

ISSN 2518-170X (Online)

ISSN 2224-5278 (Print)



«ҚАЗАҚСТАН РЕСПУБЛИКАСЫ  
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫ» РҚБ  
«ХАЛЫҚ» ЖҚ

# Х А Б А Р Л А Р Ы

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## ИЗВЕСТИЯ

РОО «НАЦИОНАЛЬНОЙ  
АКАДЕМИИ НАУК РЕСПУБЛИКИ  
КАЗАХСТАН»  
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## N E W S

OF THE ACADEMY OF SCIENCES  
OF THE REPUBLIC OF  
KAZAKHSTAN  
«Halyk» Private Foundation

**SERIES**

**OF GEOLOGY AND TECHNICAL SCIENCES**

# 5 (466)

**SEPTEMBER – OCTOBER 2024**

THE JOURNAL WAS FOUNDED IN 1940

PUBLISHED 6 TIMES A YEAR

ALMATY, NAS RK

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*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.*

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**«ҚР ҰҒА» РҚБ 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/>

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**«Известия РОО «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/>

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**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/>

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NEWS of the National Academy of Sciences of the Republic of Kazakhstan  
SERIES OF GEOLOGY AND TECHNICAL SCIENCES  
ISSN 2224-5278  
Volume 5. Number 466 (2024), 167-177  
<https://doi.org/10.32014/2024.2518-170X.452>

UDC 621.876.113

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Abylkas Saginov Karaganda Technical University, Karaganda, Kazakhstan.  
E-mail: [barton.kz@mail.ru](mailto:barton.kz@mail.ru)

### **PNEUMATIC LOAD HOISTS FOR MINERAL TRANSPORTATION FROM MINES**

**Taranov Alexandr** – Candidate of Technical Sciences, associate professor of the Energy Systems Department, NCJSC «Abylkas Saginov Karaganda Technical University», Karaganda, Kazakhstan, E-mail: [energy\\_kstu@mail.ru](mailto:energy_kstu@mail.ru), <https://orcid.org/0000-0002-1534-9737>;

**Mekhtiyev Ali** – Candidate of Technical Sciences, Professor, Vice-Rector for Research NCJSC «Abylkas Saginov Karaganda Technical University», Karaganda, Kazakhstan, E-mail: [barton.kz@mail.ru](mailto:barton.kz@mail.ru), <https://orcid.org/0000-0002-2633-3976>;

**Bulatbayev Felix** - Candidate of Technical Sciences, Dean of the Faculty of Energy, Automation and Telecommunications, NCJSC «Abylkas Saginov Karaganda Technical University», Karaganda, Kazakhstan, E-mail: [felix4965@mail.ru](mailto:felix4965@mail.ru), <https://orcid.org/0000-0002-3574-1189>;

**Neshina Yelena** – Candidate of Technical Sciences, Head of the Energy Systems Department, NCJSC «Abylkas Saginov Karaganda Technical University», Karaganda, Kazakhstan, E-mail: [1\\_neg@mail.ru](mailto:1_neg@mail.ru), <https://orcid.org/0000-0002-8973-2958>;

**Balandin Vitaliy** – Master of Technical Sciences, Senior Lecturer, Department of Energy Systems, NCJSC «Abylkas Saginov Karaganda Technical University», Karaganda, Kazakhstan, E-mail: [vetal11@mail.ru](mailto:vetal11@mail.ru), <https://orcid.org/0000-0002-6593-1864>.

**Abstract.** To solve the problems of achieving high reliability and safety of load hoists, the authors present three modifications of pneumatic load hoists that are their own development. The existing rope hoists have been analyzed. They have a number of design flaws, and their further improvement only complicates and increases the cost of the design. The article presents the results of studying the energy parameters of the PPG-100 load pneumatic hoist. The main design features of the hoist have been described and the principles of its operation have been analyzed. The study considers the key factors that affect the efficiency of converting compressed air energy into mechanical work. The optimum operating modes of the pneumatic hoist have been determined that ensure the maximum energy efficiency and reliability of operation with minimal energy costs. Factory and production tests of load pneumatic hoists have proven the operability, reliability and durability of these machines, their environmental safety. The results can be used in designing and modernizing similar devices, as well as in

the development of recommendations for their operation in various industrial conditions.

**Keywords:** hoist, load, Kazakhstan, reliability, pneumatic hoist, lifting capacity.

**Financing:** *This research has is funded by the Science Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan (Grant No. AP19675518).*

**Conflict of interest:** *The authors declare that there is no conflict of interest.*

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Әбілқас Сағынов Атындағы Қарағанды Техникалық Университеті,  
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E-mail: barton.kz@mail.ru

## **ПАЙДАЛЫ ҚАЗБАЛАР МЕН ШАХТАЛАРДЫ ЖЕТКІЗУГЕ АРНАЛҒАН ЖҮК ПНЕВМАТИКАЛЫҚ КӨТЕРГІШТЕР**

**Таранов Александр** – техника ғылымдарының кандидаты, «Әбілқас Сағынов атындағы Қарағанды техникалық университетінің» «Энергетикалық жүйелер» кафедрасының доценті, Қарағанды, Қазақстан, energy\_kstu@mail.ru, <https://orcid.org/0000-0002-1534-9737>;

**Мехтиев Али Джаванширович**, техника ғылымдарының кандидаты, асс. профессор, «Әбілқас Сағынов атындағы Қарағанды техникалық университетінің» ғылыми жұмыстар жөніндегі проректоры, Қарағанды, Қазақстан, E-mail: barton.kz@mail.ru, <https://orcid.org/0000-0002-2633-3976>;

**Булатбаев Феликс** - техника ғылымдарының кандидаты, «Әбілқас Сағынов атындағы Қарағанды техникалық университеті» КЕАҚ Энергетика, автоматика және телекоммуникация факультетінің деканы, Қарағанды, Қазақстан, E-mail: felix4965@mail.ru, <https://orcid.org/0000-0002-3574-1189>;

**Нешина Елена Геннадьевна**, техника ғылымдарының кандидаты, «Әбілқас Сағынов атындағы Қарағанды техникалық университетінің» «Энергетикалық жүйелер» кафедрасының меңгерушісі, Қарағанды, Қазақстан, E-mail: l\_neg@mail.ru, <https://orcid.org/0000-0002-8973-2958>;

**Баландин Виталий** – техника ғылымдарының магистрі, «Әбілқас Сағынов атындағы Қарағанды техникалық университетінің» Энергетикалық жүйелер кафедрасының аға оқытушысы, Қарағанды, Қазақстан, E-mail: vetal11@mail.ru, <https://orcid.org/0000-0002-6593-1864>.

**Аннотация.** Жүк көтергіштердің жоғары сенімділігі мен қауіпсіздігіне қол жеткізу мәселелерін шешу үшін авторлар өз әзірлемелері болып табылатын пневматикалық жүк көтергіштердің үш модификациясын ұсынады. Қолданыстағы арқан көтергіштер талданды. Олар дизайндағы бірқатар кемшіліктерді жояды және оларды одан әрі жетілдіру дизайнның құнын қиындатады және арттырады. Мақалада рpg-100 жүк пневматикалық

көтергішінің энергетикалық параметрлерін зерттеу нәтижелері келтірілген. Көтергіштің негізгі конструкциялық ерекшеліктері сипатталған және оның жұмыс істеу принциптері талданған. Зерттеу барысында сығылған ауа энергиясын механикалық жұмысқа айналдыру тиімділігіне әсер ететін негізгі факторлар қарастырылады. Пневматикалық көтергіштің оңтайлы жұмыс режимдері анықталды, олар максималды энергия тиімділігі мен минималды энергия шығындарымен жұмыс істеу сенімділігін қамтамасыз етеді. Пневматикалық жүк көтергіштердің зауыттық және өндірістік сынақтары осы машиналардың жұмыс қабілеттілігін, сенімділігі мен беріктігін, олардың экологиялық қауіпсіздігін дәлелдеді. Нәтижелерді ұқсас құрылғыларды жобалау мен модернизациялауда, сондай-ақ оларды әртүрлі өндірістік жағдайларда пайдалану бойынша ұсыныстарды әзірлеуде қолдануға болады.

**Түйін сөздер:** лифт, жүк көтергіш, Қазақстандық, сенімділік, пневматикалық көтергіш.

***Қаржыландыру:** Бұл ғылыми жұмыс Қазақстан Республикасы Ғылым және жоғары білім министрлігінің ғылым комитетімен гранттық қаржыландыру шеңберінде ЖТН № АР19675518 жобасын іске асыру барысында алынған нәтиже болып табылады.*

***Мүдделер қақтығысы:** Авторлар осы мақалада мүдделер қақтығысы жоқ деп мәлімдемейді.*

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В.С. Баландин, 2024.

Карагандинский технический университет имени Абылкаса Сагинова,  
Караганда, Казахстан.

E-mail: barton.kz@mail.ru

## ГРУЗОВЫЕ ПНЕВМАТИЧЕСКИЕ ПОДЪЕМНИКИ ДЛЯ ДОСТАВКИ ПОЛЕЗНЫХ ИСКОПАЕМЫХ И ШАХТ

**Таранов Александр** – кандидат технических наук, доцент кафедры «Энергетические системы» НАО «Карагандинский технический университет имени Абылкаса Сагинова», Караганда, Казахстан, E-mail: energy\_kstu@mail.ru, <https://orcid.org/0000-0002-1534-9737>;

**Мехтиев Али Джаванширович** – канд. техн. наук, ассоциированный профессор, проректор по научной работе в НАО «Карагандинский технический университет имени Абылкаса Сагинова», Караганда, Казахстан, E-mail: barton.kz@mail.ru, <https://orcid.org/0000-0002-2633-3976>;

**Булатбаев Феликс** – кандидат технических наук, декан факультета энергетики, автоматике и телекоммуникаций, НАО «Карагандинский технический университет имени Абылкаса Сагинова», Караганда, Казахстан, E-mail: felix4965@mail.ru, <https://orcid.org/0000-0002-3574-1189>;

**Нешина Елена Геннадьевна** – канд. техн. наук, заведующая кафедрой «Энергетические системы» НАО «Карагандинский технический университет имени Абылкаса Сагинова», Караганда, Казахстан, E-mail: 1\_neg@mail.ru, <https://orcid.org/0000-0002-8973-2958>;

**Баландин Виталий** – магистр технических наук, старший преподаватель кафедры



«Энергетические системы», НАО «Карагандинский технический университет имени Абылкаса Сагинова», Караганда, Казахстан, E-mail: vetal11@mail.ru, <https://orcid.org/0000-0002-6593-1864>.

**Аннотация.** Для решения проблем достижения высоких показателей надежности и безопасности работы грузовых лифтов авторами представлены грузовые пневмолифты трех модификаций, что является собственной разработкой. Приведен анализ существующих канатных подъемников, которые имеют ряд конструктивных недостатков, а их дальнейшее усовершенствование лишь усложняет и увеличивает стоимость конструкции. В статье представлены результаты исследования энергетических параметров грузового пневмоподъемника ППГ-100. Описаны основные конструктивные особенности подъемника и проанализированы принципы его работы. В ходе исследования рассмотрены ключевые факторы, влияющие на эффективность преобразования энергии сжатого воздуха в механическую работу. Определены оптимальные режимы работы пневмоподъемника, обеспечивающие максимальную энергоэффективность и надежность эксплуатации при минимальных затратах энергии. Заводские и производственные испытания грузовых пневмолифтов доказали работоспособность, надежность и долговечность этих машин, их экологическую безопасность. Полученные результаты могут быть использованы при проектировании и модернизации аналогичных устройств, а также при разработке рекомендаций по их эксплуатации в различных промышленных условиях.

**Ключевые слова:** лифт, грузовой, Казахстан, надежность, пневмоподъемник, грузоподъемность.

**Финансирование:** Настоящая научная работа является результатом реализации проекта ИРН №AP19675518 в рамках грантового финансирования Министерства науки и высшего образования Республики Казахстан.

**Конфликт интересов:** авторы заявляют об отсутствии конфликта интересов.

## **Introduction**

At present, transportation of rock mass from open pits is mainly carried out by rail and road transport. For mines, mine hoisting machines remain the main type of transport (Salloom, et al, 2015; Babu, et al, 2017). Each type of transport has its own advantages and benefits that have been studied previously (Nikolaev, et al, 2018)

To solve the problem of transporting rock mass from open pits and mines, it has been proposed to use pneumatic load hoists that have a number of advantages over traditional rope hoists and can also be quite effective in transporting minerals. Transportation costs can make up to 70% of all the costs for open pits, and their

depth is limited by the capabilities of the transport system (Voronov, et al, 2016; Soldatchenkov, 2018; Leontiev, et al, 2021). In theoretical terms, pneumatic hoists have no limit on lifting capacity and lifting height; the same applies to underground mining (Kopytov, et al, 2019). This article discusses the results of experimental studies of the pneumatic load hoist prototype that can be used both for open pits and mines.

It should be noted that Kazakhstan does not manufacture its own mine hoists for the needs of the mining industry; they are all imported from abroad (Voronov, et al, 2016). 70% of the hoist fleet was developed in the former USSR. The process of modernization of this fleet is extremely slow and requires significant material resources. The main disadvantage of mine hoists is the presence of a steel rope, as well as a low filling factor of the vessel, which can be eliminated with the use of the pneumatic lifting principle (Anar, et al, 2018; Kitaeva, et al, 2015). The absence of a rope significantly reduces energy costs for lifting 1 ton of cargo, as well as the cost of the hoisting unit itself. The article presents three types of pneumatic mine hoists with the lifting capacity of 100, 250, 500 kg. But in the future, with the development of this type of transport, their lifting capacity can be increased to hundreds of tons, while the lifting depth can be more than 3 km, which is a prospect for mining at great depths.



Figure 1 - Three modifications of load pneumatic hoists with the lifting capacity of 110, 250 and 500 kg

The development of pneumatic load hoists is based on many years of experience in the development of this type of transport. Some results related to the design,

the operating principle, and maximum load parameters, are presented in the early articles of the authors (Nikolayev, et al, 2021). The advantages and disadvantages of pneumatic load hoists are described in (Istabraq, et al, 2022), where the design diagram explaining the main elements of this type of transport is also given.

Scientists from different countries are engaged in improving hoisting mechanisms. For example, there is an electro-hydraulic servo system (EHSS) that can be used with a traditional hydraulic hoist. This technology can use speed and position input data to provide the desired degree of speed control, ride comfort, and alignment accuracy. The EHSS is a closed-loop control system that acts as a drive unit that raises and lowers the cabin in response to such a variable as position, speed, or force (Gi-Young, et al, 2024). Typically, one traction machine operates by lifting the main cable on the traction pulley, thus vertically moving the elevator cabin through the rotational movement of the pulley. Scientists from Korea have conducted research and developed a traction machine with the lifting capacity of up to 50 tons. The innovation involves the development of a dual traction system in which two traction machines interact to lift the elevator (Lodovika, et al, 2023).

Scientists from Indonesia have studied the issue of replacing manual control buttons of pneumatic hoists with automatic control buttons that are provided on each floor, adding automatic opening and closing of doors and the process of automatic lifting and lowering the cabin using rails equipped with toothed belts and several electronic components (Panickar et al, 2021). There are also developments on the use of a BLDC motor powered by an independent photovoltaic source for the hoist with a diesel generator added as a backup source to ensure greater reliability of the system (Kwon, et al, 2019). Scientists are also conducting studies on manufacturing safety devices using safety standards and test criteria required for load hoists (Mekhtiyev, et al, 2018). Compared with a rope elevator, the design of a pneumatic hoist is simple and ingenious. It consists of a cylindrical sealed shaft, inside which a lifting platform with guides moves. The shaft is equipped with a loading hatch with eccentric locks. The use of an annular elastic element with a floating sealing edge ensures the tightness of the lumbar cavity and safety of operation. The main working element is a fan (Kassymkanova, et al, 2018).

### **Research methods**

The object of the study is three samples of pneumatic load hoists with the lifting capacity of 100, 250, 500 kg, respectively. Detailed characteristics are discussed earlier. The pneumatic load hoist operates using pneumatic energy from the blower. After the platform is loaded, the hatch is closed and the latches are locked and eliminate the possibility of their opening. Then the "Start" button is pressed, the fan is turned on, and compressed air begins to flow into the space under the platform. When the required pressure is reached, the platform on an air

cushion rises to the upper mark, where it is stopped by stops. A green indicator lights up on the control panel, signaling that the hatch can be opened to unload the platform. During the entire unloading process, the platform is held in the upper position due to the pressure of the fan. After unloading, the hatch is closed again, the latches are locked, the "Stop" button is pressed, and the fan is turned off. Compressed air begins to flow out through a calibrated pipe and allows smooth descending of the platform onto the lower stops. The green indicator lights up to indicate that the hatch can be opened for a new load, after which the cycle repeats.

During the movement of the load platform in the shaft, a red light is on, indicating that opening the hatches is prohibited.

Table 1 shows the technical and economic characteristics of pneumatic load hoists.

Table 1 - Technical and economic characteristics

Load capacity, kg	110	250	500
Shaft diameter, mm	1020	1420	1620
Compressed air pressure, MPa	0.003	0.004	0.0045
Installed fan power, kW	3	5	7
Lifting speed, m/s	0.3	0.3	0.3
Cost depending on the number of floors, thousand tenge	1117-1405	1532-1846	1788-2088

All the parameters that are studied for a given hoist are considered depending on time, covering all the stages of lifting and lowering the pneumatic hoist, as well as at different load levels: maximum and minimum. The hoist is prepared for operation as follows:

- the hoist is connected to the compressed air supply system;
- the APPA-30R electrical measuring clamps and the D301 device for measuring the power factor are connected to record the consumed electrical energy and the power of the hoist;
- calibrated weights are prepared;
- a chronometer is prepared to measure the time of lifting and lowering the hoist;
- tables are prepared for recording the measured parameters;
- the operation of the hoist and measuring devices is tested.

Then the empty load platform is lifted and lowered the required number of times, while the following is recorded:

- electricity consumption and electric motor power during pneumatic lift operation using the APPA-30R and D301 devices;
- the time of lifting and lowering the PPG-100 pneumatic hoist.

Based on the obtained graphs, there is assessed the performance, reliability and safety of the PPG-100 pneumatic hoist.

**Results and discussion**

Figure 2 shows some test results that establish the dependence of changing pressure in the working cavity of the loaded platform on the lifting time of PPG-110, 250, 500.

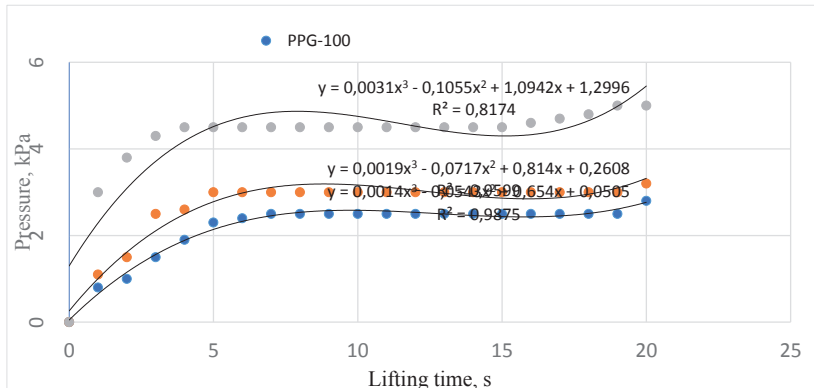


Figure 2 - The working cavity of the loaded platform pressure dependence on the lifting time

Figure 3 shows the parameters of the current consumption of a three-phase electric motor with voltage of 380 V when lifting the PPG-110, PPG-250 and PPG-500 loaded platforms.

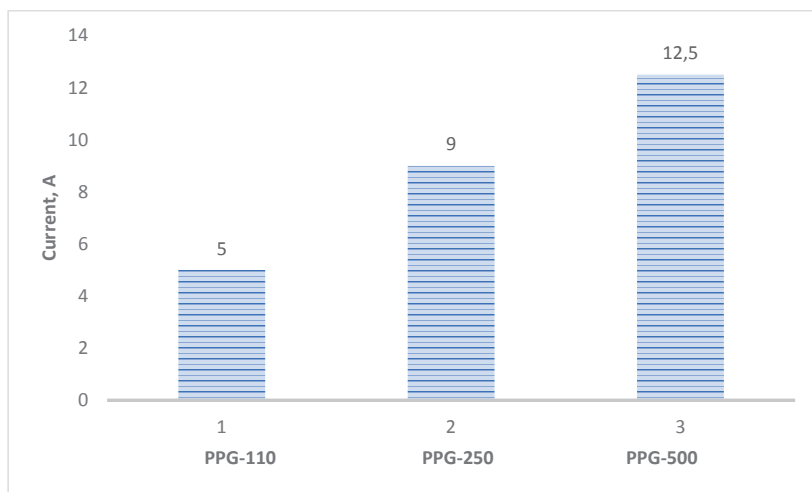


Figure 3 - Experimental data on the operating current when lifting the PPG-110, 250, 500 loading platforms

The air consumption values for lifting the PPG-110, PPG-250 and PPG-500 load platforms of pneumatic hoists have been obtained experimentally.

The following equipment and devices have been used to measure the parameters: a pressure gauge of the NMP-52UZ type with the measurement limit of 0-5 kPa; a dynamometer; the power and electrical energy consumption has been measured using an ARRA-30R electrical measuring clamp with a flexible system for measuring operating voltage and current; the time has been measured using a chronometer; the load during testing of the pneumatic load hoist has been provided by reference weights.

Table 2 - Determining the air consumption when lifting the load platform of the PPG-110, PPG-250 and PPG-500 pneumatic hoists

Type	Lifting speed, $m/s$	The shaft cross section area, $m^2$	Air consumption, $m^3/s$
PPG-110	0.178	0.785	0.137
PPG-250	0.18	1.54	0.28
PPG-500	0.193	2	0.386

According to the measurements of the electrical parameters, the pneumatic load hoists shows the following indicators: the consumption of electrical energy when lifting an empty platform is 7 W\*h, and 13 W\*h per lift when lifting a loaded platform. When taking a motor of the same power for a rope hoist for comparison, it will consume at least 1.5 times more energy per “lifting - lowering” cycle, since the PPG-100 hoist under consideration does not consume electrical energy when descending. The platform is lowered by removing air from the under-vessel cavity naturally. The power of the motor with a fan is 2.7 kW when lifting an empty platform, and 2.85 kW when lifting a loaded platform, which allows concluding that even when lifting the maximum load, there is a power reserve.

### Conclusions

The experiments carried out, as well as the results of previous studies, allow drawing the following conclusions regarding the advantages of pneumatic load hoists:

- simplicity of design;
- reliability and safety in operation;
- ease of mounting and maintenance;
- reduction of costs for purchasing, mounting and operation of a pneumatic hoist (by 2-5 times);
- low pressure of compressed air (0.003-0.007 MPa) in the shaft cavity forms favorable and safe dynamic conditions for the operation of the pneumatic hoist.

At Abylkas Saginov Karaganda Technical University, the prototypes of pneumatic load hoists have been developed and tested at organizations of small-scale production of a new type of transport for various industries. These hoists can be used not only for transporting rock mass from open pits and mines but

also for lifting cargo, for example, in the construction or mining and metallurgical industries. In the course of experimental studies, such advantages of pneumatic load hoists as low air consumption, smooth platform movement, and low noise levels during operation have been identified.

Taking into account all the above, it can be concluded that pneumatic load hoists are competitive with rope mine hoists and can also replace road transport in open pits with the depth of more than 300 meters.

This research has is funded by the Science Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan (Grant No. AP19675518).

#### **References**

Salloom M., Hussein H., Roaa A. (2015). Performance of PLC controlled pneumatic elevator. *International Research Journal of Engineering and Technology (IRJET)*. 02. 457-464. (in Eng).

Nikolayev Yu. A., Taranov A.V., Mekhtiyev A. D., Neshina Y. G. (2021) The freight pneumatic elevators as a new form of transport. IMET 2020. *Journal of Physics: Conference Series* 1843 012007 IOP Publishing doi:10.1088/1742-6596/1843/1/012007

Istabraq H. A., Farag M., Jamal A.-K. M. (2022) A review on the employment of the hydraulic cylinder for lifting purposes. *Indonesian Journal of Electrical Engineering and Computer Science* 28(3):1475 28(3):1475. DOI:10.11591/ijeecs.v28.i3.pp1475-1485. Pp.1-6. (in Eng).

Gi-Young K., Seung-Ho J. (2024) Elevating Innovation: Unveiling the Twin Traction Method for a 50-Ton Load Capacity Elevator in Building and Construction Applications. *Buildings* 2024, 14(5), 1244; <https://doi.org/10.3390/buildings14051244>. Pp. 1-6. (in Eng).

Lodovika, G.Rudy, Didin K.R., Sukadwilinda, Aryanti R.R., Frisca S.W. (2023) Prototype of Automatic Control of Freight Elevator Models in a 3-Floor Building. Conference: 2023 17th International Conference on Telecommunication Systems, Services, and Applications (TSSA). DOI:10.1109/TSSA59948.2023.10366885 (in Eng).

Panickar M., Sreelekha V. (2021) Investigation of Performance of BLDC-Driven Dumbwaiter Elevator System Fed from SPV Array and Diesel Generator. *International Conference on Smart Energy and Advancement in Power Technologies*, 927, pp.539. (in Eng).

Kwon S.-P., Jung B.-J.. (2019) Study on design of safety gear for fall prevention of freight elevator. *International Journal of Advanced Science and Technology*, Vo. 28, Number 5, pp. 76 – 84. (in Eng).

Mekhtiyev A.D., Yurchenko A.V., Bulatbayev F.N., Neshina Y.G., Alkina A.D. (2018) Theoretical bases of increase of efficiency of restoration of the worn out hinged joints of mine hoisting machine. *News of the National Academy of Sciences of the Republic of Kazakhstan, Series of Geology and Technical Sciences*, , 5(431), pp. 66–75. (in Eng).

Kassymkanova Kh., Jangulova G., Bekseitova R., Miletenko N., Baidauletov G., Turekhanov V., Zhalgasbekov Y., Shmarova I. (2018) Express-Assessment Of Geomechanic Condition Of The Rock Massive And Development Methods Of Its Strengthening And Reinforcing For Safe Ecological Developing Of The Fields Of Mineral, *News Of The National Academy Of Sciences Of The Republic Of Kazakhstan Series Of Geology And Technical Sciences*, Vo.5, Number 431, pp. 37-46. <https://doi.org/10.32014/2018.2518-170X.33> (in Eng).

Babu B., Kamalanathan J., Nallasivam Dr. (2017). Design and Fabrication of Pneumatics Lifting System for Four Wheeler. *International Journal of Latest Engineering and Management Research*. 02. 12-15. (in Eng).

Nikolaev Yu.A., Mekhtiev A.D. (2018) Some results of work on the creation of a new type of transport for mines and quarries. *Mining magazine of Kazakhstan. Scientific, technical and production*. Almaty. No. 4, P. 44-48. (in Russ).

Voronov V.A., Kucher E.S. (2016) The control system of the electric freight elevator. *The science. Technology. Innovation*. [Sistema upravleniia elektroprivodom gruzovogo lifta. Nauka. Tekhnologii. Innovatsii], pp. 112-113. (in Russ).

Soldatchenkov A.R. (2018) Special elevators for low-rise buildings. Proceedings of the conference of the Bryansk State Technical University [Spetsial'nye lifty dlia zdanii maloi etazhnosti. Sbornik trudov konferentsii Brianskogo gosudarstvennogo tekhnicheskogo universiteta], pp. 95-97, (in Russ).

Leontiev A., Volkov V., Volkov E. (2021). The dynamics of a laden skip of the shaft pneumatic winding plant during acceleration. Izvestiya vysshikh uchebnykh zavedenii. Gornyi zhurnal. 115-121. 10.21440/0536-1028-2021-1-115-121. (in Eng).

Kopytov A., Pershin V., Fadeev Yu. (2019). Influence of dynamic loads on safety appliance design in skip shaft sinking. Gornyi Zhurnal. 27-31. 10.17580/gzh.2019.04.06. (in Eng).

Anar K., Wang Z. , Baktybaev M. K. (2018) Analysis Of The Sensor Of Temperature And Humidity Measurement Based On The Optical Fiber, News Of The National Academy Of Sciences Of The Republic Of Kazakhstan Series Of Geology And Technical Sciences, Vo.5, Number 431, pp.133-140. <https://doi.org/10.32014/2018.2518-170X.19>. (in Eng).

Kitaeva M.V., Nikolaev Yu. A., Taranov A.V., Mekhtiyev A. D. (2015). Studying mathematical model of mine and quarry pneumatic lifting equipment in «skip-guidance» devices systems. IOP conf. Publishing. Materials Science and Engineering 81, doi10.1088/1757-899X/81/1/012114.



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<http://www.geolog-technical.kz/index.php/en/>  
ISSN 2518-170X (Online),  
ISSN 2224-5278 (Print)**

Директор отдела издания научных журналов НАН РК *А. Ботанқызы*

Редакторы: *Д.С. Аленов, Ж.Ш. Әден*

Верстка на компьютере *Г.Д. Жадыранова*

Подписано в печать 15.10.2024.

Формат 70x90<sup>1/16</sup>. Бумага офсетная. Печать – ризограф.  
18,0 п.л. Тираж 300. Заказ 5.