ISSN 2181-8622

Manufacturing technology problems

Scientific and Technical Journal Namangan Institute of Engineering and Technology

INDEX COPERNICUS INTERNATIONAL

Volume 10
Issue 1
2025

Google Scholar
Crossref doi
SLIB.UZ Scientific library of Uzbekistan

UDC 629.1.07

ANALYSIS OF FACTORS INFLUENCING THE INCREASED CONSUMPTION OF DIESEL FUEL BY BELAZ DUMP TRUCKS IN A QUARRY

KAYUMOV UMIDJON

Senior Lecturer, Navoi State Mining and Technological University, Navoi, Uzbekistan
E-mail.: kayumov_umidjon@mail.ru
ORCID: 0000-0002-2147-8973

KAKHKHAROV ORIFJON

Assistant, Navoi State Mining and Technological University, Navoi, Uzbekistan

PARDAEVA SHAHLO

Assistant, Navoi State Mining and Technological University, Navoi, Uzbekistan
**Corresponding author*

Abstract: The purpose of this article is to analyse the problems affecting the increase in fuel consumption of mine dump trucks, as well as the efficiency of BelAZ dump trucks. Various methods of determining fuel consumption rates for dump trucks have also been analysed. As a result of the study, data on the operation of dump trucks from the road transport department of the Central Mining Department of Navoi Mining Division of Navoi Mining and Metallurgical Combine were collected, and the factors affecting the consumption of diesel fuel were analysed. As a result of researches the estimation of operational indicators of dump trucks is given, and also the indicators influencing fuel consumption during transportation of rock mass are revealed. In addition, several methods of calculation of fuel consumption are proposed and additional parameters affecting this indicator are determined. As a result of the research, recommendations were developed to improve efficiency by reducing fuel consumption during the operation of dump trucks.

Keywords: dump truck, fuel, internal combustion engine, diesel fuel, consumption rates, road surface, load capacity, turning radius, performance indicators, tire pressure.

Introduction. The pace of development of the mining industry is sharply increasing. This encourages improvements to mining equipment as well as vehicles used in it to improve the efficiency of mining enterprises. As a result of this, special attention is paid to the auto industry, which is considered the largest share of the transport of minerals in the world.

Today, the Department of Road Transport is a multifaceted and multidisciplinary unit of the Central Mining Department of the NKMC, which performs the following functions:

In the careers" Muruntog","Tashkura "and" Amantaytog " are engaged in the transportation of mass of rocks and ores in technological car transport;

The transfer of gold ore into a heap solution provides loading into the grinding and sorting complex at the workshop.

The technological park of the traffic structure of the Department of Road Transport consists of modern motor vehicles with a carrying capacity of Caterpillar and BelAZ, from 55 to 220 tons, road-building cars Caterpillar, Komatsu, Dressta, Kirovets, as well as an auxiliary park of motor vehicles with mainly different BelAZ models.

One of the main indicators for analyzing the performance of dump trucks is fuel consumption, which represents the amount of fuel required to cover a certain distance or perform a certain amount of work (Sadudin Hodzic et. al., 2008; V. Kecojevic et. al., 2010).

One of the operational problems of dump trucks in quarries is excessive consumption of diesel fuel, which leads to material losses for mining enterprises. This indicator has a significant impact on planning the operation of dump trucks and assessing their efficiency (S. Masic et. al., 2005; Kurganov V.M. et. al., 2020; Kuznetsov I.S. et. al., 2021).

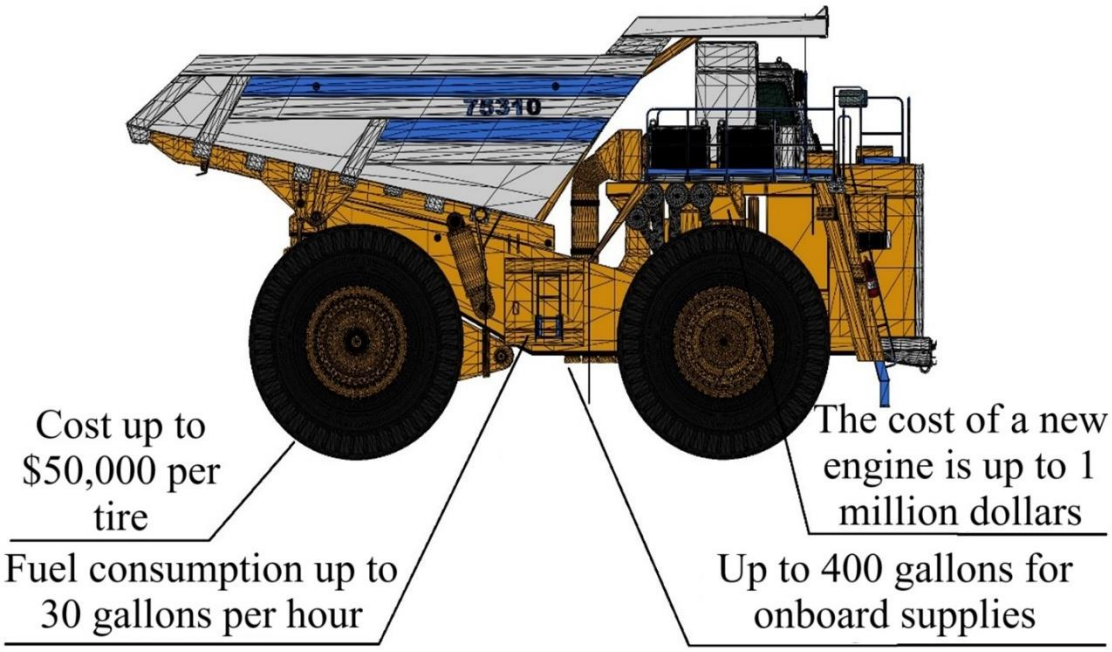

Figure 1. Dump trucks used in mining industries are characterized by high initial purchase and running costs

Fuel consumption is usually expressed in tons and grams per ton kilometer. To solve this problem, we will use the following scheme to evaluate the factors affecting diesel fuel consumption.

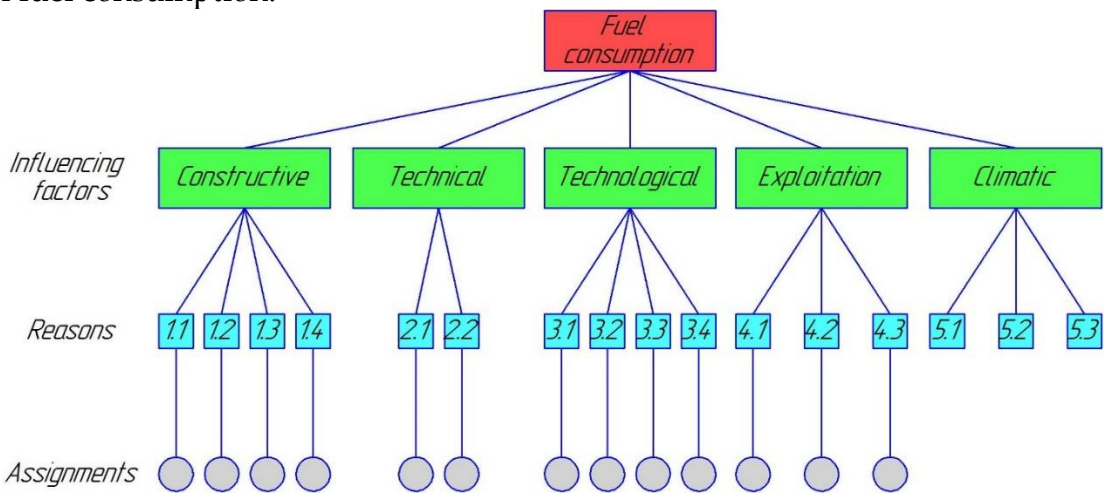

Figure 2. Factors affecting diesel fuel consumption

Materials and methods. The issues of increasing the efficiency of dump trucks were considered in their scientific research works by V.I. Novikov, N.S. Zakharov, V.A. Korchagin, M.A. Kuzminov, R.S. Grigoryev, A.I. Petrov, N.N. Maslov, G.M. Yakovlev, L.G. Reznik, V.S. Volkov and others.

Methods for determining and normalizing fuel consumption have been developed by many institutes, scientific organizations and enterprises, namely the St. Petersburg Mining Institute (technical university), the Mining Institute of the Ural Branch of the Russian Academy of Sciences, BelAZ and Navoi Mining and Metallurgical Combines (BelAZ-holding, 2017;).

Despite a number of fundamental studies conducted by scientific researchers and scientific organizations on issues of increasing the reliability of aggregates and organizing repair work, changes in the design, technical and technological factors that significantly affect the efficiency of quarry dump trucks have not been taken into account, and in addition, the methods and hypotheses proposed in a number of scientific studies have not been practically applied as a basis for solving the above problems (Ali Soofastaei, 2016).

The study of various methods for determining fuel consumption for dump trucks allows us to identify a number of indicators, each of which has its own characteristics and can be effectively used in different approaches.

The above factors serve as the basis for a detailed analysis of the technical parameters of dump trucks. In order to solve these factors, we mainly take into account the following indicators, namely, load capacity, engine power, rolling resistance coefficients and duty cycle. The calculation of these indicators serves as the basis for reducing the fuel consumption of dump trucks used in quarries.

Table - 1 presents the reasons underlying the factors affecting fuel consumption.

Table 1. Indicators underlying factors affecting fuel consumption

Factors	Reasons	Indicators
Constructive	1.1	Improving the design of dump trucks.
	1.2	Load capacity
	1.3	Wheel performance
	1.4	Road surface design
Technical	2.1	Depth of quarry
	2.2	For transportation
Technological	3.1	Turning radius and number
	3.2	Slope index, ‰
	3.3	Length of sloping sections and their number
	3.4	Load capacity utilization rate
Operation	4.1	Internal combustion engine wear rate
	4.2	Large tire pressure
	4.3	Rational driver control techniques
Climatic	5.1	Ambient air temperature
	5.2	Seasonal cycle
	5.3	Precipitation

As a result of the analysis of the factors affecting fuel consumption presented above, we exclude structural and technical factors from the assessment. The reason is that we cannot directly influence these factors, since we cannot change the design of dump trucks, the design of road surfaces, or the depth of the quarry.

When assessing the factors affecting fuel consumption, we can take into account the influence of technological, operational, and climatic factors and directly influence them.

Research results. A detailed analysis and calculation of fuel consumption is carried out for each dump truck, taking into account its individual technical indicators and performance characteristics. Therefore, we can calculate the standard fuel consumption using the following formula.

$$Q_n = 0.01 \cdot H_n \cdot S \cdot (1 + 0.01 \cdot D) + H_{q.n} \cdot Z$$

This is Q_n – a complex indicator of the soft standard fuel consumption in liters;

H_n – an indicator expressing the fuel consumption of a dump truck for cargo operations;

S – a dynamic indicator of the total distance traveled by dump trucks, measured in kilometers.

$H_{(q.n)}$ – an indicator expressing the additional energy consumption of dump trucks, taking into account the number of trips with a load, measured in liters;

Z – a figure expressing the number of trips with a load in one shift;

D – a coefficient reflecting the total increase or decrease in energy consumption relative to this standard, expressed in percent.

Based on the above formula, we can determine the fuel consumption of a dump truck H_n for transportation operations as follows.

$$H_n = H_t + H_{q.m} \cdot (G_{a.m} + 0.5 \cdot q) \qquad l/100\ km$$

Here H_t – is the standard fuel consumption indicator for transportation of dump trucks with a load coefficient of 0.5;

$H_{(q.m)}$ – is the fuel consumption indicator for transportation of dump trucks taking into account the additional mass of the dump truck;

$G_{a.m}$ – is the weight of the dump truck;

q – is the load-carrying capacity of the dump truck.

Based on the above formulas, we used data from january 2024 to february 2025 to analyze the fuel consumption of dump trucks with a full load. As a result of the calculations, a comparison diagram of the fuel consumption of dump trucks with a full and average load was drawn up in Figure 3.

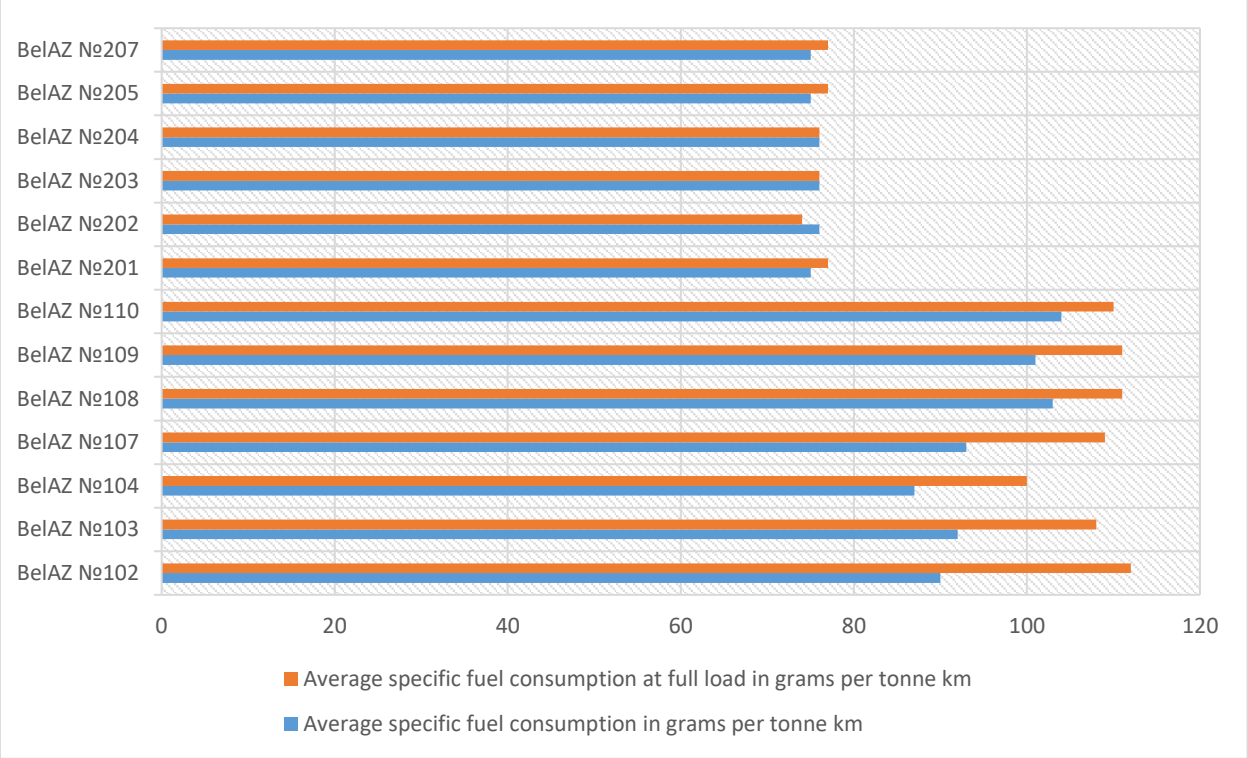

Figure 3. Comparison diagram of fuel consumption of dump trucks with full and average load capacity

Analyzing the above diagram, we can conclude that the average diesel fuel consumption for BelAZ 7513 dump trucks exceeded the standard by 13.5%, the maximum value by 23.9%, and the minimum value by 6.3%. The best indicators of compliance with the standard for diesel fuel consumption for BelAZ 75310 dump trucks were shown by BelAZ No. 202, BelAZ No. 203, BelAZ No. 204, but we can see that the diesel fuel consumption for BelAZ No. 201, BelAZ No. 205, BelAZ No. 207 exceeded the standard by 1%, 0.9%, and 1.03%, respectively.

Analysis of the research results. It is clear that optimizing fuel consumption in dump trucks helps to minimize operating costs and increase overall efficiency. This article discusses several practical recommendations that can help significantly reduce fuel consumption:

Regular maintenance and tuning of dump trucks. This mainly consists of servicing internal combustion engines, which can optimize fuel consumption by properly tuning the engine, fuel supply system, and ignition system.

Controlling the pressure of dump truck tires. Maintaining effective pressure in the tires reduces rolling resistance and, accordingly, fuel consumption.

Efficient loading and distribution of loads. Evenly distributing the load within the permissible carrying capacity of the dump truck body reduces the load on the internal combustion engine and fuel consumption.

Turn off the dump truck engine during stops. When waiting in one place for a long time, it is recommended to turn off the engine to avoid excessive fuel consumption.

Use of high-quality fuel. Using high-quality fuel with additives that improve combustion and reduce consumption reduces fuel consumption.

Driver training. Regular training of drivers on effective driving techniques, including smooth acceleration and braking, and maintaining an efficient speed at all times, can help reduce fuel consumption and improve the overall performance of the dump truck.

Conclusions. In conclusion, following the above recommendations can significantly reduce fuel consumption in dump trucks, which in turn will lead to reduced costs and increased efficiency. Regular maintenance, tire pressure monitoring, efficient loading and distribution of loads, use of quality fuel, and driver training are some of the main factors in reducing fuel consumption.

References

1. N.A.Makhutov, M.M.Gadenin (2000) Durability, resource and safety of machines and structures / Moscow: IMASH RAS, pp 528.

2. S. Hodzic, S. Masic (2005) Collection of Solved Problems from Continuous Transport in Mining, Faculty of Mining, Geology and Civil Engineering, Textbook, University of Tuzla (in Serbian).

3. Sadudin Hodzic, Suncica Masic (2008) Cyclic Transport, Faculty of Mining, Geology and Civil Engineering, Textbook, University of Tuzla (in Serbian).

4. V. Kecojević, D. Komljenović (2010) Haul Truck Fuel Consumption and CO2 Emission Under Various Engine Load Conditions, https://www.researchgate.net/publication/261214668_Haul_truck_fuel_consumption_and_CO2_emission_under_various_engine_load_conditions.

5. Ossetrova I.S., Ossipov N.A. (2013) Microsoft Excel 2010 for analysts. Saint-Petersburg: NIU ITMO; pp. 65.

6. Ali Soofastaei (2016) Efficiency of Haul Trucks in Surface Mines, PhD Project, DOI:10.13140/RG.2.2.18587.67365, https://www.researchgate.net/publication/309176186_Development_of_an_Advanced_Data_Analytics_Model_to_Improve_the_Energy_Efficiency_of_Haul_Trucks_in_Surface_Mines.

7. BELAZ-HOLDING (2017). BelAZ-7530 series mining dump trucks. BelAZ 75306 - 3902015 RE Operating Manual/ BELAZ-HOLDING - Republic of Belarus.

8. Azikhanov, S.S., Bogomolov, A.R., Dubov, G.M., & Nikhrin, S. (2019). Development of the instrumentation system for gas-and-diesel fuelled BelAZ dump truck. MATEC Web of Conferences, 297, 03001.

9. Dubov, G. M., Trukhmanov, D. S., Nokhrin, S. A., & Sergel, A. (2020). Method for installing cryogenic fuel tanks on the deck of BelAZ 7513 mining dump truck. E3S Web of Conferences, 174, 03016.

10. Dubov, G.M., Trukhmanov, D.S., & Nokhrin, S. A. (2020). The use of alternative fuel for heavy-duty dump trucks as a way to reduce the anthropogenic impact on the environment. IOP Conf. Series: Earth and Environmental Science, 459, 042059.

11. Kurganov V.M., Gryaznov M.V., Kolobanov S.V. (2020). Assessment of operational reliability of quarry excavator-dump truck complexes. *Journal of Mining Institute.*; 241:10–21. DOI: 10.31897/PMI.2020.1.10.

12. Kuznetsov I.S., Sinoviev V.V., Kuznetsova A.V. (2021). Increase of accuracy and reliability of cumulative distribution functions identification of timing data for cave-auto complex simulation. Bulletin of the Kuzbass State Technical University.; 3(145):113–119.

13. Polozov Dmitry Igorevich. (2021). Reducing fuel consumption and increasing the productivity of BelAZ dump trucks at Vostochno-Baysky Razrez LLC, Kirba village [Electronic resource]: Bachelor's thesis: 03/23/03 / D. I. Polozov. — Abakan: SFU, KHTI — branch of SFU.

14. Oleynikov A.V. (2021). Organization of freight transportation, a course of lectures, Siberian Federal University. un-t, KHTI is a branch of SibFU - Abakan. - Title page. the screen. - Text: electronic.

15. Gorina L.N., Fesina M.I. (2021). Bachelor's thesis section "Safety and environmental friendliness of a technical facility". Teaching and methodological manual (2nd ed. Supplement). Tolyatti: TSU Publishing House, pp 22.

16. J. Jamakovic, S. Masic (2021): “Fuel consumption of the BelAz dump trucks on an example of the open pit "Turija" of the brown coal mine Banovici”, Mining and Metallurgy Engineering Bor, UDC 622, ISSN 2334-8836 (Štampano izdanje) ISSN 2406-1395 (Online).

17. Makhmudov, S. A., Kayumov, U. E., & Pardayeva, Sh. S. (2022). Excavator bucket design and analysis in the ansys. Universum program: technical Sciences, (5-5 (98)), 53-58.

18. J. Jamakovic, S. Masic (2022): “Carbon dioxide emission of a BelAz dump truck on an example of the open pit 'Turija' Brown Coal Mine Banovici”, Mining and Metallurgy Engineering Bor, UDC 622, ISSN 2334-8836 (Stampano izdanje) ISSN 2406-1395 (Online).

CONTENTS

TECHNICAL SCIENCES: COTTON, TEXTILE AND LIGHT INDUSTRY

Rakhimov R., Sultonov M. Inspection of the strength of the column lattice of the improved fiber cleaner	**3**
Turdiev B., Rosulov R. The influence of technological parameters of the elevator on cotton seed damage	**10**
Khuramova Kh. Graphic analysis of the obtained results on cotton regeneration	**15**
Sharifbayev R. Optimizing feature extraction in Ai-based cocoon classification: a hybrid approach for enhanced silk quality	**20**
Akramov A., Khodzhiev M. The current state and challenges of the global textile industry: key directions for the development of Uzbekistan's textile sector	**24**

TECHNICAL SCIENCES: AGRICULTURE AND FOOD TECHNOLOGIES

Sattarov K., Jankurazov A., Tukhtamyshova G. Study of food additives on bread quality	**30**
Madaminova Z., Khamdamov A., Xudayberdiyev A. Determination of amygdalin content in peach oil obtained by pressing method	**37**
Kobilov N., Dodayev K. Food safety and industrial importance of corn starch. the impact of the hydration process on the starch content in the grain	**43**
Mustafaev O., Ravshanov S., Dzhakhangirova G., Kanoatov X. The effect of storing wheat grain in open warehouses on the "aging" process of bread products	**50**
Erkayeva N., Ahmedov A. Industrial trials of the refining technology for long-term stored sunflower oil	**58**
Boynazarova Y., Farmonov J. Microscopic investigations on the effect of temperature on onion seed cell degradation	**64**
Rasulova M., Xamdamov A. Theoretical analysis of distillators used in the distillation of vegetable oil miscella	**79**

CHEMICAL SCIENCES

Ergashev O., Bazarbaev M., Juraeva Z., Bakhronov H., Kokharov M., Mamadaliyev U. Isotherm of ammonia adsorption on zeolite CaA (MSS-622)	**84**
Ergashev O., Bakhronov H., Sobirjonova S., Kokharov M., Mamadaliyev U. Differential heat of ammonia adsorption and adsorption mechanism in Ca_4Na_4A zeolite	**93**
Boymirzaev A., Erniyazova I. Recent advances in the synthesis and characterisation of methylated chitosan derivatives	**101**
Kalbaev A., Mamataliyev N., Abdikamalova A., Ochilov A., Masharipova M. Adsorption and kinetics of methylene blue on modified laponite	**106**
Ibragimov T., Tolipov F., Talipova X. Studies of adsorption, kinetics and thermodynamics of heavy metall ions on clay adsorbents	**114**
Muratova M. Method for producing a fire retardant agent with nitric acid solutions of various concentrations	**123**
Shavkatova D. Preparation of sulphur concrete using modified sulphur and melamine	**132**
Umarov Sh., Ismailov R. Analysis of hydroxybenzene-methanal oligomers using ^{1}h nmr spectroscopy methods	**139**
Vokkosov Z. Studying the role and mechanism of microorganisms in the production of microbiological fertilizers	**148**
Mukhammadjonov M., Rakhmatkarieva F., Oydinov M. The physical-chemical analysis of KA zeolite obtained from local kaolin	**153**
Shermatov A., Sherkuziev D. Study of the decomposition process of local phosphorites using industrial waste sulfuric acid	**160**
Khudayberdiev N., Ergashev O. Study of the main characteristics of polystyrene and phenol-formaldehyde resin waste	**168**

TECHNICAL SCIENCES: MECHANICS AND MECHANICAL ENGINEERING

Kudratov Sh. UZTE16M locomotive oil system and requirements for diesel locomotive reliability and operating conditions	**174**
Dadakhanov N. Device studying the wear process of different materials	**181**
Dadakhanov N., Karimov R. Investigation of irregularity of yarn produced in an improved drawn tool	**189**
Mirzaumidov A., Azizov J., Siddiqov A. Static analysis of the spindle shaft with a split cylinder	**196**
Mirjalolzoda B., Umarov A., Akbaraliyev A., Abduvakhidov M. Static calculation of the saw blade of the saw gin	**203**
Obidov A., Mirzaumidov A., Abdurasulov A. A study of critical speed of linter shaft rotation and resonance phenomenon	**208**
Khakimov B., Abdurakhmanov O. Monitoring the effectiveness of the quality management system in manufacturing enterprises	**217**
Bayboboev N., Muminov A. Analysis of the indicators of the average speed of units for the process of loading into a potato harvesting machine	**232**
Kayumov U., Kakhkharov O., Pardaeva Sh. Analysis of factors influencing the increased consumption of diesel fuel by belaz dump trucks in a quarry	**237**
Abdurahmonov J. Theoretical study of the effect of a brushed drum shaft on the efficiency of flush separation	**244**
Ishnazarov O., Otabayev B., Kurvonboyev B. Modern methods of smooth starting of asynchronous motors: their technologies and industrial applications	**250**
Kadirov K., Toxtashev A. The influence of the cost of electricity production on the formation of tariffs	**263**
Azambayev M. An innovative approach to cleaning cotton linters	**271**
Abdullayev R. Theoretical substantiation of the pneumomechanics of the Czech gin for the separation of fiber from seeds	**277**
Siddikov I., A'zamov S. Study of power balance of small power asynchronous motor	**282**

Obidov A., Mirzaakhmedova D., Ibrohimov I. Theoretical research of a heavy pollutant cleaning device	**288**
Xudayberdiyeva D., Obidov A. Reactive power compensation and energy waste reduction during start-up of the electric motor of uxk cotton cleaning device	**294**
Jumaniyazov K., Sarbarov X. Analysis of the movement of cotton seeds under the influence of a screw conveyor	**302**
Abdusalomova N., Muradov R. Analysis of the device design for discharging heavy mixtures from the sedimentation chamber	**310**
Ikromov M., Shomurodov S., Boborajabov B., Mamayev Sh., Nigmatova D. Study of obtaining an organomineral modifier from local raw materials to improve the operational properties of bitumen	**318**
Ikromov M., Shomurodov S., Boborajabov B., Mamayev Sh., Nigmatova D. Development of composition and production technology for polymer-bitumen mixtures for automobile roads	**324**
Muradov R., Mirzaakbarov A. Effective ways to separate fibers suitable for spinning from waste material	**332**
ADVANCED PEDAGOGICAL TECHNOLOGIES IN EDUCATION	
Xoliddinov I., Begmatova M. A method of load balancing based on fuzzy logic in low-voltage networks with solar panel integration	**336**
Murodov R., Kuchqarov A., Boynazarov B., Uzbekov M. Research on the efficiency of using hydro turbines in pumping mode and for electricity generation	**345**
Abdurakhimova M., Romanov J., Masharipov Sh. A literature review of settlement land trends (past, present, and future) based on english-language articles indexed in the web of science database from 2014 to 2023	**353**
Muhammedova M. Development and scientific justification of the design of orthopedical footwear for patients with injuries to the soul-foot joint	**360**
Akbaraliyev M., Egamberdiyev A. Methods of effective organization of fire and rescue operations	**367**

A'zamxonov O., Egamberdiyev A.	
Principles of organizing material and technical support in emergency situations	**373**
Tuychibayeva G., Kukibayeva M.	
The module of developing communicative competence of seventh and eighth-grade students in uzbekistan secondary schools	**379**
Ismoilova Z.	
Methods for enhancing the competence of future english teachers	**383**
ECONOMICAL SCIENCES	
Yuldashev K., Makhamadaliev B.	
The role of small business entities in the program "From poverty to well-being"	**389**
Mirzakhalikov B.	
Organizational mechanism for the development of state programs for poverty reduction	**397**
Rustamova S.	
Specific characteristics of administration in developed countries	**402**