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

ХАБАРЛАРЫ

ИЗВЕСТИЯ

РОО «НАЦИОНАЛЬНОЙ
АКАДЕМИИ НАУК РЕСПУБЛИКИ
КАЗАХСТАН»
ЧФ «Халық»

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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. Webof 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.

ЧФ «ХАЛЫҚ»

В 2016 году для развития и улучшения качества жизни казахстанцев был создан частный Благотворительный фонд «Халык». За годы своей деятельности на реализацию благотворительных проектов в областях образования и науки, социальной защиты, культуры, здравоохранения и спорта, Фонд выделил более 45 миллиардов тенге.

Особое внимание Благотворительный фонд «Халык» уделяет образовательным программам, считая это направление одним из ключевых в своей деятельности. Оказывая поддержку отечественному образованию, Фонд вносит свой посильный вклад в развитие качественного образования в Казахстане. Тем самым способствуя росту числа людей, способных менять жизнь в стране к лучшему – профессионалов в различных сферах, потенциальных лидеров и «великих умов». Одной из значимых инициатив фонда «Халык» в образовательной сфере стал проект Ozgeris powered by Halyk Fund – первый в стране бизнес-инкубатор для учащихся 9-11 классов, который помогает развивать необходимые в современном мире предпринимательские навыки. Так, на содействие малому бизнесу школьников было выделено более 200 грантов. Для поддержки талантливых и мотивированных детей Фонд неоднократно выделял гранты на обучение в Международной школе «Мирас» и в Astana IT University, а также помог казахстанским школьникам принять участие в престижном конкурсе «USTEM Robotics» в США. Авторские работы в рамках проекта «Тәлімгер», которому Фонд оказал поддержку, легли в основу учебной программы, учебников и учебно-методических книг по предмету «Основы предпринимательства и бизнеса», преподаваемого в 10-11 классах казахстанских школ и колледжей.

Помимо помощи школьникам, учащимся колледжей и студентам Фонд считает важным внести свой вклад в повышение квалификации педагогов, совершенствование их знаний и навыков, поскольку именно они являются проводниками знаний будущих поколений казахстанцев. При поддержке Фонда «Халык» в южной столице был организован ежегодный городской конкурс педагогов «Almaty Digital Ustaz.

Важной инициативой стал реализуемый проект по обучению основам финансовой грамотности преподавателей из восьми областей Казахстана, что должно оказать существенное влияние на воспитание финансовой грамотности и предпринимательского мышления у нового поколения граждан страны.

Необходимую помощь Фонд «Халык» оказывает и тем, кто особенно остро в ней нуждается. В рамках социальной защиты населения активно проводится

работа по поддержке детей, оставшихся без родителей, детей и взрослых из социально уязвимых слоев населения, людей с ограниченными возможностями, а также обеспечению нуждающихся социальным жильем, строительству социально важных объектов, таких как детские сады, детские площадки и физкультурно-оздоровительные комплексы.

В копилку добрых дел Фонда «Халык» можно добавить оказание помощи детскому спорту, куда относится поддержка в развитии детского футбола и карате в нашей стране. Жизненно важную помощь Благотворительный фонд «Халык» оказал нашим соотечественникам во время недавней пандемии COVID-19. Тогда, в разгар тяжелой борьбы с коронавирусной инфекцией Фонд выделил свыше 11 миллиардов тенге на приобретение необходимого медицинского оборудования и дорогостоящих медицинских препаратов, автомобилей скорой медицинской помощи и средств защиты, адресную материальную помощь социально уязвимым слоям населения и денежные выплаты медицинским работникам.

В 2023 году наряду с другими проектами, нацеленными на повышение благосостояния казахстанских граждан Фонд решил уделить особое внимание науке, поскольку она является частью общественной культуры, а уровень ее развития определяет уровень развития государства.

Поддержка Фондом выпуска журналов Национальной Академии наук Республики Казахстан, которые входят в международные фонды Scopus и Wos и в которых публикуются статьи отечественных ученых, докторантов и магистрантов, а также научных сотрудников высших учебных заведений и научно-исследовательских институтов нашей страны является не менее значимым вкладом Фонда в развитие казахстанского общества.

С уважением,
Благотворительный Фонд «Халык»!

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THE MECHANISM OF ACTION OF LUBRICATING AND COOLING TECHNOLOGICAL MEANS ON METAL REMOVAL DURING MAGNETIC ABRASIVE PROCESSING OF PARTS

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Abstract. Mining, oil and gas, exploration and other industries occupy a strategic place in the development of the economy of the Republic of Kazakhstan. Ensuring the smooth operation of these industries primarily depends on the quality of manufacturing and restoration of parts and components of technological equipment. Technological machines and equipment produced for the above-mentioned industries are characterized by high metal consumption and high labor intensity of their manufacture. The high quality of manufacturing and restoration of parts of these machines and equipment is largely determined by the finishing technology aimed at obtaining shaping, accuracy and the required quality indicators of the working surfaces of the parts. The most common of the finishing methods is magnetic abrasive treatment. A feature of this method is oriented abrasive cutting. The article examines the mechanism of influence of the composition and structure of technological means of lubrication and cooling (LCTM) on the process of magnetic abrasive treatment (MAT), in particular on the nature of metal removal from the machined parts. The mechanism of the adsorption-jamming action of polar molecules and the effect of the LCTM composition on the intensity of metal removal and,

accordingly, on the surface quality of the processed products have been studied. The results of the effect of LCTM dispersion on the efficiency of metal removal and roughness during magnetic abrasive treatment (MAP) were obtained, and a new composition of LCTM was proposed.

Keywords: magnetic abrasive treatment, lubricating and cooling technological means, surfactants, adsorbed layer, metal dispersion, microcracks, deformations

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БӨЛШЕКТЕРДІ МАГНИТТІК АБРАЗИВТІ ӨҢДЕУ КЕЗІНДЕ МЕТАЛДЫ КЕТІРУГЕ МАЙЛАУ ЖӘНЕ САЛҚЫНДАТУ ТЕХНОЛОГИЯЛЫҚ ҚҰРАЛДАРЫНЫҢ ӘСЕР ЕТУ МЕХАНИЗМІ

Аннотация. ҚР экономикасын дамытуда стратегиялық орынды тау-кен, мұнай-газ, геологиялық барлау және басқа да салалар алады. Бұл салалардың үздіксіз жұмыс істеуін қамтамасыз ету, ең алдымен, технологиялық жабдықтың бөлшектері мен тораптарын дайындау және қалпына келтіру сапасына байланысты. Жоғарыда аталған салалар үшін өндірілген технологиялық машиналар мен жабдықтар үлкен металл сыйымдылығымен және оларды өндірудің жоғары еңбек сыйымдылығымен сипатталады. Осы машиналар мен жабдықтардың бөлшектерін өндіру мен қалпына келтірудің жоғары сапасы көбінесе бөлшектердің жұмыс беттерінің қалыптасуын, дәлдігін және қажетті сапа көрсеткіштерін алуға бағытталған әрлеу технологиясымен анықталады. Мақалада майлау және салқындату технологиялық құралдарының (LCTM) құрамы мен құрылымының магнитті-абразивті өңдеу (МАТ) процесіне, атап айтқанда, өңделетін бөлшектерден металды алу сипатына әсер ету механизмі қарастырылады. Полярлы молекулалардың адсорбциялық-кептелу әсерінің механизмі және LCTM құрамының металды кетіру қарқындылығына және тиісінше өңделетін бұйымдардың бетінің сапасына әсері зерттелді. LCTM дисперсиясының металды кетіру тиімділігіне және магнитті-абразивті өңдеу (МАР) кедір-бұдырлығына әсер ету нәтижелері алынды және жаңа LCTM құрамы ұсынылды.

Түйін сөздер: магнитті абразивті өңдеу, майлау және салқындату технологиялық құралдары, беттік-белсенді заттар, адсорбцияланған қабат, металл дисперсиясы, микрожарықтар, деформациялар

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МЕХАНИЗМ ДЕЙСТВИЯ ТЕХНОЛОГИЧЕСКИХ СРЕДСТВ СМАЗКИ И ОХЛАЖДЕНИЯ НА СЪЕМ МЕТАЛЛА ПРИ МАГНИТНО-АБРАЗИВНОЙ ОБРАБОТКЕ ДЕТАЛЕЙ

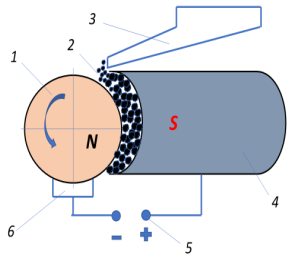
Аннотация. Стратегическое место в развитии экономики РК занимают горная, нефтегазовая, геологоразведочная и другие отрасли. Обеспечение бесперебойной работы этих отраслей в первую очередь зависит от качества изготовления и восстановления деталей и узлов технологического оборудования. Технологические машины и оборудование, производимые для вышеуказанных отраслей промышленности, характеризуются большой металлоемкостью и высокой трудоемкостью их изготовления. Высокое качество изготовления и восстановления деталей данных машин и оборудования во многом определяется технологией финишной обработки, направленной на получение формообразования, точности и требуемых показателей качества рабочих поверхностей деталей. Наиболее распространенным из финишных методов является магнитно-абразивная обработка. Особенностью этого способа является ориентированное абразивное резание. В статье рассматривается механизм влияния состава и структуры технологических средств смазки и охлаждения (LCTM) на процесс магнитно-абразивной обработки (MAT), в частности на характер снятия металла с обрабатываемых деталей. Изучен механизм адсорбционно-заклинивающего действия полярных молекул и влияние состава LCTM на интенсивность удаления металла и, соответственно, на качество поверхности обрабатываемых изделий. Были получены результаты влияния дисперсии LCTM на эффективность удаления металла и шероховатость при магнитно-абразивной обработке (MAP) и предложен новый состав LCTM.

Ключевые слова: магнитно-абразивная обработка, технологические средства смазки и охлаждения, поверхностно-активные вещества, адсорбированный слой, дисперсия металлов, микротрещины, деформации

Introduction

The study of the influence of LCTM on the process of magnetic abrasive machining of parts is carried out to improve the quality of the surface of products and control this process. Such a study is relevant due to the requirements imposed on the quality of processed products and to ensure the specified characteristics of micro and macrogeometry of the surface layer of these products (Kassenov, 2022: 6; Toshov, 2023: 13). An analysis of research in the finishing field shows that one of the promising methods of finishing with an elastic (flexible) tool is magnetic abrasive treatment (MAT). When processing in a magnetic field, the orientation of abrasive grains with the sharpest edge to the surface to be processed is carried out using the energy of the magnetic field (Akulovich et al., 2022: 5). The low temperature in the cutting

zone contributes to forming a new surface quality and structure of the surface layer compared with traditional methods of abrasive processing (Akulovich et al., 2022: 360). The schematic diagram of MAP is shown in Figure 1.



1 – workpiece of the part; 2 – ferromagnetic powder; 3 – hopper dispenser; 4 – pole tip of the magnet; 5 – process current source; 6 – sliding contact

Fig. 1. Schematic diagram of the MAP surfaces of parts of the type of bodies of rotation

It is established that the required finishing properties are provided by choosing an effective type of LCTM in composition, aggregate state, and mechanism of action (Dudak, 2019: 12). Despite the large number of developed LCTMs differing in composition, structure, and action features, the task of predicting their use for MAP has not been solved in many ways yet (Kadyrov, 2021: 9).

Currently, the recommendations for selecting LCTM are more empirical in nature, based on the specific results of mechanical processing. It should be noted that, depending on the processing conditions, the LCTM should perform lubricating, cooling, washing, or dispersing actions (Akulovich et al., 2022: 360). Therefore, the study of the influence of LCTM on the MAT process in interaction with the working environment remains relevant and makes it possible to identify some patterns of the interaction of ferro-abrasive powder and LCTM (Markov et al., 2011: 201).

The most common among LCTM are surfactant-based products (Akulovich et al., 2021: 200).

Their characteristic feature is the mismatch of the centers of gravity of positive and negative charges in molecules, even in an isolated state (Sakulevich et al., 1981: 210).

Studies show that surface-active molecules contained in LCTM are adsorbed by layers on contacting metal surfaces and can move from an area where there is excess to places where they are not enough to cover the surface completely. The surface layer of the metal has a high activity because any solid has a microscopic heterogeneity of physical and mechanical characteristics caused by the anisotropy of metal crystals (Chichinadze, 2003: 575; Škamat et al., 2021: 6).

Considering that the surface energy is proportional to the interface of the phases and especially increases with the dispersion of materials, it can be argued that the movement of the adsorbed layer is primarily determined by the temperature of the working zone (Sherov, 2019: 6).

Materials and methods

The theoretical prerequisites for explaining the mechanism of action of LCTM,

contributing to the intensification of the metal cutting process, are based on the works of P.A. Rebinder (Rebinder et al., 1972: 3), explaining the effect of adsorption reduction of the strength of metals in the presence of surfactants. Figure 2 shows the adsorption-wedging effect of polar molecules.

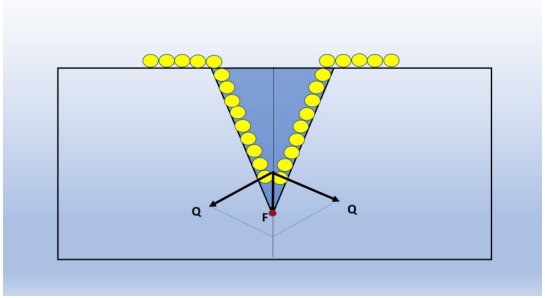


Fig. 2. Scheme of adsorption-wedging action of polar molecules

Here, F - is the pressure of the adsorbed layer; Q - is the wedging forces.

Tensile stresses (residual or from an external load) reveal microcracks and contribute to the manifestation of the Rebinder effect.

According to (Rebinder et al., 1972: 3), surface defects are microscopic and submicroscopic cracks of wedge-shaped cross-sections. The free surface energy increases from 0 to the maximum normal value on the body's surface.

The effect of the adsorption action of surfactants significantly depends on the type of machining and reaches its greatest value at the minimum depth of the cut layer (Khudobin et al., 2006: 544). These effects are significant in magnetic abrasive processing, which provides fine metal dispersion and free access of the LCTM to the micro-cutting zone. It has been established that the MAT of non-ferrous metals, such as bronze BrAF9-4 GOST 18175–72, from which, for example, parts of food industry equipment – dough divider heads – are made, causes a phenomenon of so-called structural adaptability (SA) (Abramzon et al., 1984: 392).

Thus, due to the occurrence of the SA phenomenon, it is essential to solve the problem of increasing the washing effect of the LSTM, which consists in increasing the intensity of washing out of the processing zone of metal dispersion products and worn-out particles of ferro-abrasive powder (FAP). The determination of washing capacity is determined according to (Akulovich et al., 2017: 312) by the maximum value of the relationship between its surface activity and surface strength in the form of the average colloidality of the substance ($M_K\beta_K$):

$$M_1\beta_1 < M_K\beta_K < M_2\beta_2 \quad (1)$$

where M_K - is the colloidality of the substance, β_K - is the content of the colloidal dispersed part.

Such a theoretical approach makes it possible to explain the choice in determining the composition of LCTM, which is expedient for MAP, and to determine the influence of the composition and structure of LCTM on the intensity of metal removal experimentally.

Traditionally, surfactants solutions are used as LCTM agents, with a high level of detergent and lubricating properties that provide the necessary quality indicators of processing. In previous studies, this problem was proposed to be solved by creating a productive binary

system – surfactant + water – or by introducing appropriate additives to form of a more complex system.

Results and discussion

The present study also examines the influence of LCTM composition on the MAT process and obtains comparative values of the selected types of LCTM. Manufactured synthetic and semi-synthetic LCTM can significantly reduce the consumption of petroleum products. In addition, they fully meet modern production requirements and represent an equivalent replacement for emulsions widely used in various branches of mechanical engineering (Shkolnikov, 1989: 432). Synthetic and semi-synthetic LCTM advantages include higher cooling capacity and fire safety, lower toxicity, and low cost. Since the operating temperature in the processing zone at MAP with the observance of optimal parameters does not exceed 50–70 °C (Akulovich et al., 2021: 200), there is no need for intensive heat removal for these LCTM, and the main characteristics are cutting and washing properties (Naumov et al., 2020: 7).

The modes of the MAT process are adopted as follows: the rotation speed of the part V_r = 2.5 m/s, the oscillation speed V_o = 0.12 m/s, the magnitude of the magnetic induction B = 1 T, the amplitude of the oscillation A = 2 mm, the magnitude of the working gap δ = 1 mm with its concentricity, processing time t = 60 s. As samples, bushings D × d × l = 36 × 30 × 32 mm are presented, the material is steel ShCr15 (Sh - bearing steel with 1.5 % chromium (Cr) content, AISI 52100, G52986) GOST 801–78, 58–62 HRC and aluminum alloy D16 GOST 21488–76. The initial roughness of their surface averaged R_{a1} = 1.2 microns. As a ferro-abrasive powder Fe15TiC TI 6-09-03-483-81 was used, the grain size of which Δ = 0.2 ... 0.315 mm. The samples were washed in kerosene before processing and dried with compressed air to reduce the amount of trace impurities on their surface. The results of the studies are presented in Table 1.

Table 1 - Productivity and quality of materials processing after using the types of LCTM

Types of LCTM	Processed material			
	ShCr15 (bearing steel with 1.5 % chromium content)		D16	
	ΔG mg/cm²·min	Ra_2, mc	ΔG mg/cm²·min	Ra_2, mc
SynMA-1	7,36	0,05	4,59	0,11
SynMA-2	6,39	0,06	4,87	0,13
SynHO-2M	10,35	0,04	7,57	0,12

Figure 3 shows the samples before and after treatment by the MAP method using the LCTM SynHO-2M. The washing properties of SynMA-1, SynMA-2, and SynHO-2M were determined visually.

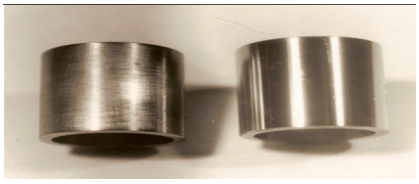


Fig. 3. Details before (on the left) and after (on the right) processing by the MAP method using LCTM SynHO-2M

According to the data presented, the indicators of specific mass removal when using SynHO-2M are 1.2...1.4 times higher than the indicators of the fundamental compositions, and the achieved roughness is within the same limits as when using LCTM SynMA-1 and SynMA-2. As mentioned above, the dispersion of the material directly depends on the reduction of the surface tension of multicomponent systems of the LCTM type, which is reflected by the following equation (Akulovich, et al., 2017:312):

$$= \quad + \quad , \tag{3}$$

where σ_0 - is the surface tension index at 0 °C, mN/m^2;

t - is the temperature of the working area, °C;

dσ/dt is the temperature coefficient of surface tension, mN / (m^2·deg).

The physic-mechanical properties of the various compositions of LCTM are presented in Table 2.

Table 2 – Physical and mechanical properties of various compositions of LCTM

Indicator	Composition of LCTM			
	1	2	3	SynMA-1
Kinematic viscosity at 50°C, mm^2/s	38,7	41,0	42,7	40,5
pH - 3%solution	8,2-8,6	8,0-8,5	8,5-8,7	8,5-8,7
Penchant for foaming, cm^3, no more than	450	500	450	500
Foaming resistance, cm^2, no more than	120	150	130	150
Density, kg/m^3	1,0	1,1	1,05	1,1

The productivity of the process was estimated by the value of the specific mass removal, mg/cm^2·min. The composition of SynMA-1 TI 38.5901176–91, 3 % aqueous solution is presented as a base. The test results are presented in Table 3.

Table 3 – Test results

Types of LCTM	The value of the specific mass removal of processed materials, mg/cm^2 min		
	ShCr-15(bearing steel with 1.5 % chromium content)	D16	Steel 20
SynMA-1	10,31	6,25	12,35
Composition 1	6,12	4,78	8,07
Composition 2	10,55	7,39	11,74
Composition 3	7,44	5,31	7,98

Figure 4 shows the results of studies of the MAP process depending on the duration of treatment at a flow rate of 60 ml/min and 100 ml/min. An analysis of the results shows that an increase in the consumption of LCTM by an average of 1.5 times does not significantly increase the productivity of specific material removal for steel ShCr15. In contrast, for duralumin D16 and especially for steel 20, this increase provides an increase in the above-mentioned material removal by an average of 20 % and 30 %, respectively.

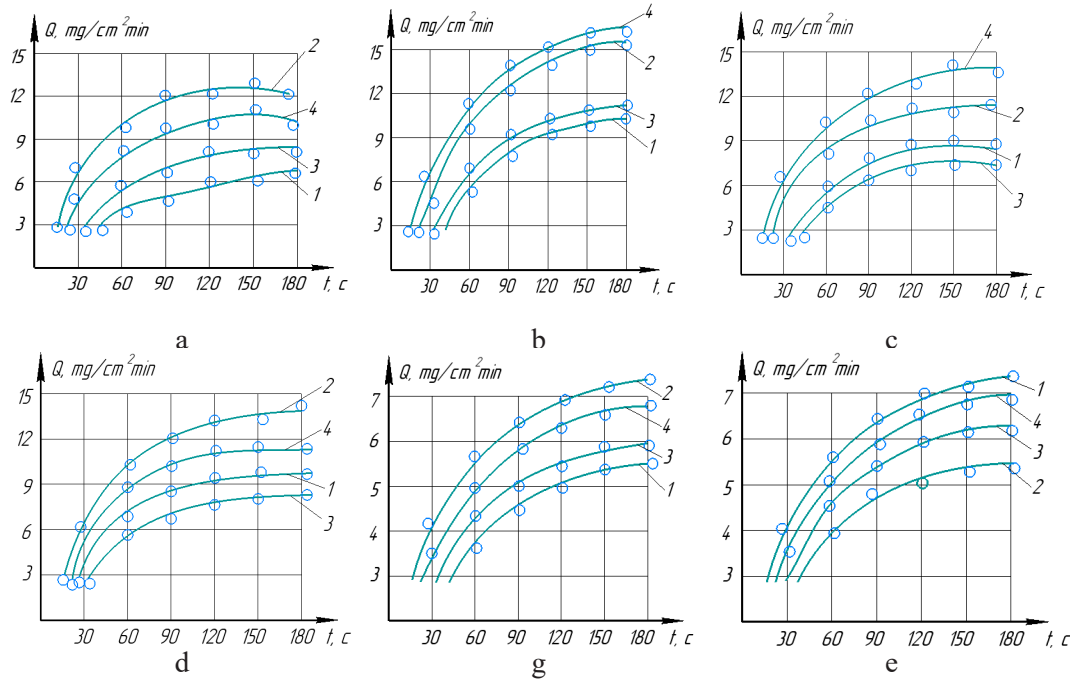


Fig. 4. Dependence of the productivity of the MAT process on the processing time for various consumption indicators of LCTM (1 – composition 1; 2 – composition 2; 3 – composition 3; 4 – SynMA – 1): for steel ShCr15(a, b); for steel 20 (c, d); for duralumin D16 (g, e); a, c, d – 60 ml/min, b, g, e – 100 ml/min

Conclusions

As a result of the conducted research:

1. It can be unequivocally stated that the mechanism of action of the composition of LCTM in MAT is more effective with the transition from coarse-dispersed emulsion-type systems to highly dispersed semi-colloidal ones, the particle size of the dispersed phase of which is 10–4 – 10–6 mm. This is due to both intensive filtrations of viscous components of emulsions by the working medium and magnetic-electric phenomena that contribute to the stratification of complex coarse-dispersed systems.

2. A new composition of LCTM is proposed for the finishing of machine parts made of steels: 20 and ShCr15, and duralumin D16. It is based on triethanolamine esters of the C7-C9 fraction and technical lignosulfonates. It is characterized by the availability of raw materials, simplicity of the manufacturing process, and use efficiency.

3. The roughness of the samples according to the parameter Ra after MAP, on average, for the composition of LCTM 2 and SynMA-1 is: for steel ShCr15: 0.05–0.1 and 0.07–0.09 microns; for steel 20: 0.2–0.3 and 0.1–0.2 microns.

REFERENCES

Akulovich L.M., Miranovich A.V., Voroshukho O.N. (2022). Hardening and finishing abrasive treatment of agricultural machinery parts in a magnetic field. — Minsk: BGATU, 2022. — 360 p. (in Russ).

Akulovich L.M., Romanyuk N.N., Mendalieva S.I. (2021). Finishing magnetic abrasive processing of agricultural machinery parts. — Nursultan: KATU named after S. Seifullin, 2021. — 200p. (in Russ).

Akulovich L.M., Senchurov E.V., Dubnovitsky S.K. (2017). A lubricating and cooling technological agent based on oxyethylated alkylphenols for finishing abrasive treatment of aluminum alloys in a magnetic field / Modern problems of production and repair in industry and transport: Materials of the 17th International Scientific and Technical Seminar, February 20–24, 2017, Svalyava. — Kiev: ATM of Ukraine, 2017. — 312 p. (in Russ)

Akulovich L.M., Sergeev L.E., Mendaliyeva S.I., Sherov K.T. (2022). Features of Magnetic Field Modeling for Magnetic-Abrasive Treatment of Complex-Profile Surfaces. Material and Mechanical Engineering Technology. — Vol. 40. — Pp. 37–42. 2022. —https://doi.org/10.52209/2706-977X_2022_4_37 (in Eng)

Dudak N., Itybayeva G., Kasenov A., Mussina Zh., Taskarina A., Abishev K. (2019). Multi-ute drill-broach for precision machining of holes / Scientia Iranica, Transactions B: Mechanical Engineering 26. — Pp. 1415–1426. — DOI: https://doi.org/10.24200/sci.2018.5623.1379 (in Eng.).

Friction, wear and lubrication (tribology and tribotechnics) / ed. A.V. Chichinadze. — M.: Mechanical engineering, 2003, 575p.

A.V. Chichinadze (1989). Fuels, lubricants, technical liquids. Range and application: Reference edition / Edited by V. M. Shkolnikov. — M., 1989. — 432 p.

KassenovA.Zh., Abishev K.K., Absadykov B.N., Yessaulkov V.S., Bolatova A.B. (2022). News of the National Academy of Sciences of the Republic of Kazakhstan. Series of geology and technical sciences. — Volume 1. — Number 451. — Pp. 63–68. — https://doi.org/10.32014/2022.2518-170X.141 (in Eng)

Kadyrov A., Zhunusbekova Zh., Ganyukov A., Kadyrova I., Kukesheva A. (2021). General Characteristics for Loading the Working Elements of Drilling and Milling Machines when Moving in the Clay Solution // Communications — Scientific Letters of the University of Zilina. — Vol. 23. — №. 2. — Pp. 97–105. — DOI: https://doi.org/10.26552/com. (in Eng.).

Khudobin L.V., Babichev A.P., Bulyzhev E.M. (2006). Lubricating and cooling technological means and their application in cutting processing: Handbook. — M. Mechanical engineering, 2006. — 544 p.

Markov V.V., Kiseleva E.V. (2011). Lubricating and cooling technological means for metal cutting. — Ivanovo. — ISEU. — 2011. — 201 p.

Naumov A.G., Novikov V.V., Naumova O.A., Shvetsov I.V. (2020). Influence of technological means of lubrication and cooling of micro- and nanodots (LCTM) on the process of blade cutting of materials. — IOP Conf. Series: Materials Science and Engineering 939 (2020). — 012052. Publisher IOP. — doi:10.1088/1757-899X/939/1/ 012052. — Veliky Novgorod. (Russ.).

Rebinder P.A., Shchukin E.D. (1972). Surface phenomena in solids in the processes of their deformation and destruction, “Successes of Physical Sciences”, 1972. — Vol. 108, — V. 1. — P. 3.

Sakulevich F.Yu., Skvorchevsky N.Ya. (1981). The role of lubricating and cooling liquids in magnetic abrasive treatment. — Mn., 1981. — 210 p.

Soshko A.I., Soshko V.O., Siminchenko I.P. (2019). The effect of lubricating and cooling process media on the destruction of metal during cutting. High technologies in mechanical engineering. Journal of Mechanical Engineering, 2019. — Volume 22. — No. 3. — Pp. 57–62. Surfactants: Guide / Edited by A.A. Abramzon and E.D. Shchukin. — L.: Chemistry, 1984. — 392 p.

Surfactants and compositions: Handbook / Ed. PletnevaM.Yu. - M.: LLC “Firm Klavel” 2002. – 768p.

Sherov K.T., Zharkevich O.M., Karsakova N.Zh., Okimbayeva A.E., Imasheva K.I. (2019). Control of Functionally Connected Surfaces of the Basic Details of Metal-Cutting Machines. Material and Mechanical Engineering Technology, 2019, 2(2). — Pp. 20–25. DOI https://doi.org/10.52209/2706-977x_2022_2_20

Škamat J., Černašėjus O., Zhetessova G., Nikonova T., Zharkevich O., Višniakov N. (2021). Effect of laser processing parameters on microstructure, hardness and tribology of nicrcofecbsi/wc coatings//Materials, 2021. — 14(20). — 6034. — DOI: 10.3390/ma14206034

Toshov J.B., Malikov Sh.R., Ergashev O.S., Sherov A.K., Esirkepov A. (2023). Improving the efficiency of the process of drilling wells in complex conditions at geological prospecting sites // NEWS of the National Academy of Sciences of the Republic of Kazakhstan “Series of geology and technical sciences”. — Almaty. — Volume 3. — Number 459. — Pp. 282–294. https://doi.org/10.32014/2023.2518-170X.313

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