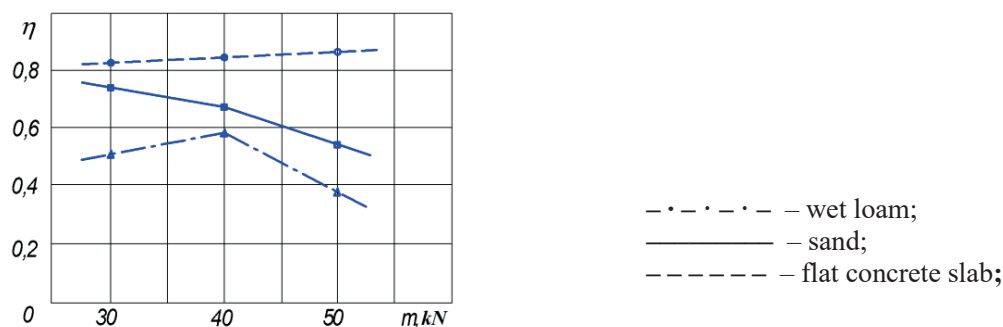


Figure 4 – Dependence of the efficiency of the undercarriage system on the mass of the vehicle.

Conclusions. The considered experimental results showed that each type of soil corresponds to its own value of the optimal weight of the machine. In this regard, it is rational to set the mass of the tractive and transportation vehicle according to those soil conditions that require its minimum value, and to load the vehicle with additional ballast weight on other soils.

Financing. The research was carried out within the framework of grant funding for fundamental and applied scientific research on scientific and technical projects for 2021-2023 under the IRN AP09258862 project “Development and research of a multipurpose vehicle”, funded by the Science Committee of the Ministry of Education and Science of the Republic of Kazakhstan.

Acknowledgments. The authors are grateful to M. Kairova, G. Itybayeva, A. Baltabekova and V. Yessaulkov [11, 12] for preparing and collecting materials for this publication.

Абишев К.К.*, Касенов А.Ж., Муканов Р.Б., Сембаев Н.С., Сулейменов А.Д.

Торайғыров университеті, Павлодар, Қазақстан.
E-mail: a.kairatolla@mail.ru

ПАЙДАЛЫ ҚАЗБАЛАР КЕН ОРЫНДАРЫН ИГЕРУГЕ АРНАЛҒАН ТАУ-КЕН МАШИНАСЫНЫҢ ПАЙДАЛАНУЛУ ҚАСИЕТТЕРІН ЗЕРТТЕУ

Аннотация. Геологиялық барлау жұмыстарын жүргізу үшін әртүрлі техникалық сипаттамалары бар әртүрлі типтегі және құрылымдағы тау-кен машиналары жасалды. Тау-кен өндірісі саласында жұмыс істейтін тау-кен және көлік машиналары паркі үнемі өсіп келеді. Алайда, еңбек өнімділігін тез арттыру үшін парктың сандық өсуі жеткіліксіз. Өздерінің техникалық-экономикалық көрсеткіштері бойынша техниканың үздік отандық және шетелдік үлгілерінен асып түсетін мүлде жаңа еңбек құралдарын жасау және енгізу есебінен сапалы өзгерістер қажет.

Тау-кен машиналарының қазіргі заманғы дамуы олардың қуаттылығының, тарту-ұстасу қасиеттерінің, өткіштігінің, сенімділігінің артуымен және басқаларымен сипатталады. Машиналардың дамуының көрсетілген тенденцияларын машиналардың жаңа үлгілерін жасау немесе машиналардың жеке түйіндері мен агрегаттарының қолданыстағы құрылыстарын жаңарту арқылы шешуге болады. Шынжыр табанды машиналарды жаңғырту қуат қондырғысының энергиямен қанықтылығын арттыру арқылы жүзеге асырылады. Жүріс бөлігінің құрылысын айтарлықтай жетілдірусіз тау-кен машинасының массасының ұлғаюына әкеледі. Бұл машина қозғалтқыштарының топырыққа қарқынды әсер етуіне, оның құрылымының бұзылуына әкеледі.

Сондықтан қозғалтқыштың тірек бетімен өзара әрекеттесуін сипаттайтын машиналардың жүріс жүйелерінің көрсеткіштерін жақсарту қажет. Ол үшін машинаның құрылымдық параметрлерінің оның пайдалану сапасына әсерін зерттеу қажет. Тарту-көлік машинасының құрылымдық параметрлерінің оның пайдалану сапасына әсерін эксперименттік зерттеу ресурстардың, уақыт пен қаражаттың үлкен шығындарын талап етеді.

Эксперименттік зерттеулер жүргізуге және деректер алуға арналған материалдық, уақыттық және ресурстық шығындарды азайту мақсатында қозғалтқыштың топырақпен өзара әрекетін математикалық модельдеу үшін физикалық модельдеу әдістері қолданылады.

Модельдердегі сынауды жүргізу нақты машиналардағы сияқты, қозғалтқыштардың тірек бетімен әрекеттесуі сияқты күрделі процестердің сапалы жағын анықтауға мүмкіндік береді. Модельде бірқатар жалпы заңдылықтарды нақты машинаға қарағанда қатаң түрде орнатуға болады, өйткені кездейсоқ факторлардың әсерін жою оңайырақ.

Жүргізілген зерттеулердің нәтижелері тау-кен машиналарының жүріс жүйелерін жасау және пайдалану кезінде уақыт пен материалдық құралдар шығындарын қысқартуға мүмкіндік береді.

Түйінді сөздер: тау-кен машиналар, пайдалы қазбалар кен орындары, жүріс жүйесі, физикалық модельдеу, грунт, пайдалану қасиеттері, машина жүріс бөлігінің моделі, тарту-ұстасу қасиеттері.

Абишев К.К.*, Касенов А.Ж., Муканов Р.Б., Сембаев Н.С., Сулейменов А.Д.

Торайғыров университет, Павлодар, Қазақстан.

E-mail: a.kairatolla@mail.ru

ИССЛЕДОВАНИЕ ЭКСПЛУАТАЦИОННЫХ КАЧЕСТВ ГОРНОЙ МАШИНЫ ДЛЯ РАЗРАБОТКИ МЕСТОРОЖДЕНИЙ ПОЛЕЗНЫХ ИСКОПАЕМЫХ

Аннотация. Для проведения геологоразведочных работ созданы горные машины разных типов и конструкций с различными техническими характеристиками. Парк горных и транспортных машин, занятых в сфере горного производства, постоянно растет. Однако только количественного роста парка недостаточно для быстрого повышения производительности труда. Необходимы качественные изменения за счет создания и внедрения принципиально новых средств труда, превосходящих по своим технико-экономическим показателям лучшие отечественные и зарубежные образцы техники.

Современное развитие горных машин характеризуется повышением их мощности, тягово-сцепных качеств, проходимости, повышением надежности и другими. Указанные тенденции развития машин могут быть решены путем создания новых образцов машин или модернизации существующих конструкций отдельных узлов и агрегатов машин. Модернизация гусеничных машин идет за счет увеличения энергонасыщенности силовой установки, что приводит к увеличению массы горной машины, без существенных усовершенствований конструкции ходовой системы. Это приводит к более интенсивному воздействию движителей машин на грунт, к разрушению ее структуры.

Поэтому требуется улучшить показатели работы ходовых систем машин, которые характеризуют взаимодействие движителя с опорным основанием. Для этого необходимо провести исследование влияния конструктивных параметров машины на его эксплуатационные качества.

Экспериментальные исследования влияния конструктивных параметров горной машины на ее эксплуатационные качества требуют больших затрат ресурсов, времени и средств.

С целью снижения материальных, временных и ресурсных затрат на проведение экспериментальных исследований и получения данных для математического моделирования взаимодействия движителя с грунтом используются методы физического моделирования.

Испытание на моделях позволяют так же, как и на реальных машинах, выявить качественную сторону даже столь сложных процессов, как взаимодействие движителей с опорной поверхностью. Ряд общих закономерностей может быть установлен на модели более строго, чем на реальной машине, поскольку здесь проще исключить влияние случайных факторов.

Результаты проведенных исследований позволяют сократить затраты времени и материальных средств при создании и эксплуатации ходовых систем горных машин.

Ключевые слова: горные машины, месторождения полезных ископаемых, ходовая система, физическое моделирование, грунт, эксплуатационные свойства, модель ходовой части машины, тягово-сцепные качества.

Information about authors:

Abishev Kairatolla Kairollinovich – Candidate of Technical Sciences, ass.Professor, Toraihyrov university, a.kairatolla@mail.ru, ORCID: 0000-0001-8117-128X;

Kassenov Assylbek Zhumabekovich – Candidate of Technical Sciences, ass.Professor, Toraihyrov university, asylbek_kasenov@mail.ru, ORCID: 0000-0001-9552-1439;

Mukanov Ruslan Batyrbekovich – doctoral student, Toraighyrov university, *ruslangr82@mail.ru*, ORCID: 0000-0001-9552-1439;

Sembaev Nurbolat Sakenovich – Candidate of Technical Sciences, ass.Professor, Toraighyrov university, *n.sembaev@mail.ru*, ORCID: 0000-0003-3032-1094;

Suleimenov Ansagan Dyusembaevich – doctoral student, Toraighyrov university, *Ansar_muslim_91@mail.ru*, ORCID: 0000-0001-9319-0285.

REFERENCES

- [1] Horeshok A.A., Tsekhin A.M., Buyalich G.D., Meshkov A.A., Maslennikov N.R. (2019) Mining machines and equipment for underground mining operations. Moscow. Russia. ISBN 978-5-905450-98-3.
- [2] Sklyarov V.I., Miroshnikova L.K. (2017) Technology and technique of geological exploration in the development of solid mineral deposits: textbook. Norilsk. Russia. ISBN 978-5-89009-674-6.
- [3] Kozbagarov R.A., Taran M.V., Zhussupov K.A., Kanazhanov A.E., Kamzanov N.C., Kochetkov A.V. (2021) Increasing the efficiency of motor graders work on the basis of working elements perfection // News of the National Academy of Sciences of the Republic of Kazakhstan, Series of Geology and Technical Sciences. Vol. 1, No. 445, pp. 98-105. <https://doi.org/10.32014/2020.2518-170X.97> (in Eng.).
- [4] Abishev K.K., Kassenov A.Zh., Mukanov R.B., Assylova K.B., Kairolla B.K. (2020) Semi-tracked propulsion [Polugusenichnyj dvizhitel'] Patent for a utility model of the Republic of Kazakhstan [Patent na poleznuju model' Respubliki Kazahstan]. (In Russian).
- [5] Abishev K.K., Kasenov A.Zh., Assylova K.B., Gumarov G.S. (2019) Study of the Interaction of a Transport Vehicle with an Open Road // Lecture Notes in Intelligent Transportation and Infrastructure. pp. 154-163. <https://doi.org/10.1007/978-3-030-39688-6> (in Eng.).
- [6] Khalturin D.V., Finchenko N.I., Davydov A.V. (2017) Testing of cars and tractors. Tomsk. Russia. ISBN 978-5-93057-791- 4.
- [7] Eismont N.G., Danshina V.V., Biryukov S.V. (2018) Theoretical foundations and practice of scientific research. Omsk. Russia. ISBN 978-5-8149-2589-3.
- [8] Turgumbayev J.J., Turgunbayev M.S. (2021) Predicting the resistance force of homogeneous ground to cutting // News of the National Academy of Sciences of the Republic of Kazakhstan, Series of Geology and Technical Sciences. Vol. 4, No. 448, pp. 91-98 <https://doi.org/10.32014/2021.2518-170X.86>.
- [9] Gatapova N.Ts, Koliukh A.N., Orlova N.V., Orlov A.Yu. (2014) Fundamentals of the theory and technique of physical modeling and experiment [Electronic resource]: textbook. Tambov. Russia.
- [10] Teltayev B.B., Izmailova G.G., Zhrebitskiy M. (2021) Complex stabilization of soils and base course materials during construction and repair of the highways // News of the National Academy of Sciences of the Republic of Kazakhstan, Series of Geology and Technical Sciences. Vol. 2, No. 446, pp. 174-179. <https://doi.org/10.32014/2020.2518-170X.97> (in Eng.).
- [11] Mukanov R., Kasenov A., Itybayeva G., Musina Z., Strautmanis G. (2019) Modeling of the cutting head for treating holes in the railway. In: ICTE 2018. Procedia Computer Science. No. 149, pp. 355–359. <https://doi.org/10.1016/j.procs.2019.01.148> (in Eng.).
- [12] Buss D., Abishev K., Baltabekova A. (2019) Driver's reliability and its effect on road traffic safety. In: ICTE 2018, Procedia Computer Science. No. 149, pp. 463–466. <https://doi.org/10.1016/j.procs.2019.01.163> (in Eng.).

CONTENTS

Abetov A.E., Yessirkepova Sh.B., Curto Ma J. GEOMAGNETIC FIELD TRANSFORMS AND THEIR INTERPRETATION AT EXPLORATION FOR HYDROCARBON FIELD IN THE SOUTHERN PART OF THE USTYURT REGION.....	6
Abdirova R.D., Mashekov S.A., Fedorov S.V., Absadykov B.N., Ibragimova R.R. INFLUENCE OF THERMOMECHANICAL ROLLING SCHEDULES ON SCREW-SHAPED AND FLAT ROLLS AND NITRIDING SCHEDULES ON THE STRUCTURE AND MECHANICAL PROPERTIES OF P6M5 STEEL CUTTERS.....	15
Abdullaev A.U., Yessenzhigitova Y.Zh., Turabaeva Zh. MEDIUM-TERM FORECASTING OF STRONG EARTHQUAKES BY ANOMALOUS VARIATIONS OF THE GROUNDWATER REGIME.....	23
Abishev K.K., Kassenov A.Zh., Mukanov R.B., Sembaev N.S., Suleimenov A.D. RESEARCH OF THE OPERATIONAL QUALITIES OF A MINING MACHINE FOR THE DEVELOPMENT OF MINERAL DEPOSITS.....	30
Akhmetov S.M., Efendiev G., Akhmetov N.M., Iklasova Zh.U., Ikhsanov Ye.U. INVESTIGATION OF THE INFLUENCE OF THE MODE PARAMETERS OF THE DRILLING WELLS ON THE BIT SPEED INDICATORS.....	37
Begalinov A., Shautenov M., Medeuov Ch., Almenov T., Bektur B. MECHANOCHEMICAL ACTIVATION OF THE PROCESSING OF GOLD-BEARING SULFIDE RAW MATERIALS.....	46
Bekbasarov I., Nikitenko M., Shanshabayev N., Atenov Y., Moldamuratov Zh. TAPERED-PRISMATIC PILE: DRIVING ENERGY CONSUMPTION AND BEARING CAPACITY.....	53
Zhalgasuly N., Kogut A.V., Estemesov Z.A., Ismailova A.A., Shaltabaeva S.T. DEVELOPMENT OF TECHNOLOGIES FOR RECYCLING AND BIOTECHNICAL RECOVERY OF ASH SLAGS WASTE.....	64
Zhurinov M.Zh, Teltayev B.B, Amirbayev Ye.D, Begaliyeva S.T., Alizhanov D.A. MECHANICAL CHARACTERISTICS OF ROAD COMPOUNDED BITUMEN AT LOW TEMPERATURES.....	71
Zapparov M.R., Kassenov M.K., Raimbekova Zh., Auelkhan Y., Abishev B. MAIN CRITERIA DEFINING GLOF RISK ON THE TERRITORY OF ALMATY REGION, KAZAKHSTAN.....	77
Kozbagarov R.A., Zhussupov K.A., Kaliyev Y.B., Yessengaliyev M.N., Kochetkov A.V. DETERMINATION OF ENERGY CONSUMPTION OF HIGH-SPEED ROCK DIGGING.....	85
Nurpeissova M., Menayakov K.T., Kartbayeva K.T., Ashirov B.M., Dai Huayang SATELLITE OBSERVATIONS OF EARTH CRUST AT ALMATY GEODYNAMIC POLYGON.....	93
Petukhova Zh., Petukhov M., Nikulin A., Pargachev A. DEVELOPMENT OF AN INFORMATION AND ANALYTICAL SYSTEM “GEOTECHNICAL MONITORING OF THE SOIL CONDITION OF RESIDENTIAL BUILDINGS AND STRUCTURES”.....	102

Sedina S.A., Berdinova N.O., Abdikarimova G.B., Altayeva A.A., Toksarov V.N. NUMERICAL MODELING OF THE STRESS-STRAIN STATE OF THE KURZHUNKUL OPEN-PIT MINE.....	110
Seitov N., Kozhakhmet K. ASTHENOSPHERE AS AN INTERMEDIARY BETWEEN THE PLANET’S ENDOGENOUS ACTIVITY AND THE TECTONIC AND MAGNETIC ACTIVITY OF ITS LITHOSPHERE.....	118
Skydan O.V., Fedoniuk T.P., Pyvovar P.V., Dankevych V.Ye., Dankevych Ye.M. LANDSCAPE FIRE SAFETY MANAGEMENT: THE EXPERIENCE OF UKRAINE AND THE EU.....	125
Tarikhazer S.A, Kuchinskaya I.Y., Karimova E.J., Alakbarova S.O. ISSUES OF GEOMORPHOLOGICAL-LANDSCAPE RISK (on the example of the Kishchayriver).....	133
Tolegenova A.K., Akmalaiuly K., Skripkiunas G. STUDY OF THE EFFECTIVENESS OF THE USE OF COMPLEX ADDITIVES MASTER RHEOBUILD 1000 AND MASTER AIR.....	141
Tulegulov A.D., Yergaliyev D.S., Aldamzharov K.B., Karipbaev S.Zh., Bazhaev N.A. QUANTITATIVE ESTIMATES OF THE TRANSIENT PROCESS OF THE NON-CONTACT GYROSCOPE ROTOR.....	147
Sherov A.K., Myrzakhmet B, Sherov K.T., Sikhimbayev M.R., Absadykov B.N. GEAR PUMP QUALITY IMPROVING BY CHANGING THE DESIGN AND SIZE OF THE SUPPORT BUSHINGS.....	155
Shevko V., Aitkylov D., Badikova A., Karatayeva G., Bitanova G. CHLORINATION OF IRON PHOSPHIDE WITH CHLORINE AT THE PRESENCE OF OXYGEN TO PRODUCE PHOSPHORUS (V) OXIDE AND IRON (II, III) CHLORIDES.....	163

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 described work 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 Cross Check originality detection service <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 сайтах:

[www:nauka-nanrk.kz](http://www.nauka-nanrk.kz)

<http://www.geolog-technical.kz/index.php/en/>

ISSN 2518-170X (Online),

ISSN 2224-5278 (Print)

Редакторы: *М.С. Ахметова, А. Ботанқызы, Д.С. Аленов, Р.Ж. Мрзабаева*
Верстка на компьютере *Г.Д.Жадыранова*

Подписано в печать 15.12.2021.
Формат 60x881/8. Бумага офсетная. Печать – ризограф.
4,6 п.л. Тираж 300. Заказ 6.