SCIENTIFIC RESEARCH OF THE SCO COUNTRIES: SYNERGY AND INTEGRATION

上合组织国家的科学研究：协同和一体化

Materials of the International Conference

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上合组织国家的科学研究：协同和一体化
国际会议

参与者的英文报告

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Part 1: Participants’ reports in English

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这些会议文集结合了会议的材料 – 研究论文和科学工作者的论文报告。 它考察了职业化人格的技术和社会学问题。一些文章涉及人格职业化研究问题的理论和方法论方法和原则。
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These Conference Proceedings combine materials of the conference – research papers and thesis reports of scientific workers. They examines tecnical and sociological issues of research issues. Some articles deal with theoretical and methodological approaches and principles of research questions of personality professionalization.

Authors are responsible for the accuracy of cited publications, facts, figures, quotations, statistics, proper names and other information.

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CONTENT

PHYSICS AND MATHEMATICS

Foreword

We thank all participants of our conference "Scientific research of the SCO countries: synergy and integration" for the interest shown, for your speeches and reports. Such a wide range of participants, representing all the countries that are members of the Shanghai Cooperation Organization, speaks about the necessity and importance of this event. The reports of the participants cover a wide range of topical scientific problems and our joint interaction will contribute to the further development of both theoretical and applied modern scientific research by scientists from different countries. The result of the conference was the participation of 49 authors from 7 countries (China, Russia, Uzbekistan, Kazakhstan, Azerbaijan, Tajikistan, Kyrgyzstan).

This conference was a result of the serious interest of the world academic community, the state authorities of China and the Chinese Communist Party to preserve and strengthen international cooperation in the field of science. We also thank our Russian partner Infinity Publishing House for assistance in organizing the conference, preparing and publishing the conference proceedings in Chinese Part and English Part.

I hope that the collection of this conference will be useful to a wide range of readers. It will help to consider issues, that would interest the public, under a new point of view. It will also allow to find contacts among scientists of common interests.

Fan Fukuan,
Chairman of the organizing committee of the conference
"Scientific research of the SCO countries: synergy and integration"
Full Professor, Doctor of Economic Sciences

前言

我们感谢所有参加本次会议的“上海合作组织国家的科学研究：协同作用和整合”，感谢您的演讲和报告。代表所有上海合作组织成员国的广泛参与者都谈到此次活动的必要性和重要性。参与者的报告涵盖了广泛的主题性科学问题，我们的联合互动将有助于不同国家的科学家进一步发展理论和应用的现代科学研究。会议结果是来自7个国家（中国，俄罗斯，乌兹别克斯坦，哈萨克斯坦，阿塞拜疆，塔吉克斯坦，吉尔吉斯斯坦）的83位作者的参与。

这次会议的召开，是学术界，中国国家权力机关和中国共产党对维护和加强科学领域国际合作的高度重视的结果。我们还要感谢我们的俄罗斯合作伙伴无限出版社协助组织会议，准备和发布中英文会议文集。

我希望会议的收集对广大读者有用，将有助于在新的观点下为读者提供有趣的问题，并且还将允许在共同利益的科学家中寻找联系。

范福宽，
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没有比例感作为道德意识的破坏（关于Ob Ugrians和Samoyeds的材料）

THE ABSENCE OF SENSE OF PROPORTION AS THE DESTRUCTION OF MORAL CONSCIOUSNESS (ON THE MATERIALS OF THE OB UGRIANS AND SAMOYEDS)

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注解。 道德意识的结构要素是道德规范 - 一种衡量人类行为的可允许和强制性变体的方法，在此基础上对个人的活动和关系进行管理，从善恶的立场出发。 B. H. Bgazhnokov区分了五个反映人类道德经验中最积极的道德原则，它是：人性，尊重，智慧，勇气，荣誉。 它们是道德理性思考和行为的模型，任何不正常的行为似乎都是不合理的，扰乱了社会实践的平衡。 文章侧重于道德原则的对立，因为缺乏行动，表现为缺乏谨慎。

关键词：汉特，曼西，涅涅茨，行为规范，不道德行为，醉酒，骄傲，粗鲁，失禁，健谈，吹嘘，贪婪。

Annotation. *The structural element of moral consciousness is the moral norm – a kind of measure of permissible and obligatory variants of human behavior, on the basis of which the regulation of activities and relations of individuals from the position of good and evil. B. H. Bgazhnokov distinguishes five moral principles that reflect the most positive that has developed in the moral experience of mankind, it is: humanity, respect, intelligence, courage, honor. They are models of moral reasoned thinking and behavior, and any deviant behavior seems unreasonable, disturbing the balance of social practices. The article focuses on such the antithesis of moral principles, as the lack of action, manifested as a lack of prudence.*

Keywords: *Khanty, Mansi, Nenets, behavioral norm, immoral behavior, drunkenness, pride, rudeness, incontinence, talkativeness, boasting, greed.*

The concept of reasonableness refers to the sense of proportion as the correct assessment of a particular situation and the definition of one's capabilities. As B.H. Bgazhnokov rightly remarked "unreasonable is considered as excess of this or that quality, and its lack" [1, 33]. A striking example of deviant behavior associated with the lack of measures is drunkenness. It is truly known that the so-

called "Northern alcoholism" has no aboriginal roots. Gr. Novitsky wrote that in the early XVII century "water is the only drink of Ostyaks" and S. G. Patkanov dated the "acquaintance" of Ostyaks with vodka to the XVIII century Earlier, the folk tales and fairy tales prove, that the Ostyaks had known the drink of corn called "Ostyak Braga" and also "honey water" [9, 66-67]. I. I. Zavalishin, describing the life of voguls in the late XIX century., wrote about their addiction to wine: "This is a common vice for all of the Northern savages... in addition, the voguls also like bread wine, and the are completely powerless over it" [4, 253]. In former times, the Nenets were not familiar with this pernicious habit. F. A. Gizatullina gives details of the informants that previously, "a bottle of vodka was exchanged to 1-2 deers" [2, 46], i.e. the alcohol is not consumed in large quantities. Alcohol dependence of Khanty and Nenets was a big problem everywhere. Practically each family had an alcohol addict. In some cases,people feel sorry for them (*вотлпысытл атым* 'one lives poorly', 'unlucky ont',*ыотлпыс* 'handwriting of his life is bad', *коти* 'one who has nothing, a poor'), others feel irritation, rejection, neglect. A person in a state of intoxication, as a rule, actively demonstrates forms of etiquette ignorance: behaves aggressively *хора йӣмі* (букв.:(lit.: to become a male, a bull) [10, 291], *лык эсалты* ("releases evil") [7, 280].

Etiquette norm of communication in traditional society is respect. The antithesis of respect is considered to be pride, brutality and lack of restraint in relation to people. An overly proud person is arrogant, supercilious, selfish. He is vile to others, confident in his superiority over other people. There is such a person in front of you, "proudly throwing his head, tapping him in his chest, selflessly cracks: "I'm the strongest, not like you...", "I'm rich, I have everything", "It's hard to find such a craftsmen like I am." Arrogant people consider themselves as "chosen", "special", consider themselves to be people with power and wealth. The Nenets say about the conceited man: "one wants to go up" (that means "one wants to bring himself over the other", "stands like an idol").

The state of incontinence, irritability, rage is often accompanied by quarrel, abuse. As a result of these emotional behaviors, people may break up and no longer communicate. In the khanty language, the word "quarrel" literally means "to form a gap between two people." A quarrel in the traditional culture of the Khanty means a line (*вӯр*), an edge, a limit, expressing the idea of the maximal condition.

The concept of "to quarrel" (*вӯрая хойты*) literally means "to hit the line, to touch", and is usually accompanied by shouting and insulting words for which there may come a cruel punishment. These include the so-called "saber words". They are extremely displeasing to God, and that one who pronunce them "is punished by the saber, i.e. killed" [6, 285]. In Khanty language there is the concept of *лакатты* expressing insult with "notes of mockery". The Nenets believe that God punishes people for the mockery (*Нум нянмы* 'God punished, deprived').

Quarrel is often combined with a fight (letters.: face together). In Mansi language the verb *алхатуӈкве* 'to fight' is formed from *алунгкве* 'to kill'. The highest degree of aggressiveness is expressed by the word *хорахщи*, which accommodates concepts such as vandal, a thug, a terrorist, a destroyer, an enemy, a marauder and is sharply condemned by the society. It is not an accident that the fight was widely condemned by the Khanty, Mansi and Nenets. Even if the child who as a joke raised a hand at any of the older, as the punishment, the bully's hands will shake and he will never become a successful hunter [5, 8].

Intemperate man, allowing himself to grimace, squirm (*шохрємәты*, hant.), to change posture, to gesticulate actively , making sounds, it shows the lack of action. Such interlocutor is characterized as "one who does not worth the attention or senses" (*нэмтэг хой*) [7, 280]. Khanty compare an unrestrained human with the bull or reindeer that behaves aggressively. Irritable behavior is unequivocally condemned in traditional culture, as it borders on the manifestation of aggression.

Excessive is everything that violates the ethical norms of the talking, bragging, conceit. If the interviewee oversteps the bounds of conversation (*нямпатла* 'friendly'), forest Nenets say about him the following: "mouth (his) like fire" (*нянтащи тутлха*), and Priuralsky Khanty emphasize that he wants them "conversation feed" (*потарна лапаты*), meaning "to speak out of turn". To the violation of a sense of proportion are bragging and arrogance, which is manifested in excessive praise of their merits, success and other qualities. Boasting is regarded as the greatest Vice, since it entails the emergence of a sense of envy, which threatens the destruction of the human soul and, as a consequence, makes it useless to society.

A boastful person specifically praises, exaggerates any of his qualities in order to stand out among other people, to get their approval. About bouncer talking in vain, Khanty say: "The hole of his mouth the Ob river crosses without a paddle-boat " [9, 170]. Boastful people cause dislike of others and become a common object for stable phraseological units: "At the conceited person you will not get a nose chorea" [4, 64]. A person who has a tendency to greatly exaggerate, forest Nenets will give a derogatory nickname "Seven fathoms" (*Ще"эв чимя*) [12, 246]. (literaly: face together). Bragging, despite the fact that openly in traditional culture is not condemned, however, is considered a negative quality of man for two reasons: 1) it can bring on itself envy, and means – threatens with destruction of soul; 2) can put an obstacle on the way to self-development, self-assertion and thus to make the person useless for society.

A man devoid of action, according to the Nenets, only thinks about himself – "(your) side" (*нянымта патиля*). In the division of production, fish or anything else in their direction will certainly put more [13, 235-236].

In the Khanty language of the Kazym dialect for the abstract concept of "greed" there are several options: *сякар* (literally.: greedy for money or things) or *нелянг* (literally.: greedy for food). Khanty characterize a greedy, avaricious person in the following expressions: "one will not give a piece even of a nail size" (*кускар ловат атл ант мал*, khanty); "a mouse lode" (*ай вой тлон хурыйэ*, khant.) [11, 12]. Z. S. Ryabchikova, following V. Shteinits, makes an idiomatic expression describing a greedy person among Kazym Khanty: *śăr-kŭš* "greedy" (liter.: bare nails) – "nothing but nails, hand, offers nothing, the guest leaves man empty-handed, empty-handed" [9, 182]. Greedy man (*малу* 'greedy', *тиши* 'avaricious', forest nenets.), according to the Nenets, "one drops nothing, even the womb of a deer." For the Nenets people, the sign of a greedy person can be bulging eyes ("bull-eyed"). About such a person they say: "The eyes of (his) stick" (*Хэмта нянтленена'*). They also characterize a scared, worried person and in all case this characteristics is negative. Greedy young person will not even "give a cup of water." If such a person give you chance to "heat at his place - it is already good" (*чикехатлта хома*). Mansi folklore contains an interesting example of human greed. "What a *Ватахум* he is! If even bad water (urine) flowed out of him, he would drink it too" [14, 81].

Envy is a feeling associated with the desire to possess something that the other person has, and sharply condemned by traditional society. An envious person is defined by the Khanty as "having a bile heart". L. N. Panchenko distinguishes between "malicious envy" *лавыл нэглым сым сяры*г(lit.: my heart aches filled with evil and hatred) and "good envy" *–сым сярыг* (lit.: heart ache) [Oral saying L. N. Panchenko, Khanty-Mansiysk. 2014]. She believes that "good envy" does not have devastating consequences for a person, although a person in such a state is not free from experiences associated with a lack of benefits that are available to another person. But at the same time he is ready to make efforts to achieve the success of another person.

A person with "black" envy is not able to cope with his unrestrained desire to possess goods that do not belong to him. This uncontrolled emotion is manifested in the possession of other people's property – theft(*титли* 'a thief', 'to steal', forest. nenets.; *тулманты* 'a thief', *каттангкве* 'to make it to belong to smb', mans.). About the thief Nenets say that he has "long arms" (*нгучи тямп*) and compared to the magpie, which tend to carry to his nest small bright shiny objects (*капити" халахку таймана тытлитля шэ"эв хамьта* 'a magpie before stealing, she's already seven eyes'), and Khanty – Wolverine, which is "seen" in stealing fish from pots-mugs [2, 42].

As you can see, the lack of measures, as a source of deviant behavior, is a great danger to society. Any excess destroys ethically sustained balance of social practices, hence the need for distance, based on a sense of fear of such people. Violation of measures, and as a consequence, the fall of morals, appears in traditional culture as a threat to the foundations of human existence.

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帝国行政精英形成的特殊性
PECULIARITIES OF FORMATION OF IMPERIAL ADMINISTRATIVE ELITE

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注解。 本文作者对俄罗斯和英国帝国行政结构的典型代表的实践经验和个人素质进行了比较分析。 根据所进行的分析，确定了专业人员招聘过程的一些通用标准，以解决在特定帝国空间内管理有条件的敌对领土的典型问题。 作者强调，招募的来源是军事精英的代表，专注于解决具体的行政任务。

关键词：I.V。 Gurko，F。Lugard，总督，尼日利亚，波兰，军事精英，行政精英，招募，帝国扩张，俄罗斯帝国，大英帝国。

Annotation. *The authors of the article conduct a comparative analysis of practical experience and personal qualities of typical representatives of the administrative structures of the Russian and British empires. Based on the analysis performed, a number of universal criteria for the recruitment process of professional personnel to solve typical problems of managing conditionally hostile territories within a particular imperial space are determined. The authors emphasize that the source of recruitment are representatives of the military elite, focused on solving specific administrative tasks.*

Keywords: *I.V. Gurko, F. Lugard, Governor-General, Nigeria, Poland, military elite, administrative elite, recruitment, imperial expanse, Russian Empire, British Empire.*

The main obstacle to the natural death of the empire is not only and not so much the imperial idea and imperial structures, as the human factor and the quality of managerial personnel. In any historical epoch, in any part of the world, the need to solve the problems of managing the conquered spaces was con-

ditioned by the effectiveness of the functioning of the imperial administrative elite, which was the main guarantee of the preservation and stability of the imperial possessions. An integral part of this elite were immigrants from the military environment, who had extraordinary qualities that civilian officials lacked and conditionally hostile territories integrated into the imperial space needed for effective management.

According to the hypothesis underlying this article, the criteria for recruiting members of the military elite to the administrative elite and the criteria for the results of their follow-up are universal for any empire, regardless of geographic location or epoch. Determining factors are the existence of the need for specific managers in the empire and the professional skills of the candidates of the empire. To confirm the hypothesis, a comparative analysis of two typical representatives of the imperial administrative elite of the Russian and British empires was carried out using the example of the Warsaw Governor-General I.V. Gurko and Governor General of Nigeria F. Lugard.

One of the main criteria for the formation of the imperial administrative elite was belonging to certain privileged social sectors of society and obtaining specialized education, which opened up prospects for a military and administrative career.

Frederick John Diltry Lugard was born in 1858 in India in the family of military chaplain Frederick Grueber Lugard, who served as a lieutenant colonel, and grew up in Worcester in England. Two of his father's brothers were army officers, and the third, General Edward Lugard, a participantof the Sikh Wars and the suppression of the Indian uprising, reached the position of Deputy War Minister of the British Empire, and was knighted. Lugard graduated from a church school in England and a crash course at the famous Royal Military College in Sandhurst [14, p. 7].

Joseph Vladimirovich Gurko was born on July 16, 1828 in the family of General of Infantry V.I. Gurko, who took part in the suppression of the Polish uprising, as well as the events of the Caucasian war. The noble family Gurko-Romeiko had Lithuanian roots. His descendants subsequently entered the service of the princes of Tver [3, p. 3]. The noble birth and high position of the father opened the way for I.V. Gurko in the elite military school of the Russian Empire, the Page of His Imperial Majesty Corps, whose graduates held key positions in the court, military or civil service of tsarist Russia.

The choice of a military career in the context of ongoing wars and conflicts on the borders of any empire, natural inclinations, predetermined gaining real experience of military operations, mastering rigid subordination and skills of making operational decisions. Military experience was becoming the next criterion necessary for recruiting into the ranks of the imperial administrative elite.

Two decades after receiving education, for F. Lugard, they began to accumulate rich military experience in numerous wars and conflicts related to the protection of British interests in the Middle East, India and Africa. From 1879 to 1886 Lugard was on active duty, worked in the colonial administrations of Burma and India, participated in hostilities in Afghanistan, Sudan and Burma. In 1888, after leaving the reserve, he joined the ranks of the "imperial soldiers of fortune" and for many years became one of the most popular colonial military mercenaries in Africa. In the years 1888-1889 he was in the service of the African Lake Company, provided security to British missionaries, and fought the Arab slave trade. In the years 1889-1894 in the service of the East African Company, played a key role in Uganda's entry into the empire, and in 1885, at the peak of the colonial confrontation between England and France, at the suggestion of J. Chamberlain, he led the British armed forces in West Africa. In 1896, Lugard commanded the border troops in the Kalahari, and a year later, until 1900, led the troops of the Royal Niger Company [14].

After completion of training I.V. Gurko receives the title of Cornet and is sent to serve in the Life Guards Hussars. In 1849, Lieutenant Gurko's regiment was transferred to Austria-Hungary to suppress the uprising, but by the time of arrival the military actions against insurgents had already been completed. The beginning of the Crimean War of 1853-1856 and non-participation in it's Guards formations was a heavy blow for the captain Gurko. On his own initiative, he goes down in rank with the Chernigov army regiment, which occupied Belbek positions in the Crimea. The bureaucratic delays in the transition led to a delay in the theater of military operations - the Paris Peace Treaty was already signed. After that there was a long service in St. Petersburg and training of troops of the capital garrison. Turkish campaign of 1877-1878 truly became for Lieutenant-General I.V. Gurko time realization of leadership talents. In 1877, commanding the Forward Squad, Gurko seized the most inaccessible Khainokoy Pass, which opened the way for the Russian army beyond the Balkans. The rapid capture of several points by Gurko on the Sofia highway allowed the ring of encirclement around the Pleven citadel to close. In January 1878, Gurko's detachment completed the crossing of the Churyak Pass, which predetermined the fate of Turkish Sofia. Until the end of the campaign, the general was not released, although only diplomats and politicians were already operating.

The third criterion for the inclusion of high-ranking military in the administrative elite was the fact that the empire had an internal problem with the management of any region. It's decision, as a rule, required the use of force, emergency measures and the adoption of operational and non-standard solutions. Civilian administrators have rarely been able to do this. As a result, experienced servicemen who had administrative skills were invited to manage such problem areas.

January 1, 1900 in the settlement of Lacoja F. Lugard was appointed to the post of High Commissioner of the new British ownership in Africa - the protectorate of Northern Nigeria. These were the former "Nigerian territories" that were under the control of the Crown from the jurisdiction of the Royal Niger Company. The appointment of a professional military man to an administrative position, equal in status to a colonial governor, was explained by a rather simple fact. The settlement of Lakoja was on the border of the protectorate, which really was a group of independent Muslim emirates and existed only on paper [11, p. 52]. Before managing the new colonial territories, Colonel Lugard had to conquer and pacify them.

On April 5, 1879, Alexander II appointed General I.V. Gurko for the position of interim governor-general of St. Petersburg. Changes in the management structure were associated with a new wave of “nihilism” that began to manifest itself in terrorist acts against odious generals and officials and a real “hunt” for the emperor. Extreme circumstances explained the harshness of the response. In the competence of I.V. Gurko entered control of all local provincial power structures. At the same time, the powers of the temporary governor-generals expanded to the powers of the commander-in-chief of the army in the part of the empire that declared martial law [7, p. 908]. The task was extremely clear - to eradicate the "sedition."

The subsequent brilliant career and recognition of the achievements of administrative figures who came from the military sphere to the managerial elite is evidence of their effectiveness and relevance, which can be considered as the fourth criterion.

After a three-year conquest of the North Nigerian emirates, F. Lugard’s career developed brilliantly and rapidly, and he himself was awarded every possible honor. From 1900 to 1906 he served as High Commissioner of Northern Nigeria and was knighted. In 1907-1911 Lugard was appointed governor-general of Hong Kong, and after that in 1912 he returned to Africa to fulfill the daunting task of uniting the scattered Nigerian possessions of the Crown into a single colony — Nigeria, of which he was appointed governor-general. For services to the empire, he was awarded the title of peer. After retirement in 1919, Britain’s need for the ability of the former colonial administrator did not diminish. From 1922, for thirteen years, Lord Lugard was the British representative of the Standing Committee of the League of Nations [9, p. 308-309]. He wrote the theoretical work “The Double Mandate in British Tropical Africa”, which withstood repeated reprints and was the reference book of every British colonial official. Lugard is considered to be one of the main ideologues of British colonialism and officially recognized as the creator of the administrative system of indirect control, spread over almost all British ownership in Africa.

In 1883, I.V. Gurko was appointed to the post of governor-general of Odessa, where he was engaged in the training of troops and the pursuit of popular terrorists. The continuation of the civil service was associated with Poland. In the period 1883-1894 Gurko performs the duties of the Governor-General of Warsaw. After the suppression of the uprising of 1863, Poland was viewed as nothing more than a combat point, the alienation of which from the empire reached the size of the abyss [6]. An aggravating circumstance seemed anti-Russian sentiments of the Poles, who were ready to go to the side of Germany or Austria-Hungary in a possible military conflict. Following the general course of the Russification policy, Gurko, with his characteristic methodic, brought the well-established norms of the national borderland in line with the general imperial realities. The training system of the Warsaw garrison troops, laid down by the general, was maintained until the First World War. The completion of a career was marked for I.V. Gurko recognition of merit and the assignment of the highest military rank of the Russian Empire - Field Marshal General.

The fifth criterion is the special personal qualities of the new members of the administrative elite who have come from the military sphere. These qualities influenced their ambiguous perception on the part of the imperial authorities and contemporaries. The result of the uniqueness of military and managerial experience became individualism, the desire for administrative independence, specific ideas of honor and justice, as well as a non-standard framework for the admissibility of maximum action. All this led to frequent conflicts with senior management, with which it preferred to put up, because the benefits of effective administrative activities of the governor-general greatly outweighed all possible difficulties.

Throughout his administrative career, F. Lugard was distinguished by extraordinary authority, individualism and a desire for independence. He felt himself not a governor, but a general, and in the colonial officials saw military officers. Most of all he was outraged by the attempts of the Ministry of Colonies to control his work. So with the spread of British influence in Northern Nigeria, the ministry advocated the priority of peaceful methods of penetration into the region. Lugard, on the other hand, demanded from the local emirates complete unconditional obedience based on the “right of conquest” [11, p. 60-61]. With the submission of the emirates of Bida and Kantagor, the Ministry of Colonies first received a telegram about the aggression of these two emirates. Then there was a long silence, after which a report came about a successful military operation and the conquest of the emirates. Relatives of Lugard's subordinates who received correspondence from Nigeria were sometimes better informed than the Ministry of Colonies [8, p. 62]. This was the cause of constant conflicts with officials of any rank, which not only did not irritate Lugard, but even brought him a kind of joy. In a letter to his wife, he wrote that he would have loved his work much less if there had been no perma-

nent obstacles in front of him created by the Ministry of Colonies [15, p. 194]. The ministerial clerks of the Nigerian department hated Lugard, but it was persistence, firmness and perseverance that made the High Commissioner in their eyes the most valuable administrative staff.

The willfulness, partly the conflict of I.V. Gurko often questioned not only further progress through the career ladder, but also the very presence in the service. In 1861, the adjutant Gurko was sent to the Samara province to organize the announcement of the Manifesto and the Provisions on the Liberation of Peasants. One of the results was giving publicity to numerous cases of oppression of peasants by Count M.V. Kochubey, gofmarshala imperial court. During the Turkish campaign of 1877-1878. Gurko often faced Tsarevich Alexander Alexandrovich, was critical of the actions of the army at Plevna. When he was the governor-general of the capital of 1879-1880. I.V. Gurko allowed himself to go against the opinion of Alexander II and canceled the death sentence of L. Mirsky [2, 353], who had made an unsuccessful impingement on the life of General AR Drentelna, taking into account the repentance of the accused and his minority. During his duties as Governor-General of Warsaw, Gurko radically disagreed with the trustee of the school district, A.A. Apukhtin and his patron, the head of the government D.A. Tolstoy. The Governor-General was opposed to the total prohibition of teaching God's law in Polish, which could have led to open confrontation with the authorities [5]. At the same time, his own ideas about justice, lack of conformity in no way affected the effectiveness of solving managerial tasks and assessing its merits to the state.

Military experience influenced the formation of a special style of administrative behavior, expressed in managerial acuteness, preference for volitional and forceful decisions, and the achievement of administrative goals by military methods. This predetermined the ambiguous perception of representatives of the administrative elite with the military background in the eyes of the imperial authorities, the population of the governed territories, contemporaries and descendants. The dramatic themes of their perception and evaluation can also be identified as a criterion.

The perception of the image of F. Lugard was very ambiguous. Contemporary British society saw him as a glorious conqueror, famous builder of the empire, a knight of civilization, any undertakings of which inevitably led to glorious victories. But after a few decades, after "great glory" came "bad glory." The crisis and criticism of the colonial system, the rejection of the "reactionary" system of indirect control, the author and symbol of which was Lugard, led to the fact that it was he who was perceived as the main culprit of all the failures and mistakes of the colonial regime in West Africa [12]. Special relations of mutual hostility connected the governor-general with representatives of the new Europeanized African elite.

Lugard, like a typical Victorian gentleman, disliked educated natives who pompously and ineptly copied the European way of life. He was much more respected Africans who existed within their original civilization [10, p. 69-72]. The Nigerian Europeanized intelligentsia responded with overt hatred to Lugard. Indirect management was compared with the Spanish Inquisition, and its main goal was the humiliation of all progressive members of Nigerian society [17, p. 272-279].

Bulgaria, obliged to Russia to overthrow the four-hundred-year-old Turkish yoke, immortalized I.V. Gurko in historical memory. The streets and cities are named after the national hero. In Russia, the commander and statesman are given a few stingy pages in textbooks of national history. Over time, Gurko's military achievements dimmed against the background of an eccentric and extraordinary MD. Skobelev, literally eclipsed his brilliance of the rest of the generals of the era of the Russian-Turkish war of 1877-1878. Participation in the conduct of the peasant reform of 1861 fell out of the sight of historians due to the insignificance of the third-order phenomenon. However, the personal and administrative qualities of Gurko were not determined by his rank, and the effectiveness of solving managerial tasksm, but his scale on the political arena. The temporal being of main governor-general of the capital was reflected in his assessment and perception by hanging ideological labels - "satrap", "punisher", "one of six Arakcheevs" [1, p. 154]. His actions to pardon the Narodovol'tsy and solve the student issue were not in the focus of attention. The Polish period in the biography was characterized as following the russification policy, which is primitively understood in the framework of the slogan - "Russia for Russians". The Warsaw Governor-General himself was largely undeservedly attributed to the "typical military of the Nikolaev era" or was considered the "devourer of the Poles" [4, p. 573]. At the same time, the sphere of civilian government remained unaffected by the researchers in relation to actions to unify the Polish norms and the empire as a whole.

Thus, the assumption underlying the hypothesis seems to be reasonable in fact. The analysis of two typical representatives of the imperial administrative elite, recruited from the military sphere with the aim of solving the tasks of managing conditionally hostile territories within the imperial possessions, demonstrates the adequacy of the selected criteria. It seems likely that repeating the analysis using other typical representatives of the administrative elite of any imperial space, according to the identified criteria, will lead to similar results.

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俄罗斯文学语言的历史与现状
HISTORY AND CURRENT STATE OF THE RUSSIAN LITERARY LANGUAGE

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抽象。本文分析了俄语文学语言的历史和现状，作为语言学和学科的一个分支，考察了各种复杂的语言事实和现象，用来表示非常广泛的术语。解决文学语言问题的历史方法需要密切关注其运作领域。文学语言的运作范围从时代到时代并没有保持不变，但仍处于俄语文学语言发展的各个阶段，其运作的最重要领域是文学。因此，将文学语言视为文学语言更为简单和自然。至少，在对绝大多数俄语语言学家进行具体的历史语言学研究的过程中，“俄语文学语言”恰恰就是“俄语文学语言”。

关键词：特异性，语言分析，文体学，语言学，抽象，研究方面，语法。

Abstract. The article analyzes the history and current state of Russian literary language as a branch of linguistics and academic discipline examines various and complex linguistic facts and phenomena, which are used to denote very extensive terminology. The historical approach to the problem of the literary language requires close attention to the areas of its operation. The sphere of functioning of the literary language does not remain unchanged from epoch to epoch, but still at all stages of the development of the Russian literary language, the most important sphere of its functioning is literature. Therefore, it is simpler and more natural to consider literary language as a literary language. At least, in the practice of concrete historical-linguistic investigations of the overwhelming majority of Russian linguists, the “Russian literary language” acts precisely as the “Language of Russian Literature”.

Keywords: Specificity, linguistic analysis, stylistics, Linguistics, abstraction, aspect of research, grammar.

The history of the Russian literary language is an integral part of the general course of the history of the Russian language, including historical grammar. Each

of these parts has its own content, its tasks and its own specifics. “And in essence both these disciplines are organically interconnected, since their perdmet is the interpenetrating sides of a single whole - the language of the people” [1, p.3].

The object of the study of the history of the Russian literary language is the Russian literary language, its development primarily in historical and functional terms, in terms of language use. In other words, the history of the Russian literary language should study all historical changes in the conditions of the social functioning of the literary language at different stages starting from the XI century. And to this day. [2, p. 3-4].

In national universities, the history course of the Russian literary language is closely related to other linguistic disciplines (“Introduction to the history of the Russian language” Historical grammar, “Modern Russian”, “Stylistics of the Russian language”, “Linguistic analysis of artistic text”), each of which contributes to students of conscious perception of historical and literary facts of the Russian language, understanding of the prehistory of the Russian literary language, lays the foundation for a conscious attitude to the facts of the Church Slavonic language, to its role in the history of the culture of the Russian people at different stages of society’s development, to understanding the problem of bilingualism, especially national-bilingualism.

The history of the Russian literary language (like the theory and history of literary languages in general) “works” at the levels of text and language as a system of subsystems, i.e. its object is literary texts and the literary language as a whole as a system of technological aggregates of literary texts. Language units are considered only as text components. This is the specificity of the theory and history of literature of languages, which distinguishes these disciplines from other disciplines, “working” at the language level, that is, having their object language units in their “inner level” relationships.

At the same time, the theory and history of literary languages, of course, relies on these discourses, using their observations and communication. [3-p. 6].

The objective of this course in a national university is to give students a scientific idea: 1) On changes in the structure of the literary language; 2) On the types of literary language and the forms of its interaction; 3) On the history of the social functions of the literary language. Russian literary language has played a huge role in the development of the culture of the Russian people. Created on a national basis, absorbed in itself the best features of the national language, it was already in deep antiquity was a reflection of the high culture of the Russian people.

Penetrate into the past of the people, to trace how the development of society, and with it the language, we are allowed to write scripts. They are valuable as a source of history of the people, which makes it possible to trace the development of the language. The whole history of the Russian literary language from the an-

cient period to the present day is the history of its continuous growth and enrichment. [2 p.5]. So far we only know about the Russian literary language that it is one of the varieties of the Russian language. But this, of course, is not enough so that one can speak about the subject and objectives of the course "History of the Russian literary language.

Many linguists seek to define a literary language by some of its properties, qualities, while taking into account the current state of the language and neglecting its history. As a result, many definitions of a literary language are historically limited. The definition of a literary language on the basis of describing only its modern properties cannot provide a clear concept of this complex phenomenon. V.V. Vinogradov emphasizes:

It is extremely important… to trace the phenomenon that plays the role of the "literary language" in the history of ... nations, throughout the whole course of their history, not only in its new and especially in the newest stage; It is necessary to overcome the widely observed tendency to limit the study of the literary language of the XIX-XX centuries. Only the study of this language in the movement on the course of the entire history of individual languages available to us will make it possible to determine the scale of the problem of the literary language, reveal the real nature of this phenomenon, show the historical changes occurring in it, establish the influence of these changes on the very essence of the literary language [4 p. 37-38].

Taking into account all the above, we can finally turn to the question of what is the subject of the history of the Russian literary language as an independent branch of linguistics and academic discipline and what distinguishes it from historical grammar as an adjacent aspect of the history of language. First, the historical grammar examines the facts of the Russian language in the totality of its varieties, and the history of the literary language-facts from only one species of the Russian language.

Secondly, which is much more important, since the history of a literary language is the history of the language of a specific existing text, it does not abstract from the language of these texts, but only summarizes, summarizes some similar, average features of the language of certain groups of texts and the differences between the language of certain groups of texts, considers the specifics of different varieties of literary language, its styles in their specific functioning and development.

Historical grammar, in contrast to the history of the literary language, considers language facts in the abstraction, in abstraction from their concrete functioning, from their realization. In other words, the history of a literary language considers the facts of the language "in the text", and the historical grammar "in the system". Third, the historical grammar considers only the structure of a language, while

the history of a literary language also considers the history of its interaction with various non-literary varieties of language and the history of its social functions.

Thus, the history of the Russian literary language as an independent branch of linguistics and academic discipline is built as the indissoluble unity of three aspects of the research: 1) The history of the structure of the literary language, more precisely, the history of the structure of varieties of the literary language in their interaction; 2) History of interaction of the literary language and "non-literary" varieties of the language; 3) History of the social functions of the literary language; These three aspects of research in their inextricable connection are the subject of the history of the Russian literary language. [5 p.17-18].

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诱导诱变在植物育种中的应用。 评论 – 第一部分
THE USE OF INDUCED MUTAGENESIS IN PLANT BREEDING. REVIEW - PART ONE

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注解。 该评价文章表明，随着基因库相互融合，需要扩大栽培植物的遗传多样性。 寻找新的变异来源以克服作物的遗传侵蚀和改善农业产业的结果。 揭示了在为实际植物育种创造有希望的原料时使用化学诱变的可能性。 考虑了实验诱变方法的主要发展阶段及其对理论选择基础发展的影响。

关键词：菌株，基因库，诱变，突变体，诱变剂，遗传变异，遗传，选择。

Annotation. *The review article shows the need to expand the genetic diversity of cultivated plants as their gene pools are merging each other. There are the results of the search for the new sources of variability to overcome genetic erosion of crops and to improve agricultural industry. The possibilities of using chemical mutagenesis in the creation of a promising source material for practical plant breeding are revealed. The main stages of development of the method of experimental mutagenesis and its influence on the development of theoretical bases of selection are considered.*

Keywords: *strain, gene pool, mutagenesis, mutant, mutagens, genetic variability, genetics, selection.*

Introduction. One of the main strategic aspects of the national security of any state and of the Russian Federation in particular - includes food security. It is necessary to improve selection and seed production as the base of successful industry to provide food safety in long terms. The main objectives of the state agrarian policy of Russia in this context are: to ensure the population needs with food of domestic production with effective import substitution in the market and

to create the developed export potential [19]. Selection has the integral role in the stable growth of pant breeding productivity, creation and use of the new strains and hybrids of crops as an innovation resource of agricultural complex of the state.

Successful plant breeding seriously depends on the stable genetic variability in the primary or initial population. However the intensive programs of interbreeding and selection which took part in recent decades and aimed to increase the productivity of the plants caused the decrease of the level of genetic variability of cultivated plants in all their properties. The cultivated plans have tendency to become more homogeneous genetically, therefore sowing in whole becomes vulnerable to biotic and abiotic environment [6,28]. Insufficient adaptability of strains with high productivity is caused by the decrease in their resistance to adverse environmental factors. The aim to have more crops caused the increase of plant vulnerability to stress [8,15,20].

It is known that genetically homogeneous strains usually have high genetic potential for productivity, but monogenic strains have the same genetic basis which often leads to a mass lesion of plants with pathogens. For example, the helminthosporiosis-affected hybrid maize lines (USA, 1970: losses amounted to about $ 1 billion) had the identical cytoplasm, as the same maternal components of interbreeding were used to make hybrids [15].

To prevent such damage to agriculture, it is necessary to maintain the level of available genetic diversity of the source material for breeding programs [3] and conduct profound studies to increase the level of genetic variability of the main crops by means of use of different sources of its variability [1-3, 10, 33]. There is a highly effective method of creating a source material for breeding named experimental mutagenesis, with the skillful use of which it is possible to change the plant beyond recognition and in a short time to create a variety of breeding material [7, 10]. For example, "the Green Revolution", which doubled rice and wheat yields in developing countries, was largely based on the use of induced mutants [25].

The history of the development of the experimental mutagenesis method

The study of spontaneous and induced mutational variability in plants began in the late 19th – early 20th centuries. The first idea of changing the hereditary substance by mutations developed Hugo de Vries, who introduced the term "mutation" in 1901 name random genetic changes [3]. In Russia, the first work on the study of mutational variability were conducted by S. I. Korzhinsky and I. I. Gerasimov [26]. In the beginning the researchers studied only natural, that is spontaneous mutational variability. After the researches of G.A. Nadson and G.S. Filippov who made mutant forms of lower fungi in 1925 by means of radium rays and american researchers, namely G. J. Muller who made the

mutation of drosophila, and L. Stadler who induced the mutations in corn and barley by means of x-ray, it became possible to artificially produce mutations using ionizing radiation.

G. Muller showed for the first time that the finest hereditary structures of chromosomes can change abruptly under the influence of x-rays - thus there are transformations of some genes into others. The possibility to make the mutation process faster helped to discover the good method which states some of the most difficult questions of modern genetics. Since that time the research on the use of experimentally induced mutations in the selection of a number of crops has been intensively developed. The first genetic use of x-ray on soft wheat, which gave positive results, was conducted by L. N. Delaunay in 1934 and A. A. Sapegin in 1935.

As a result of research L. N. Delaunay concluded that x-rays many times increase the probability of practically valuable mutations compared to the frequency of spontaneous mutation. And the mutation occurs in various directions, touching each side of the body. A. A. Sapegin made wheat x-ray mutants which were different from the original forms on different features. The main result of these studies was the accumulation of extensive data, which proved the high mutagenic activity of ionizing radiation and the practical value of induced mutations [26]. A. S. Serebrovsky and N. P. Dubinin has successfully used this method in the solution of theoretical problems of genetics and by the end of the 30s of the 20th century the creation of a common theory of the origin of mutations, the so-called "target theory" was completed [21]. However,chromosomal mutations predominated among the mutations caused by ionizing radiation. They caused, as a rule, regressive phenotypic changes. That is why Stadler denied the prospects of x-ray mutations usability in selection in 1930 [27]. After a long gap, the research on the use of radiation method in breeding was resumed in the USSR in 1957 by N. P. Dubinin. Today there is a huge number of agricultural cultivated strains of plants which were produced by means of radiation and were introduced in the industry. For example, in the last decade, the international atomic energy Agency of Austria, IAEA, has widely disseminated mutation techniques in the Asian and Latin American regions and achieved very good results. These examples include: mutant hulless high-protein barley strain called Molina-5 grown in the Andean highlands, and the strain of rice called Zhefu-802 which grows in China on more than 11 million ha [25].

Together with ionizing effect there were other external effects revealed which make the natural mutational process go faster: high temperature (the works of P. F. The Rokicky and A. N. Promptova), ultraviolet rays (works of A. N. Promptova).

The mutagenic action of chemical compounds was firstly shown by E. Bauer in 1916. The nature of the effects of chemicals and, above all, iodine, stud-

ied in the work of V. V. Sakharov. In 1932 Sakharov was the first to discover chemical mutations and specificity of action of chemicals of inorganic nature in comparison with action of ionizing radiation and spontaneous mutagenesis. However, neither mustard gas nor iodine, acetic acid and ammonia could be used for practical purposes, as they showed very low mutagenic activity at a narrow mutation spectrum. The experiments of M. E. Lobashev (1934) with ammonia, the frequency of mutations was very low and only slightly exceeded the spontaneous level. Acetic acid in his experiments did not cause mutations at all. Mustard gas in the works of Auerbach and Robson (1946) was characterized by a rigid action and caused exclusively chromosome breaks or gene mutations that were of no practical interest [30]. The first successful works in this field were related to 1939-1941, they belonged to I.A. Rapoport and F. Olkers in 1943 [14].

In the 40s of the last century the intensive study of the mutagenic action of organic compounds began. The reveal of mutagene activity of ethyleneimine and diethyl sulfate in 1947 by I.A. Rapoport and S.Auerbach stimulated the studies of inducted mutants in plants. Studies on chemical mutagenesis, initially conducted on drosophila, had, however, a broader meaning in the formulation of problems of mutagenesis, as was the widespread use of chemical agents in studies on mutagenesis in various living organisms [26].

It should be noted that the effectiveness and nature of the impact of physical and chemical mutagens are different: if the temperature increase the frequency of mutations just several times in relation to natural frequency of hereditary changes, the radiation with short rays increase their exit in hundred times, chemical mutagenes - in hundred, thousand, tens of thousand times [11]. Chemical mutagenes are under special attention also because their mutagene action is observed to be special [27]. Chemical mutagens on the specifics of the action are incomparably farther apart than different types of radiation. The specificity of mutagens is, first of all, the fact that some of them with high genetic activity induce chromosome rearrangements, while others do not cause their structural disorders [11]. The specificity also includes the ability to cause mutation of certain chromosome loci with a particular frequency [9]. Chemical mutagens have greater order of action in comparison with radiation mutagens, form a much wider range of genetic changes, have greater selectivity, cause a sharp increase in the output of breeding mutations [9]. They induce more viable mutations [27] and, taken even in high concentrations, chemical mutagens form chromosomal rearrangements with a moderate frequency, much less than radiation, even taken in extremely small doses [11].

The specificity property distinguishes the action of chemical mutagens from the action of ionizing radiation, the action of which is more accidental due to the

lack of chemical affinity with the molecular structures of the cell and the presence of a mechanism of only a target for their action. This determines a rather rough intervention in the cell and the opposite to the soft action of chemical super mutagens on the genetic structures of the cell in optimal concentrations [30]. Chemical mutagens have a low aberration effect, and some induce exclusively gene mutations [18]. Such mutations are most beneficial in breeding work, since in this case it is more likely to preserve the useful trait, since there is no sterility, often associated with chromosomal aberrations. The specific nature of the action of chemical mutagens (at the phenotypic level) often consists in the fact that it causes only gene mutations with a high yield of breeding valuable traits [30].

The specificity of the mutagenic effect of different compounds has been established by many researchers. This phenomenon, which is important for the development of methods of heredity management, has been studied in different aspects. At the same time, the other side of the mutagenesis, the specificity of the object itself has long eluded the attention of researchers [28]. According to I. A. Rapoport, the effect of N - nitro compounds found a specific dependence both on the structure of the compound itself and on the characteristics of the biological object [11]. Features of the genotype of the organism are a factor guiding the mutation process [22]. The genotype of the strain significantly affects the sensitivity, frequency and spectrum of visible mutations. T. V. Salnikova said that the body's ability to variability depends on its genetic characteristics, the number and size of chromosomes, age, ploidy and other factors [17]. The world achievements of induced mutagenesis in relation to different cultures show the role of genotype in the mutation process: cultivated plants are classified into plans with high mutability and low mutability. Rye, oats and hard wheat are low mutable, and barley, rice and soft wheat are higly mutable [25].

Selectivity of the chemical mutagen is probably associated with the characteristics of the metabolism of the biological system: the sensitivity of individual stages of the life cycle to the agent, the presence or absence of enzymes that inactivate the functional group of the mutagen, the permeability of cell membranes, etc. Mutations, taken into account at the level of the organism, are the result of a complex of phenomena at different levels of the organization of genetic systems - from molecular to organizational and population. The specificity of the organism in mutagenesis is showed as a reflection of the mechanisms of organizational homeostasis, based on the functioning of genetic and physiological protective and restorative systems of the body [28]. The specificity of mutations depends both on the type of the influencing factor (mutagen) and genetic characteristics of the object, but also on the modifying effect of external conditions under the influence of mutagen on the body [26, 27] as well as on the conditions of growing of the first mutant generation (M-1).

All factors of specificity of mutation process and their interaction make the wide spectrum of mutations, the majority of which are important for the selection. The increase of genetic variety of selection materials concerns the widest variety of economically valuable features. For example, wheat was mutated with changed habitus, ear, signs of germination, semi-dwarf and resistant to brown rust [31]. There was a sharp increase in hereditary diversity on such quantitative grounds as the growing season, the gluten and protein content in the grain, productivity, shape, intensity of root system growth and other features in spring wheat. Spring and winter wheat became more productive and resistant to fungal diseases and lodging of mutant lines. Academician P. P. Lukyanenko, using N - nitrosoaniline and ethylenimine, has allocated extremely stunted wheat plants with normal ears, as well as mutants with increased protein content. As a result of many year work, R. Singh has allocated early maturing mutants of wheat, barley, rice, millet, peas, sunflowers with short stems, high level of protein, which are resistant to diseases and have better composition of fatty acids etc. [32]. Some studies note that mutants appear to have positive features which can not be found in nature [12,18] and such kind of features appear saving origin complx of features [11]. One of the striking examples of the emergence of a new property is a sign in sunflower oil which is similar to olive one. It was got by breeder K.I. Soldatov (Pervenets strain) who used the scheme developed by I.A. Rapoport. Oleic sunflower was created by the fusion of mutations in a typical sunflower under the influence of super-mutagene of nitrosomethyl moequine. K. I. Soldatov created a series of sunflower lines with different ratios of oleic and linoleic acids (which always contained a high amounnt of oleic acid), some of which can be used in the aviation industry [29].

The ability to preserve the external properties and former advantages of genotypes with the introduction of individual positive changes in the form of high productivity, greater resistance to extreme temperatures, immunity to diseases, etc. is a privilege of chemical mutagenesis [11].

Problems solved by the method of experimental mutagenesis

Hereditary variability of organisms is known to be the basis of artificial selection. In the early stages of its formation selection was based on the choose of naturally occurring mutations. As the selection science was developing, the method of hybridization which really makes the variability of the features of a selectioner's interest to be more different, was discovered and is widely used today. However, this variability was not enough to meet the requirements of breeding for cultivated crops. The search for new sources of variability led to the discovery of mutagenic properties of radiation and a number of chemical compounds that increase the hereditary heterogeneity of living organisms [9]. Any changes in genetic material that occur in nature can be induced by physical (UV rays, short-wave radiation and others), biological (viruses) and chemical mutagens at a much higher frequency

than spontaneous. The ability of many environmental factors to cause mutations and thereby significantly expand the genotypic diversity of hereditary structures in organisms is effectively used in biology studies [6].

Mutations and recombinations are considered as the main sources of genotypic variability of plants, which determine the potential of phylogenetic adaptation [8]. The problem of adaptation occupies an important place in the evolutionary theory and practice of agriculture. Adaptation of plants to new environmental conditions is achieved by means of modification and genotypic variability, which allows plants to adapt to environmental conditions, as the most significant in the process of their individual development, and long-term changes in environmental factors [8]. The idea to create genetic material adapted to constantly changing weather conditions and possessing qualitatively new breeding valuable features has been and remains the leading one in plant breeding [13].

The fight against diseases and pests is one of the important tasks of modern agricultural production. The list of organisms that harm crops includes at least 160 species of pathogenic bacteria, 250 species of viruses, 8 thousand species of insects and mites, 2 thousand species of weeds [23]. Various pesticides are used to fight pests, diseases and weed. Disadvantages of chemicals are known – many of them have a mutagenic or carcinogenic effect, they have no selectivity of action and cause death along with harmful and useful organisms, with their systematic use, there is a rapid genetic adaptation of pests. It is stated that as a result of natural selection in the early 80s of XX century the biosphere included 428 species of insects resistant to chemicals [16]. Therefore, as an alternative to chemical means of plant protection, specialists use environmentally safe biological methods of pest, disease and weed control, and they try to make the solution of the breeding problem easier by breeding resistant varieties and breeds. It is extremely important to integrate the biological method with other, especially chemical, in the General system of protective measures [23].

The method of chemical mutagenesis plays an important role in solving the problem of resistance of plant varieties. For example, winter soft wheat is not characterized by signs of resistance to powdery mildew and hard smut. A few strains of wheat that are resistant to these phytopathogenes have acquired these characteristics with remote hybridization with other species and genera of wheat. The method of remote hybridization (even with the use of biotechnology and genetic engineering) is very long, laborious and often does not guarantee the preservation of the acquired adaptive properties in subsequent generations [29]. N.S. Eigyes with his collegues got rather large amount of mutants resistant to powdery mildew and hard smut. A characteristic feature of the induced mutant sign of resistance to powdery mildew is its long-term preservation for 10-40 years or more, while the resistance transmitted by remote crossings is quickly lost, on average, after 3-5 years. Mutants with complex resistance to three-five obligate phytopathogenes are particularly valuable.

They also are resistant to saprophytes that is mostly hard feature to create, for example, the resistance to root rot (Stavropolskaya kormovaya wheat strain, which is created based on 61 mutant). The same personnel of the laboratory of mutation selection which is a part of IBCP RAS has created other strains with the complexes of valuable features which are rarely match without use of chemical mutagenesis [29].

The method of experimental mutagenesis in plant breeding is effective as it helps to multiply frequency of occurence of changed forms [25]. Both the direct use of mutants and their inclusion in interbreeding lead to a significant increase in the level of genetic diversity, the reorganization of the plant genotype in the right direction for genetics and breeder based on a combination of mutational and recombinant variability [12]. This is the breeding which is the hope of specialists to solve the food problem which is very important in the postindustrial world [23].

Experimental mutagenesis is a very powerful means of creating a hereditary diversity of plants by immune, morphological, biochemical and physiological characteristics. One of the main points in plant breeding is the length of the growing season, it is one of the most powerful ways to adapt plants to environmental conditions [4]. For regions of risky agriculture, the duration of the growing season of varieties is very important, and therefore the possibility of obtaining mutations in terms of maturation is particularly relevant [5, 10]. One of the problem regions for crop production, for example, is Siberia, in which the selection of the source material is of particular importance, since the most important requirement for the varieties created is their adaptation to extremely variable conditions of the sharply continental climate. As a result of large-scale comprehensive studies in Siberia, by 1991, foreign and foreign varieties were practically replaced by varieties of local Siberian selection by leading crops and new plant species were introduced [5]. Success in the creation of genotypes with desired properties has been achieved through a radical change in the genotype of existing forms with the use of mutagenesis and hybridization of genetically different and ecologically distant forms. It was found that the creation of the initial breeding material using experimental mutagenesis accelerates this process by an order of magnitude. "A unique gene pool has been created across the entire spectrum of crops grown in Siberia, fundamentally new genetic sources, donors of particularly valuable traits have been identified and synthesized, and trait and genetic collections have been created" [5, p. 412].

Artificial induction of mutations has made a great contribution to the theory of genetics, the development of genetic methods of selection, the development of Microbiology and agricultural raw materials, as well as health problems. Currently, research in the field of experimental mutagenesis shows the effectiveness of their use and in addressing the protection of the environment from pollution [14]. Therefore it takes one of the most important places in theoretical researches and practical selection to manage the processes of variability, and the construction of genotypes becomes the root of the problem of the process.

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在念珠菌病期间的鹅消化道的大肠埃希氏菌
ESCHERICHIA COLI IN THE DIGESTIVE TRACT OF GEESE DURING CANDIDIASIS

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抽象。 念珠菌病对鹅养殖造成重大经济损失。 然而，现有的治疗和预防方法无效[1,2,3,4]。 本文介绍了研究鹅念珠菌病对作物，肌肉和腺胃中大肠杆菌动态的影响，7至90日龄鸟类的小肠和大肠刮屑的研究数据。 使用抗生素，酶，益生菌以及复合酶，益生菌和蜂胶疗法治疗鹅中念珠菌病的比较方法已显示复合酶益生菌和蜂胶疗法的高效率。 它有助于大肠杆菌在作物，肌肉和腺胃，鹅的小肠和大肠中完全恢复到生理上可接受的值。

关键词：鹅，念珠菌病，大肠杆菌，作物，肌肉和腺胃，小肠和大肠，mycobiotic，酶，裂解酶，益生菌，蜂胶。

Abstract. *Candidiasis causes significant economic damage to geese farming. However, existing methods of treatment and prevention are not effective [1, 2, 3, 4]. The article presents data on the study of the effects of geese candidiasis on the dynamics of Escherichiae coli in the crop, muscular and glandular stomachs, the small and large intestines scrapings from 7 to 90 days old birds. Comparative methods for the treatment of candidiasis in geese using antibiotics, enzymes, probiotics as well as complex enzyme, probiotics and propolis therapy have shown the high efficiency of the complex enzyme probiotic and propolis therapy. It contributed to the full restoration of Escherichia coli to their physiologically acceptable values in the crop, muscular and glandular stomachs, small and large intestines of geese.*

Key words: *geese, candidiasis, Escherichia coli, crop, muscular and glandular stomach, small and large intestines, mycobiotic, enzyme, lyticase, probiotic, propolis.*

Materials and methods. The work was carried out under the conditions of geese farms in the republics of Tatarstan and Bashkortostan on birds of the Linda breed, aged 7 to 90 days old. Microbiological studies were carried out under the conditions of bacteriological departments in regional laboratories and laboratory of the Microbiology and Immunology Department of Russian State Agrarian University. *Escherichia coli* was isolated on MPA, MPB, Endo and Levin media. A pure culture of *Escherichiae coli* was identified using the agglutination reaction. Material for the experiments were taken before the start of the experiment - (7 days old), and then at days 14, 30, 60 and 90 from the beginning of the treatment. The birds, according to the principle of analogy, were divided into 7 groups. The first group was the control group - healthy birds, 2 - 7 patients with candidiasis. Drugs were not administered on birds in group 2. Geese in group 3 were given traditional antibiotic therapy with nystatin, group 4 - lyticase enzyme therapy, group 5 - enzyme therapy with probiotic therapy using lactobifida, group 6- enzyme therapy in complex with propolis therapy, group 7- complex of enzyme, probiotic and propolis therapy.

Results and discussion. In the crop of the control group, the level of *Escherichia coli* in the course of the experiments slightly, increased (statistically significant). At days 14, 30, 60 and 90 compared with its initial value at day 7, it increased by 1.27; 1.48; 1.66 and 1.83 times.

The level of *Escherichia coli* in the crop of group 2 geese also increased in days 14, 30, 60, and 90. During the experiments, it was higher than the initial value by 1.28; 1.42; 1.83 and 1.92 times.

Treating patients with candidiasis in group 3 with mycobiotics contributed to a certain decrease in the level of *Escherichia coli* in the crop of birds compared to their content in untreated geese in the 2nd group, but it was significantly higher than their value in the control.

Significant inhibition of Escherichia coli activity in the crop was observed when the enzymatic drug lyticase was introduced into the diet of sick geese (group 4). The *Escherichiae coli* content in the geese crop of group 4 decreased in days 7, 14, 30, 60 and 90 days of the experiment by 1.19; 1.16; 1.48; 1.52 and 1.65 times. A more significant decrease in the level of *Escherichia coli* in the crop of geese was observed when lyticase with probiotics (group 5) and lyticase with propolis (group 6) were used. Parameters of birds in these groups changed relatively at the same physiological levels. The biggest decrease in *Escherichiae coli* population in the goitre of geese was recorded when lyticase, probiotic and propolis were used at the same time (group 7). Here, the content of *Escherichiae coli* in the crop of the birds decreased, compared to those in birds of groups 1 and 2, 7 days after the beginning of the experiment by1.24 and 1.71 times, at day 14 - by 2.19 and 3.05 times, at day 30 - 3.55 and 4.7 times, at day 60 - by 5.37 and 8.19 times, at day 90. - 8.74 and 13.2 times.

Significant changes in the content of *Escherichiae coli* were recorded in the muscular and glandular stomachs of geese suffering from candidiasis.

The content of *Escherichiae coli* in the muscular and glandular sections of the stomach of geese in the control group in the course of the experiments increased as the birds grew up, due to the fact that fungi of the genus *Candida* are very widespread and to prevent the transition of this process to pathology, it is necessary to take constant preventive measures to prevent candidiasis. The increase in *Escherichiae coli* population in the muscular and glandular sections of the stomach of geese in group 1 that was noted in days 14, 30, 60 and 90 of the experiment in comparison with the initial parameter on day 7 was - 1.22 and 1.1 times; by 1.84 and 1.28 times; 2.02 и 1,37; 2.23 and 1.3 times.

In the muscular and glandular sections of the stomach of group 2 geese, a pronounced increase in *Escherichiae coli* content was recorded. Their values by day 7 of the experiment were already higher compared to the data in the control group by 1.87 and 1.69 times. In the subsequent periods of the experiment, a significant increase in the level of Escherichia coli was observed in the muscular and glandular sections of the stomach of geese in the 2nd group. Their values exceeded the data of birds in control group 1 at days 14, 30, 60 and 90 in the muscular stomach by 2.62; 1.97; 2.04 and 2.24 times, in the glandular stomach - 2.21; 2.10; 2.44 and 2.93 times.

Traditional mycobiotic therapy (group 3) caused a slight decrease in the activity of *Escherichia coli* in the muscular and glandular parts of the stomach of birds, compared with the indices of geese in group 2. Group 3 parameters at days 14, 30, 60 and 90 days were lower than the data of group 2 geese by 1.29 and 1.93 times, 1.79 and 1.97 times, 2.57 and 1.13 times, 2.87 and 1.5 times .

Lyticase contributed to a significant inhibition of the activity of *Escherichiae coli* in the muscular and glandular sections of the stomach of group 4 geese. The *Escherichia coli* content in the muscular and glandular sections of the stomach of geese decreased, compared with their values in group 2 birds, in days 14, 30, 60 and 90 by 1.66 and 2.63 times, 2.48 and 3.33 times, 3.63 and 5.64 times, 5.02 and 7.1 times.

A more pronounced decrease in the activity of *Escherichiae coli* in the muscular and glandular sections of the stomach was recorded in groups 5 and 6, when lyticase in combination with probiotic and propolis was introduced into the diet of birds. At the same time, this process was more active in the gizzard of group 6 birds.

The maximum expression of the decrease in the content of *Escherichiae coli* was observed in both the muscular and glandular sections of the stomach of group 7 geese. In the muscular section of the stomach of group 7 geese, the level of *Escherichia coli* was lower compared to that of groups 1 and 2 birds, at day 14 of the

experiment in 1.35 and 3.55 times, at day 30 - by 2.55 and 4.89 times, at day 60 by 3.3 and 6.77 times, at day 90 - by 4.56 and 10.2 times. In the muscular section of the group 14 geese stomach, the level of *Escherichia coli* was lower compared to that of groups 1 and 2 birds, by 4.76 and 10.5 times, at day 30 - by 9.88 and 24.0 times. In days 60 and 90 of the experiment, *Escherichiae coli* was not detected in the muscular section of the stomach of geese in group 7, whereas their level in the muscular section of stomach of birds in group 1 and especially group 2 continued to increase intensively.

Significant changes in the dynamics of *Escherichiae coli* under the influence of *Candida albicans* during candidiasis occurred in the small and large intestines of geese. Having already a higher physiological level, *Escherichiae coli* in the small and large intestines of geese, during candidiasis, a further increase in their activity was observed. In the small and large intestines of geese in the control group, the level of *Escherichia coli* tended to increase moderately, exceeding in day 90, parameters of day 7 by 1.3 and 1.43 times.

The content of *Escherichiae coli* in the small and large intestines of the geese in group 2 during the experiments intensively increased. They were higher than the parameters of control group birds by 1.26 and 1.72 times, at day 14 by 1.43 and 1.57 times, at day 30 by 1.46 and 1.63 times, at day 60 - by 1.69 and 1.61 times, at day 90 by 1.79 и 1.92 times.

Although the level of Escherichiae coli in the small and large intestine of group 3 geese was inhibited under the influence of mycobiotic nystatin, it increased regularly. Wherein the *Escherichia coli* content in the intestines of group 3 geese decreased, compared to their values in small and large intestines of group 2 birds, in days 7, 14, 30, 60 and 90 by 1.42 and 1.15 times, 1.46 and 1.25 times, 1.44 and 1.2 times, 1.54 and 1.68 times.

The treatment of geese with candidiasis in the 4th group using the enzymatic drug lyticase contributed to a dynamic decrease in the level of *Escherichiae coli* in the small and large intestines of birds. Their content decreased as compared to the data of group 2 geese in days 7, 14, 30, 60 and 90 of the experiment, in the small and large intestines by 1.56 and 1.01; at 1.70 and 1.39; by 1.77 and 1.65; 2.47 and 1.91; 2.33 and 2.27 times respectively.

The introduction of probiotics (group 5) and propolis (group 6) into the diet of birds in the process of treatment with enzymatic drug lyticase contributed to an even more pronounced restoration of *Escherichiae coli* in the small and large intestines of the geese in these groups.

Restoring the balance of *Escherichiae coli* in the small and large intestines of geese during the development of candidiasis was recorded in group 7 birds in which complex therapy using probiotic, propolis as well as enzymotherapy with lyticase was carried out. The levels of *Escherichiae coli* in the small and large

intestines of group 7 geese corresponded to their physiological values in birds and were lower compared to the group 2 geese data in day 7 by 1.91 and 1.7 times, at day 14 - by 2.56 and 2 times, at day 30, by 2.51 and 2.59 times at day 60 by 3.03 and 2.69 times, at day 90 by 3.43 and 3.49 times.

Conclusions. Candidiasis disrupts microbiocenosis in the digestive tract of geese. They lead to a pronounced activation of *Escherichiae coli* in the crop, muscular and glandular sections of the stomach and in the small and large intestines. Treatment using the traditional method with the use of antimycotic therapy inhibits the process of increasing the level of *Escherichiae coli*, but does not restore their content to the physiological levels. Enzymotherapy using lyticase, as well as use of lyticase with probiotic and lyticase with propolis has a more positive effect on the restoration and reduction of *Escherichiae coli* content in the digestive tract of geese. Complete recovery of *Escherichiae coli* to the physiological levels in the digestive tract of geese is observed when complex therapy is utilised using a combination of enzymatic drug lyticase, probiotic and propolis.

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尿微生物群和复发性肾结石的结石
URINE MICROBIOTA AND CONCREMENTS IN RELAPSING NEPHROLITHIASIS

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抽象。 现代社会中的肾结石病发病率达到25%。 在泌尿系统中结石形成的原因中，一个重要的作用属于微生物组，它影响尿液胶体系统的稳定性尿液和结石中微生物张力水平的研究允许采用致病性和致病性的方法。 防止重复结石形成。

关键词：尿石症，微生物群尿，Tamm-Horsfall蛋白。

Abstract. *Nephrolithiasis in modern society reaches 25% of the incidence. Among the causes of stone formation in the urinary system, an important role belongs to the microbiome, which affects the stability of the urine colloidal system The study of the level of microbial tension in the urine and calculus allows to take pathogenetic approaches for both profilaxis and prevention of repeat stone formation.*

Keywords*: urolithiasis, microbiota urine, Tamm-Horsfall protein.*

Background.

Metaphylaxis of urinary stone formation today is one of the important problems of urology due to the prevalence of urolithiasis, an increase in the incidence and the difficulty of a treatment method choice. At the same time, it is especially important that the overall incidence over the past 12 years has increased by more than 1,5 times [1, 2].

Today there is no single standpoint on the pathogenesis of kidney stone formation, which undoubtedly hinders the successful prevention of urolithiasis. Existing theories explain the individual links in a chain of factors leading to the formation of urinary stones [3, 4]. More than 200 different pathological conditions are known, which may be accompanied by the concrements formation in the urinary system organs [5, 6].

In recent years, a relationship has been found between the urolithiasis development and the metabolic syndrome which characteristic signs are obesity, diabetes mellitus, arterial hypertension, those are also considered important risk factors for the urolithiasis development [7,8]. Using an integrated approach to the study of the problem of urinary stones formation, urolithiasis has now begun to be referred to as renal manifestation of the metabolic syndrome.

Being a colloidal solution, urine contains high-molecular substances (proteins, polysaccharides), providing its stability. Destabilization of urine colloids leads to the formation of calculi [9]. The main stabilizer of colloidal urine properties is uromodulin (Tamm-Horsfall protein), the kidney glycoprotein which is most often represented in urine [10]. The inhibitory effect of THP on the growth of crystals in the urine is due to the presence on its surface of sialic acids, which charge the molecule negatively. The protective role of uromodulin is also noted in inflammatory processes. Due to its structure, THP binds mannose-dependent fimbria of infectious agents, which blocks the contact of bacteria with urotheliocytes [11].

Under certain circumstances, THP can be a promoter of urolithiasis. The daily production of THP is 50–150 mg, which determines its low concentration in the urine. When the pH changes, the structure of THP changes, which accordingly reduces its functional activity. There is evidence that in patients with systemic urolithiasis megamolecular complexes THP are defined with an average size of more than 1000 nm [12, 13]. Stone formation and infection in recent years have been sufficiently studied and the concept of "infectious stones" accepted [14].

Infectious effects can be considered as a pathogenetic factor in the development of urolithiasis. Most often, infection with pathogenic bacteria occurs along the ascending path (*Escherichia coli*, *Enterococcus spp*., *Candida spp., Pseudomonas aeruginosa*, *Corynebacterium urealyticum, Proteus spp*.), but sometimes hematogenous drift of bacteria from other infectious foci in the body (*Staphylococcus aureus, Haemophilus influenza* et cet.) [9]. Thus – THP is a protective component of the urinary tract, an important aspect of this problem is the clarification of the relationship of bacterial infection and their role in lithogenesis. Therefore, a comprehensive qualitative and quantitative assessment of urine microbiota and its influence on the state of uromodulin, lead to an improvement in the quality of urolithiasis metaphylaxis.

Objective: to establish the relationship of various microbial associations with changes in quantitative and qualitative deviations in the structure of the Tamm-Horsfall protein to optimize treatment and metaphylaxis in patients with urolithiasis.

Materials and methods.

In the urological clinic of the SBEI HPE “First St. Petersburg State Medical Universitynamed by Acad. I.P. Pavlov ”of the Ministry of Health of the Russian Federation in 2014-2017, 273 patients with urolithiasis (ICD) were examined - 144 (52.8%) men and 129 (47.2%) women, the age of the patients was 21-76

years. Recurrent urolithiasis was observed in 131 patients (47.9%), in 210 (76.3%) was unilateral, and in 63 (23%) bilateral.

Investigated 492 calculus, 198 (40.2%) were removed promptly and 294 (59.8%) that were retired after lithokinetic therapy. The control group consisted of 35 healthy individuals. Patients, along with standard clinical research, determined the microbiota of urinary stones and urine using gas chromatography - mass spectrometry GCMS with the determination of microbial markers of bacteria (including anaerobic), viruses, fungi, a total of 104 samples. To study the megamolecular complexes of the Tamm-Horsfall protein, the level and structure of uromodulin, we used the method of dynamic light scattering with its programmable cooling of 273 samples. Urinary stones were examined by electron-emission microscopy for the presence of nanoparticles.

The data obtained from patients with urolithiasis and persons in the control group were subjected to statistical processing.

Results and discussion.

The method of gas chromatography-mass spectrometry (GCMS) determined the microbial landscape of urine, which is represented by a large group of microorganisms (viruses, bacteria, fungi) representing obligate pathogens, optional and transient microorganisms. It was determined that the total bacterial load in the urine in the control group was 2362 ± 1125 CFU, and out of 57 microbial markers studied, 26 (45.6%) were not detected.

Urine microbiota in patients with systemic urolithiasis is characterized by an extremely high total bacterial load, which was 82715 ± 20547 CFU, and in patients with unilateral urolithiasis, this figure is lower and is determined in the interval 21419 ± 8017 CFU (picture 1).

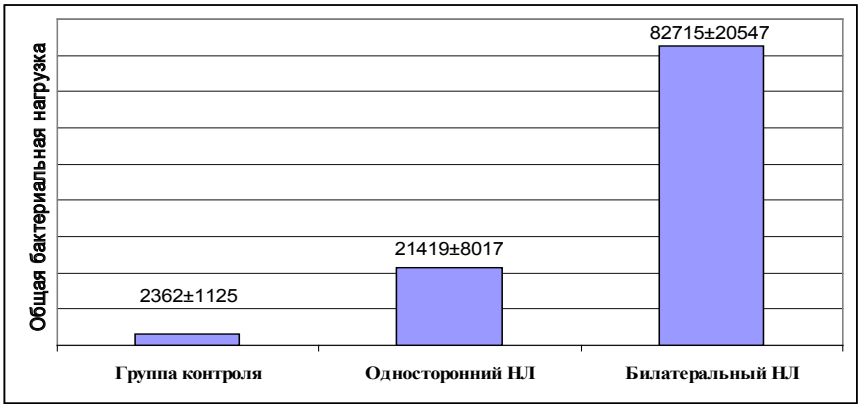

Figure 1. *Comparative characteristics of the total bacterial load in the studied groups (CFU) in order from left to right - control group; unilateral NL, bilateral NL*

The results of the study showed that the most frequent representatives of the microbiota of urine in patients with urolithiasis according to GCMS are *Aspergillus spp.*, *Herpes simplex*, *Streptococcus mutans*, *Clostridium (ramosum, difficile, coccoides*), *Nocardia asteroides*, *Klebsiella* (Table 1).

Table 1. *The most common microbial associations*

Microorganism	Frequency
Clostridium (perfringens, ramosum, tetani)	68 %
Str./Ruminococcus, Str. Mutans	46 %
Aspergillus spp.	42%
Nocardia asteroides	41 %
Herpes simplex	39 %
Bifidobacterium	36 %
Eubacterium, Eubacterium lentum (гр. A)	34 %

It is rather difficult to personify a specific pathogen in the processes of lithogenesis, due to the fact that some microorganisms can passively integrate into its structure during the formation of a urinary stone.

When studying the electron-microscopic structure of urinary stones, nanoparticles were found in all, regardless of the chemical composition (Fig. 2).

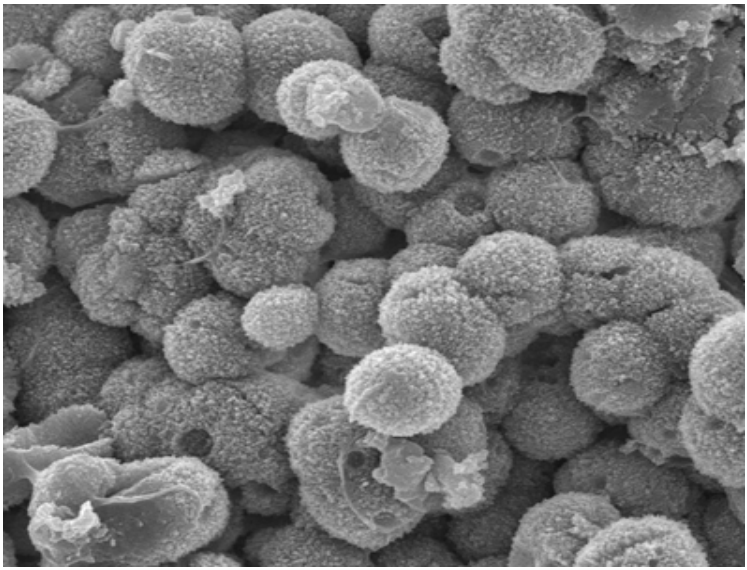

Figure 2. *Electron emission microscopy (x 10 000. 15 kv). Nanoparticles in the urinary stone*

Thus, calcific nanoparticles can be considered as structures directly involved in urinary stone formation. Taking into account the fact that microbial structures affect the acidity of urine and the structure of uromodulin, we applied the method of dynamic light scattering during programmed cooling of urine samples in order to determine the size of the Tamm-Horsfall protein complexes.

The study revealed that in patients with unilateral nephrolithiasis, the average particle size of THP was 172.8 ± 6.2 nm, in patients with the bilateral form of the disease, 1518.4 ± 12.3 nm, when this indicator in control subjects was 111.4 ± 4.8 nm (Figure 3):

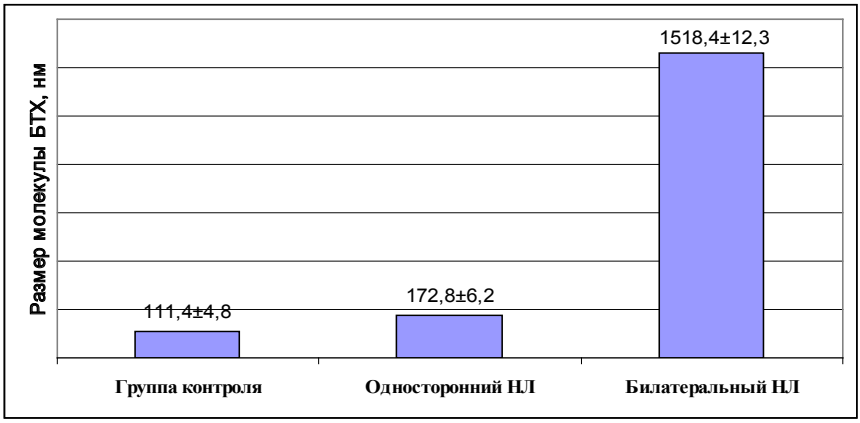

Figure 3. *Comparative characteristic of the sizes of THP molecules in the studied groups (nm).*
in order from left to right - control group; unilateral NL, bilateral NL

Conclusion.

Violation of the colloidal properties of urine, accompanied by a change in the structure of BTX, with the formation of megamolecular complexes, is combined with a high microbial load, established using mass spectrometry, which leads to the formation of crystallization centers with subsequent stone formation.

In the complex of metaphylaxis and prevention of urolithiasis, it is advisable to use antimicrobial agents (uroseptics) not only to reduce the risk of developing infectious and inflammatory complications, but also to increase the stability of the colloidal properties of urine.

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视神经原发性慢性缺血性神经病变的眼科表现和合并病理
OPHTHALMOLOGICAL MANIFESTATIONS AND COMORBID PATHOLOGY OF PRIMARY CHRONIC ISCHEMIC NEUROPATHY OF THE OPTIC NERVE

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抽象。文章描述了75名患有原发性慢性缺血性神经病的患者（150只眼）中眼球结膜，眼底，电生理指标，视神经乳头的变化。此外，还对伴随的病理进行了分析。眼球的下列变化显示：结膜微循环障碍（血管周围 – 肿胀51.3%，孤立性出血 – 46.7%的病例;血管形状改变 – 动静脉比率降低超过¼的80.0% ，小静脉和毛细血管动脉瘤 – 占67.3%;血管内改变 – 所有情况下）;在96%的病例中，视神经具有蜡质色泽，在100%的病例中，动脉粥样硬化，黄色区域的褪色和玻璃疣变化;电生理参数（眼睛电敏感性增加（p <0.05），视神经电活性降低（p <0.03））;神经视网膜纤维平均厚度显着减少（p <0.05），神经视网膜纤维横截面积显着减少（p <0.05）。

共病病理以慢性脑供血不足II期为代表，94.8%的病例为心血管疾病（IHD为67.3%，AH为86.0%）。

关键词：原发性慢性缺血性神经视网膜病变，微循环障碍，合并病理。

Abstract. *The article describes changes in the eyeball conjunctiva, fundus of the eye, electrophysiological indicators, optic nerve head in 75 patients (150 eyes) with primary chronic ischemic neuropathy. In addition, an analysis of concomi-*

tant pathology performed. The following changes in the eyeball were revealed: conjunctival microcirculation disturbances (perivascular - swelling in 51.3% of cases, isolated hemorrhages - in 46.7% of cases; changes in the shape of vessels - reduction of arteriovenous ratio more than ¼ in 80.0% of cases, aneurysm in venules and capillaries - in 67.3% of cases; intravascular changes - in all cases); pallor of the optic nerve with a waxy tinge in 96% of cases, atherosclerotic changes in the arteries, depigmentation and drusen in the macular region in 100% of cases; electrophysiological parameters (increase in the electrical sensitivity of the eye ($p < 0.05$), decrease in the electrolability of the optic nerve ($p < 0.03$)); a significant decrease in the average thickness of neuroretinal fibers ($p < 0.05$) and a significant decrease in the cross-sectional area of neuroretinal fibers ($p < 0.05$).

Comorbid pathology is represented by chronic cerebral insufficiency stage II in 94.8% of cases, cardiovascular diseases (IHD in 67.3% of cases, AH in 86.0% of cases).

Keywords: *primary chronic ischemic neuroretinopathy, impaired microcirculation, comorbid pathology.*

Relevance. The onset and development of the eye and its adnexa microcirculation disorders during aging of the body, as well as under the influence of various environmental factors, are largely determined by the endogenous features of the organism, therefore the presence of comorbidities in elderly people naturally affects the pathological changes in the optic nerve [5].

On average, elderly people have a combination of several diseases, such as: arterial hypertension (AH), atherosclerosis, coronary heart disease (CHD), diabetes mellitus, cereral vascular diseases [2, 3, 4, 5]. Chronic cerebral insufficiency, IHD, and AH are often accompanied by circulatory disorders in the vessels that supply the optic nerve. The ischemia is most often basis of the pathology in these group of diseases [2, 3, 4, 5].

The aim of our study was to examine violations of the conjunctival microcirculation, changes in the fundus of the eye, electrophysiological indicators, the optic nerve morphostructure and the presence of comorbid diseases in patients with primary chronic ischemic neuropathy.

Materials and methods. General clinical examination methods were used: collection of anamnesis with the study of risk factors for vascular atherosclerosis, the study of objective status, additional clinical and biochemical research methods, including complete blood count, blood biochemical study (plasma lipid spectrum studies, seromucoid, transaminases); ophthalmic, electrophysiological, functional, ultrasound, morphometric, magnetic resonance imaging.

Criteria for the inclusion of patients to the study: the presence of coronary artery disease, hypertension, chronic cerebral insufficiency; the presence of ophthal-

mologic clinical criteria for vascular pathology of the optic nerve; elderly patients (60 - 75 years). Exclusion criteria from the study: comorbidity of various organs and systems, including the violation of their functions (severe cardiac, respiratory, renal, hepatic, adrenal insufficiency, etc.); phlebothrombosis of the eyeball vessels, without clinical damage to the optic nerve; glaucoma of all kinds; history of penetrating wounds of the eyeball, inflammatory diseases of the retina, choroid and optic nerve, descending optic nerve atrophy, congenital pathology of the optic nerve. As a result of screening patients, the main group of 75 people (150 eyes) with vascular pathology of the optic nerve on the background of coronary artery disease, hypertension, chronic cerebral insufficiency were distinguished, among them 42 men (56.0%), 33 women (44.0%), average age 68.5 + 5.6 years.

Ophthalmologic examination included determination of visual acuity under standard lighting conditions, examination of the field of vision with standard kinetic perimetry and automatic perimetry, biomicroscopy, direct and reverse ophthalmoscopy under conditions of pharmocological mydriasis, investigation of the eye fundus using a binocular ophthalmoscope and Goldman eye optonemoscope, Maklakov tonometry. There were no statistically significant differences in intraocular pressure in all patients: the indices were 17–22 mm Hg. Art. (according to Maklakov). In addition, a study of bulbar conjunctival microvasculatory was performed using a “Slim Lamp SL-40/45/45 DX” slit lamp using a device with a WAT-202 D (pal) video camera.

The ratio of the caliber of arterioles and venules of the microvasculature was determined. The basis was a map of changes in the bulbar conjunctiva according to V.S. Volkov, where perivascular changes (PCh), changes in the shape of the vessels (ChVSh), intravascular changes (IVCh) i.e. the sludge-phenomenon form (SF) - blood flow fragmentation and microthrombosis (MT). Electrophysiological examination (EPE) of the eye made it possible to study the functional state of the retina, optic nerve, and included the determination of the electrical sensitivity threshold (ESTh) and lability of the optic nerve (ONL). Studies were performed according to the standard technique [6]. The study of the optic nerve head morphometric structure was carried out on the HRT II apparatus (Heidelberg Engineering, Dossenheim, Germany). The condition of the optic nerve head was evaluated by 15 ° stereography. The boundaries of the disk allocated manually. Statistical analysis of digital material was carried out on a personal computer using the statistical program “Statgraphics”. The methods of variation statistics were used [1], the results are presented in the form of M + m. The reliability of intergroup differences of average values was assessed using Student’s t-test, and with an abnormal distribution of samples, using the non-parametric Mann-Whitney test. The reliability of the indicators was evaluated using the paired Student’s t test and the non-parametric Wilcoxon test. The reliability of the difference between the sampling

fractions was determined by the criterion for comparing the sampling fractions z. For the reliability of the differences of the studied parameters was taken the meaning $p < 0.05$.

Results and discussion. All patients with primary chronic ischemic neuropathy noted a slow, gradual, painless decrease in vision over a period of 5 to 10 years. All patients had visual acuity in the range of 0.2 - 0.7 (Fig. 1).

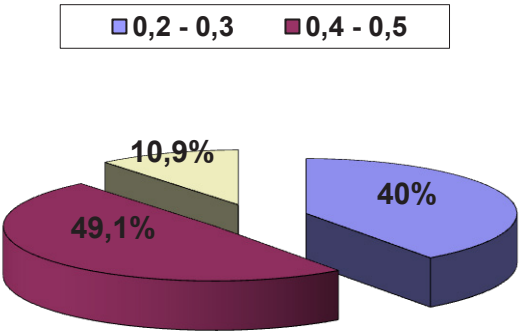

Fig. 1. *Visual acuity with correction in patients with primary chronic ischemic neuropathy* ***lilac -*** *concentric narrowing of the field of view; purple color - concentric constriction and scotoma*

According to computer static perimetry data, 111 (74.0%) of cases (eyes) showed a concentric narrowing of the visual fields, including 62 (41.3%) cases had a diffuse decrease in photosensitivity, in 49 (32.7%) cases (eyes) it was combined with paracentral and central scotomas. Most rarely, 9 (6.0%) patients were diagnosed with segmental defects of the visual field (Fig. 2).

According to biomicroscopy, perivascular changes were manifested by perivascular edema in 77 (51.3%) cases (eyes) (of these, widespread edema was detected in 43 (28.7%) cases (eyes)), with single hemorrhages in 70 (46.7% a) cases (eyes). Changes in the shape of the vessels - in the form of a decrease in the arteriovenous ratio of more than ¼, pathological tortuosity of the veins, the formation of desolation zones and the mesh structure were noted in all 120 (80.0%) cases (eyes), while aneurysms in the venules and capillaries - in 101 (eye) (67.3%). Intravascular changes were manifested as microthrombosis in all 150 (100%) cases (eyes) (Fig. 3).

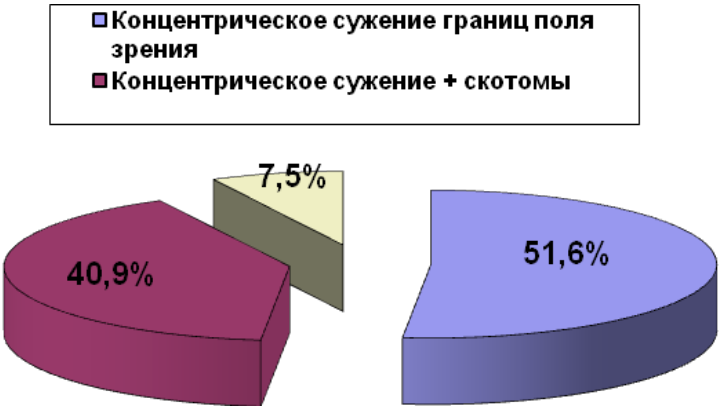

Fig. 2. *State of the visual field in patients with chronic ischemic neuropathy*

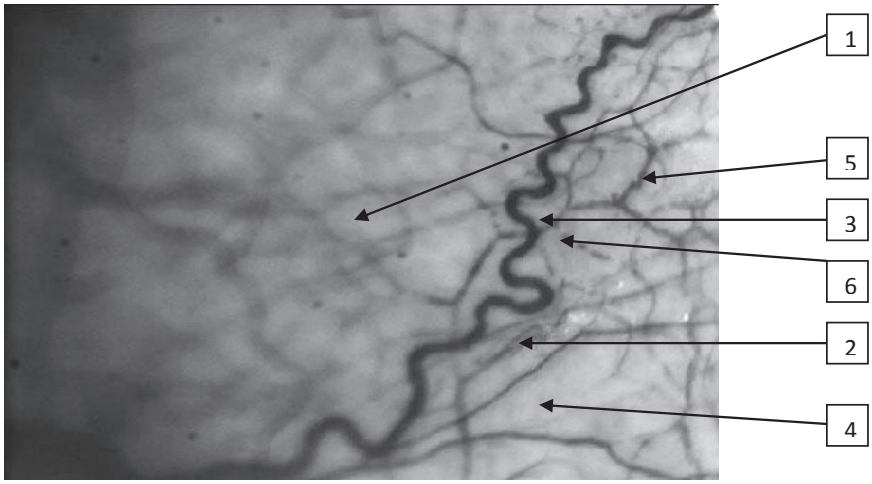

Fig. 3. *Biomicroscopic picture of the bulbar conjunctiva of a patient with primary chronic ischemic neuropathy:*
1- perivascular edema, 2 - single hemorrhage,
3 - decrease in arterio-venous ratio more ¼,
4 - desolation zones, 5 – venous and capillary aneurysms, 6 – microthrombosis

According to gonioscopy, in 37 (24.7%) cases (eyes) of patients, the angle profile was beak-shaped, the Schlemm's channel was clearly visible, the angle pigmentation took a mixed character; in 38 (25.3%) cases (eyes) there was a wide open angle, with the average position of Schlemm's channel, with a pigmentation of a hybrid nature, symmetrical.

In 72 (96%) patients, the ophthalmoscopic picture was characterized by a pale optic nerve disc with a waxy shade. In 3 (4%) patients, the optic nerve head was pale and monotonous, with clear boundaries, surrounded by a ring of peripapillary atrophy of the choroid. In addition, all patients had atherosclerotic changes in the arteries, depigmentation and drusen in the macular region (Fig. 4). Patients with pseudoglaucomatous excavation of the optic nerve head were not included in the study.

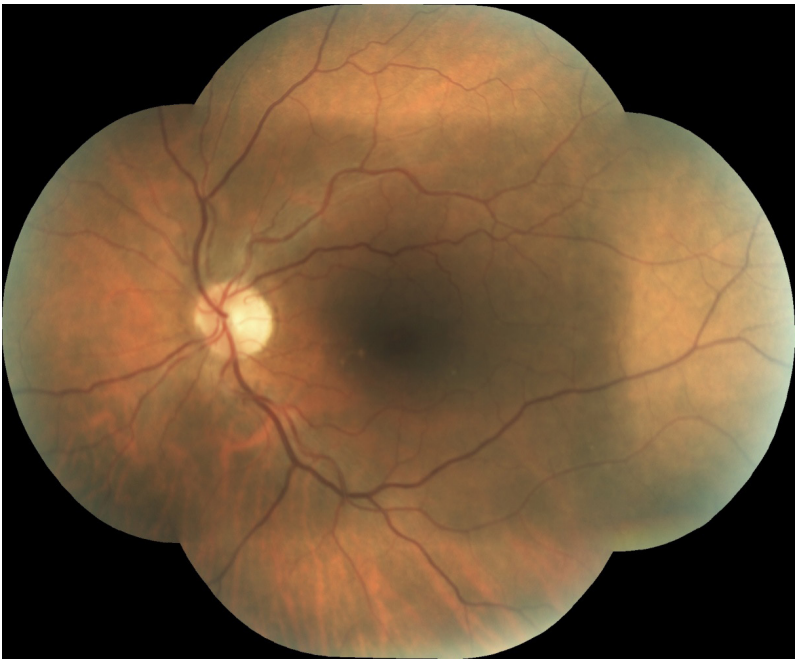

Fig. 4. *Ophthalmoscopic picture of primary chronic ischemic neuropathy (pale and monotonous optic nerve head, single drusen in the macular area)*

Electrophysiological examination of the optic nerve in all patients showed an increase in the eye electrical sensitivity threshold EEST = 296,5±52,7 μA ($p < 0,05$) and a decrease in the electrolability of the optic nerve 37,15±12,23 Hz ($p < 0,03$).

In the study of the optic disk topography (HRT II), the following changes were identified: optic disk area – 2,65 ± 0,61 mm^2; cup area – 0,68 ± 0,43 mm^2 (tendency to reduce the area of deepening); neuroretinal rim area – 1,97 ± 0,71 mm^2; cup volume – 0,10 ± 0,08 mm (tendency to reduce the volume of deepening); rim volume – 0,41 ± 0,19 mm; cup/disk area ratio – 0,26± 0,11; linear cup/disk ratio – 0,50 ± 0,14; mean cup depth – 0,17 ± 0,07 mm; maximum cup depth – 0,52 ± 0,25 mm; cup shape measure – 0,17 ± -0,13 (tendency to a decrease in the height of the deepening); height variation contour – 0,35 ± 0,17 mm; mean RNFL thickness – 0,14 ± 0,03 mm (significant decrease in the average thickness of neuroretinal fibers, $p < 0,05$); RNFL cross sectional area – 0,71 ± 0,17 mm^2 (significant decrease in the cross-sectional area of neuroretinal fibers, $p < 0,05$).

The frequency of comorbid cardiovascular diseases (IHD, AH) in the elderly group with primary chronic ischemic neuropathy was studied. The analysis showed that out of 75 patients with IHD was in 50 (67.3%), AH - in 64 (86.0%), prevailed: AH of II st. (42.7%) and AG III st. (28.6%), significantly less frequently noted hypertension I st. (14.7%).

According to the data of a clinical neurological study, functional and magnetic resonance imaging, the stage of chronic cerebral insufficiency 2 (2.5%) stage I, 71 (94.8%) stage II 2 (2.5%) stage III was determined.

Conclusion:

Elderly patients with primary chronic ischemic neuroopticopathy showed changes in the microcirculation of the conjunctiva: perivascular (edema in 51.3% of cases, isolated hemorrhages in 46.7% of cases); changes in vessel shape (reduction of arteriovenous ratio more than ¼ in 80.0% of cases, aneurysm of venules and capillaries in 67.3% of cases); intravascular changes - in all cases.

Ophthalmoscopic picture was characterized by a pale optic nerve disc with a waxy tinge in 72 (96%) of patients, all had atherosclerotic changes in the arteries, depigmentation and the drusen in the macular area.

Changes in electrophysiological parameters were manifested: an increase in the electrical sensitivity threshold of the eye ($p<0,05$), and a decrease in the electrolability of the optic nerve 37,15±12,23 Hz ($p <0,03$).

The morphometric structure of the optic nerve head revealed a significant decrease in the average thickness of neuroretinal fibers ($p <0.05$) and a significant decrease in the cross sectional area of neuroretinal fibers ($p <0.05$). Chronic cerebral insufficiency stage II was observed in the majority of patients with primary chronic neuroopticopathy (94.8%), the presence of comorbid cardiovascular diseases was noted with primary chronic ischemic neuroopticopathy in 67.3% of IHD, in 86.0% of AH.

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目前十年来该地区眼科损伤的趋势
CURRENT TRENDS IN OPHTHALMOLOGIC INJURY IN THE REGION OVER TEN YEARS

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抽象。 视力器官的损伤在失明和低视力的原因中占很大比例，这是由于受伤的高发病率和伴随的伴随的眼功能障碍的严重性。 文章分析了目前成人人群眼外伤的趋势，这需要在秋明地区全天候运营的专科医院住院十年，检查其频率和结构。

住院的主要原因，动态最常见的眼损类型指标确定。 在十年期间，眼科伤害患者的住院比例从18.5%降至8.4%，其中家庭伤害为83.8%（穿透性角膜损伤和巩膜下结膜破裂）。

关键词：眼外伤，眼外伤后遗症，眼内感染，结膜下巩膜破裂，住院率，外扩。

Astract. *Injuries to the organ of vision constitute a significant number among the causes of blindness and low vision due to the high incidence of injuries and the severity of comorid eye function disorders that occur with them. The article analyzes the current trends in eye injuries among the adult population, which required hospitalization in a specialized hospital operating around the clock in the Tyumen region for ten years, examined its frequency and structure.*

The main causes of hospitalization, dynamics of the most frequent types of eye injuries indicators identified. Over a ten-year period, the proportion of hospitalizations of patients with ophthalmologic injury decreased from 18.5% to 8.4%, of which household injury was 83.8% (penetrating corneal injury and subconjunctival rupture of the sclera).

Key words: *eye injuries, consequences of eye injuries, intraocular infection, subconjunctival sclera rupture, hospitalization rate, ectomia.*

Relevance. Recently, there has been an increase in the number of patients with severe injuries to the eyeball due to household and criminal injuries [1, 2, 5, 6]. The medico-social significance of eye injuries is indicated by the frequency mainly in people of young working age and the possibility of developing complications that pose a serious threat to vision [4].

Modern analysis of the problem state has shown that among household and criminal injuries, contusion holds a leading place in all regions of the Russian Federation [1, 3, 6]. According to statistics, an average of 12% of the adult contingent of a specialized ophthalmological hospital is treated for injuries and their consequences [1, 6]. In various regions of Russia, the consequences of severe eye injury in the structure of disability by sight are 7.0 - 22.8% and cause unilateral blindness in 50%, bilateral in 20% [1.6].

Purpose of the study. Identify the current trends in ophthalmic injury among hospital injuries of the adult population in the Tyumen Region for ten years.

Materials and methods. The statistical reports of the around the clock ophthalmology department from the State Budgetary Institution of Health Care of the Tyumen Region "Regional Clinical Hospital No. 2", Tyumen was the object of the study, for the period from 2006 to 2015. The data were studied and analyzed retrospectively. The analysis assessed the total number of patients who received inpatient treatment, the number of patients with injuries to the eyeball and its adnexa, the mechanism and types of injuries. In addition, the structure of the hospital injury and its consequences were analyzed. Statistical processing of the material carried out by the program "Statistika 6".

Research results. For 10 years, in a specialized ophthalmology department of the hospital, "RCH No. 2" Tyumen, 1917 patients were treated with injuries to the eyeball, adnexal apparatus of the eye, and injuries, which accounted for 13.0% of the total number of hospitalized. During the analyzed period, there is a fluctuation in the proportion of patients receiving inpatient treatment: in 2006, 16.2%, in 2008 -18.5% (Table 1). From 2009 to 2015, there was a decrease in the absolute number of patients with eye injuries and its consequences from 215 to 151, as well as their share in the hospital structure (from 18.5% to 8.4%).

Table 1

The total number of hospitalized patients and the number of patients with eye injury

Abs.-%	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Total	1099	1226	1296	1328	1430	1606	1620	1621	1692	1801	14721
Trauma	186 (16,2 %)	223 (18,1 %)	240 (18,5 %)	215 (16,1 %)	187 (13,0 %)	188 (11,7 %)	191 (11,7 %)	149 (9,2 %)	187 (11,0 %)	151 (8,4 %)	1917 (13,0 %)

The analysis of the injury types frequency, as well as amputations (Table 2) showed that the criminal-domestic nature of the injury prevails 8.5 times. Amputational operations are mainly represented by enucleation: - enucleation 97 (5.05%), evisceration 4 (0.3%).

Table 2

Frequency types of injuries and deletions of the eyeball

Types of injuries and organ-bearing operations	Abs ./% of the total number of injuries(n=1917) - 100%
work injuries	189 (9,9%)
domestic injuries	1607 (83,8%)
others	121 (6,3%)

Table 3 shows the indicators for hospital trauma in the structure of traumatic injuries, among them the leading place is occupied by a closed eye injury, in the second place penetrating injuries, in the third is burner, which does not differ from the average indicators in the Russian Federation

Table 3

Hospital injury structure

Analyzed indicators	Abs n=1917(100%)
Non-penetrating injured eyes	71(3,7%)
Penetrating injured eyes	694(36,2%)
Closed injury	799(41,7%)
Burns	242(12,6%)
Consequences of injury	44(2,3%)
Other	67(3,5%)

The share of penetrating wounds of the eyeball (PWE) accounts for 36.2% (Table 4), corneal wounds take the leading place, the second is scleral, the third is corneoscleral. A low percentage of intraocular infection (IOI) is associated with the provision of timely microsurgical treatment and the appointment of adequate pharmacological support.

Table 4

Clinical statistics of penetrating wounds of the eyeball

Analyzed indicators	Abs n=694 (100%)
Localization:	
Corneal	406(58,5%)
Scleral	179(25,8%)
Corneoscleral	109(15,7%)
Shredded / deleted	222(32,0%)
Intraocular infection	30(4,3%)
Traumatic cataract	91(13,1%)
Amputations	47(6,8%)
Average bed-day	11,1±2,9

In the structure of hospital ophthalmologic injury (Table 5), the share of eyeball contusions is 41.7%, of which 1/5 is subconjunctival scleral rupture (SCRS). The high rate of destruction of the eyeball and conditions requiring enucleation when seeking specialized help in this category of patients is associated with late treatment and, as a result, the development of IOI and sympathetic ophthalmia.

Table 5

Contusions of the eyeball, orbit

Analyzed indicators	Abs n=799(100%)
SCRS	158(19,8%)
Severe contusions without SCRS	608(76,1%)
Destruction of the eyeball / condition requiring enucleation	33(4,1%)
Average bed-day	9,5±1,5

A tendency was found to lengthen the average bed-day in patients with penetrating eye wounds in comparison with patients who received a dull eye injury (Tables 4, 5), which is associated with the development of IOI and traumatic cataracts, glaucoma, which require additional surgical interventions for early reconstructive surgery to improve visual function.

Conclusions:

1). Modern trends in ophthalmologic injury, which require hospitalization in a specialized hospital operating around the clock, in the Tyumen Region is a decrease in its proportion from 18,5% до 8,4%.

2). The criminal-domestic nature of the eyeball damages and its adnexa is 83.8% and holds a leading position in the hospital injury structure.

3). The main causes of hospitalization are penetrating eye wounds and the consequences of a dull eye injury.

4). Among hospital injuries, penetrating injuries occupy 36.2% in the structure of traumatic injuries, non-penetrating - 3.4%, closed injuries - 41.6%, burns - 12.6%, consequences of injuries - 2.3%, others - 3.5 %.

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心血管疾病患者CoQ10的氧化还原状态
REDOX STATE OF COQ_{10} IN PATIENTS WITH CARDIOVASCULAR DISEASES

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抽象。 背景。 辅酶Q10可保护身体免受自由基侵害。 与其他抗氧化剂不同，它不会被生物破坏，但其分子会被反复使用。 CoQ10的氧化还原状态可能起到氧化应激标记的作用。

Abstract. *Background. Coenzyme Q10 protects the body against free radicals. Unlike other antioxidants it is not destroyed by the organism, but its molecules are used repeatedly. The redox state of the CoQ_{10} may play the role of the marker of oxidative stress.*

Materials and methods. HPLC-MS/MS was used to evaluate the redox state of CoQ_{10}: the ubiquinol:ubiquinone ratio. The study included 50 patients with cardiovascular diseases

Results and Discussion. There was developed a methodology of ubiquinol determination using the difference between total CoQ_{10} and ubiquinone. According to the study, the average percentage of ubiquinol in relation to the total CoQ10 was 31.73%. Respectively, the percentage of ubiquinone in the samples was 68, 27%.

Conclusion. Cardiovascular diseases are accompanied by an increased level of oxidative stress, which leads to a decrease in antioxidant levels in the human body. And the redox state of CoQ10, namely the ubiquinone: ubiquinol ratio may play the role of marker of oxidative stress.

关键词：辅酶Q10，泛醌，泛醇，氧化还原态
Keywords: *CoQ10, ubiquinone, ubiquinol, redox state*

Introduction

Coenzyme Q10 performs an important task: it participates in the antioxidant defense of the body [1-3]. Most endogenous antioxidants (vitamins A, C, E), protecting the body against free radicals, are irreversibly oxidized and destroyed. In contrast, the active form of coenzyme Q10 is restored by the body, and the molecules of coenzyme Q10 are used repeatedly.

The redox state of coenzyme Q10 is named the ratio of its oxidized to reduced form (ubiquinone: ubiquinol). In a healthy body, this ratio is 95 (ubiquinol): 5 (ubiquinone) [4].

Since the redox state of the organism is a disturbance between the prooxidant and antioxidant balance caused by various factors (functional, organic disorders, as well as the administation of various drugs), it is assumed that if this balance is disturbed, the concentration of antioxidants in the blood plasma also changes. The main factor causing oxidative stress is ROS. The accumulation of ROS can cause both endogenous and exogenous factors. Among the endogenous sources of ROS, the most common are superoxide anion, hydroxide radical and hydrogen peroxide [5].

Materials and methods

Determination of redox-state was carried out by high performance liquid chromatograpy (HPLC) Nexera LCMS-8040 (QQQ), Shimadzu (Japan). For chromatographic separation in a gradient mode, a column Luna C18, Phenomenex (USA) was used.

The following reagents were used: acetonitrile, methanol from Biosolve Chimie (France), isopropanol, ethyl acetate, formic acid, ammonia from PanReac Applichem (Spain), DL-α-tocopherol acetate from MP Biomedicals (USA).

During ionization, the ESI electrospray method was used in a positive mode. Detection was carried out in the MRM mode (monitoring of multiple reactions). The precursor ion corresponded to [M + NH4] +: 880.7 m/z, and the fragment ion corresponded to 197.1 m/z. Tocopherol acetate was chosen as an internal standard, the precursor ion of which corresponded to the protonated molecular ion [M + H] + with 473.25 m/z.

The study included 50 patients with cardiovascular diseases. Statistical analysis was performed using Statistica SPSS.

Results and discussion

There were analyzed 50 patients with cardiovascular diseases. The total CoQ10 concentration was determined by the complete oxidation of ubiquinol to ubiquinone using DDQ. In turn, the concentration of ubiquinol was calculated from the difference of total CoQ10 and ubiquinol (Figure 1).

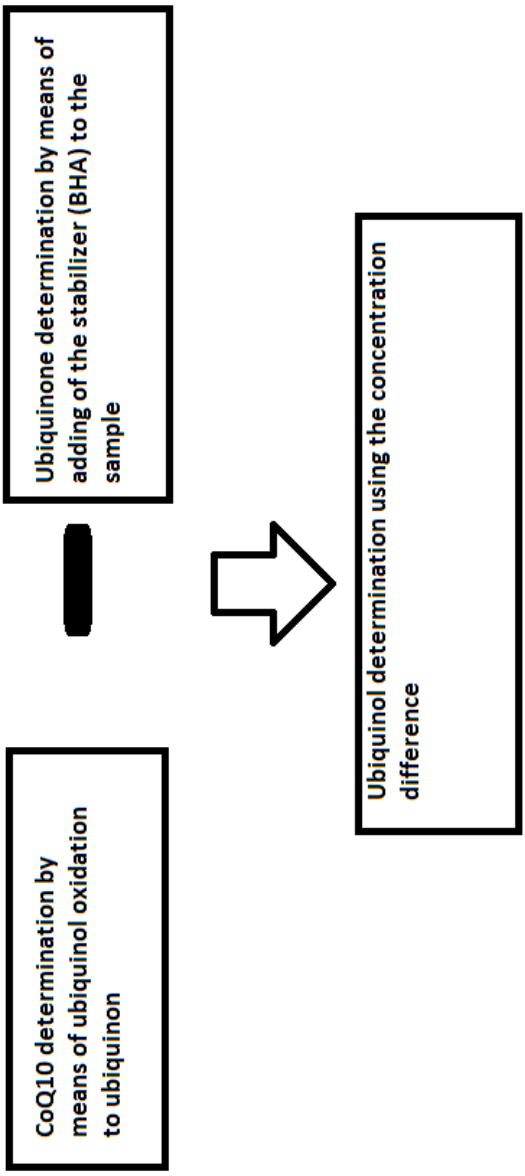

Figure 1. *Method for ubiquinol determination in plasma samples*

According to the obtained data, the ratio of concentrations of ubiquinone: ubiquinol changes in the direction of the oxidized form.

Table 1. *The ratio of the reduced form (ubiquinol) of CoQ10*

Parameter	Ubiquinol/ CoQ_{10}, %
Mean	31,73
SD	5,9
n	60
SEM	0,7483
Upper confidence interval (95%)	33,233
Lower confidence interval (95%)	30,233

In order to compare the obtained value with that considering as normal in healthy patients, we performed one-tailed Student's t-test. Usually this test is carried out to compare the variances of a previously known value with the obtained sample. For the null hypothesis, it was assumed that the percentage of ubiquinol should be 95%. While conducting the Student's one-tailed t-test, the t-criterion was equal to 84.549 with 96 degrees of freedom. The value of $p<0,0001$, which means that there was a statistically significant difference between the average sample of plasma ubiquinol concentration and the average value of healthy.

According to the study, the average percentage of ubiquinol in relation to the total CoQ10 was 31.73%. Respectively, the percentage of ubiquinone in the samples was 68, 27%.

Conclusion

With an increase in the background of oxidative stress and pro-oxidants in various diseases, the level of equilibrium between the oxidized and reduced forms of CoQ10 is shifted. This means that cardiovascular diseases are accompanied by an increased level of oxidative stress, which leads to a decrease in antioxidant levels in the human body. And suggests that antioxidants administration can restore the redox balance of organism. Furthermore the redox state of the CoQ_{10} may play the role of the marker of oxidative stress. This conclusion requires further detailed studis and an increase in the number of study patients.

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蜂痘对鸟类先天免疫系统的影响
EFFECT OF BEE PODMORE ON INNATE IMMUNE SYSTEM IN BIRDS

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摘要本文介绍了不同剂量蜂荚提取物对鹌鹑免疫系统自然机制参数影响的研究数据。 低剂量有助于鸟类的血清杀菌和溶菌酶活性的适度增加以及假嗜酸性粒细胞的吞噬活性。 平均剂量显着激活假嗜酸性粒细胞的SBA，SLA和PA，并有助于它们长期维持较高的生理水平，从而增强鸟类的免疫系统。 相反，较高剂量显着超过推荐值会抑制鹌鹑的天然免疫防御机制

关键词：鹌鹑，蜂荚，提取物，剂量，天然抗性，杀菌活性，溶菌酶，吞噬作用，假嗜酸性粒细胞。

Abstract*. The article presents data on the study of the effect of different doses of bee podmore extract on the parameters of the natural mechanisms of quail's immune system. Low doses contribute to a moderate increase in the serum bactericidal and lysozyme activity of birds'and phagocytic activity of the pseudo-eosinophils. Average doses significantly activate SBA, SLA and PA of pseudo-eosinophils and contribute to their long-term maintenance of higher physiological levels, boosting the immune system of the birds. Higher doses significantly exceeding the recommended values, by contrast, inhibit the natural immune defense mechanisms in quails*

Keywords: *Quails, bee podmore, extract, doses, natural resistance, bactericidal activity, lysozyme, phagocytosis, pseudo-eosinophils.*

Materials and methods. The research was carried out in the laboratories of the Microbiology and Immunology Department of Russian State Agrarian University. The experiments were conducted in the poultry farm of the Department of Special Animal Husbandry. 140 French breed quails for meat were used in the research. The birds, according to the principle of analogy, were divided into 4 groups. Group 1 quails were the control and no additional manipulations were carried out on them,

their feeding conditions were the same to the experimental groups. Birds of the 2nd, 3rd and 4th groups were experimental groups, they received different doses of BPE (bee podmore extract) with drinking water from the age of 15 days for 30 days. Extract was dissolved in drinking water, at the ratio of 0.1 ml BPE per 100 grams of bird weight. The low dose (group 2) was 0.05 ml / head (1 drop per bird; 10 drops per 10 birds per 100 ml water). The average dose (group 3) was 0.1 ml / head (2 drops per bird, 20 drops per 10 birds per 100 ml of water). The high dose (group 4) was 0.3 ml / head (6 drops per bird, 60 drops per 10 birds per 100 ml of water). Birds were slaughtered on days 7, 14, 30, 45, 60, 90 and 210 of the experiment. Haematological studies were carried out on Haematologic PCE analyser 90 vet. Serum bactericidal activity was determined by the Michel Teffer method with modifications by O.V.Smirnova and T.A. Kuzmina (1966) with *E. coli* test culture*;* lysozyme - according to V. G. Dorofatechuk (1983) with the *M. lisodecticus* test culture.

PA of pseudo-eosinophils was conducted by the method of V.M. Berman and E.M. Slavskaya with *Staphylococcus aureus* test culture.

Statistical analysis of the quantitative data was performed using Statistica 6.1 and Excel from MS Office XP.

Results and discussions. Studies on the natural resistance parameters of quails and phagocytic activity of pseudo-eosinophils in the blood of quails were carried out after 14, 30, 45, 60, 90 and 210 days from the beginning of the experiment.

The serum bactericidal activity of quails (Fig. 1), 14 days after the beginning of the experiment, was significantly different in groups.

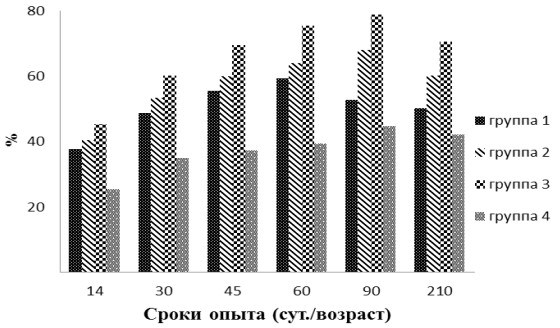

Fig. 1. *Dynamics of serum bactericidal activity of quail*

The maximum value observed in this period of the experiment was noted in group 3 - 45.4 ± 3.1, which was higher than those of groups 1, 2 and 4 by 1.2; 1.12 and 1.77 times (by 7, 64.8 and 19.8%) respectively. In the subsequent study periods (days 30, 45, and 60), group 3 quails' serum bactericidal activity continued to exceed those of the control group 1 and groups 2, 4. At day 30 the difference was by 1.23; 1.12 and

1.72 times (by 11.4; 6.7 and 25.2%), at day 45 - 1.25; 1.16 and 1.87 times (by 14.1; 9.7 and 32.4%), at day 60 - 1.27; 1.18 and 1.91 times (by 16.0; 11.4 and 36.1%); at day 90 - 1.49; 1.16 and 1.76 times (by 26.2; 10.8 and 34.2%). By day 210, there was a decrease in the bactericidal activity of quails in all groups compared to their values in the previous experimental period (day 90). However, as in all previous periods of the experiment, the maximum value of SBA was observed in group 3 quails, slightly lower than this were SBA parameters of group 2 birds by 1.17 times (20.2%). Parameters were significantly lower in control group birds by 1.4 times (10.3%).

The minimum SBA parameter of quails by the end of the experiment was noted in group 4. This parameter was lower compared to the data obtained from groups 1, 2 and 3, respectively, by 1.19; 1.42 and 1.67 times (8.1; 18.0 and 28.3%).

During the experiment, under the influence of various doses of the BPE, serum lysozyme activity (SLA) varied just like SBA dynamics in quails (Table 1).

Table 1. *The effect of different doses of BPE on the dynamics of serum lysozyme activity in quails (%)*

Groups	Stat	Study periods/age (days)					
		14/28	30/45	45/60	60/75	90/105	210/215
		SLA parameters					
1	M	13.9	15.4	18.2	16.4	17.0	17.8
	±m	1.5	1.6	1.3	1.4	2.6	1.6
	cV, %	10.9	9.0	7.2	8.4	15.0	9.1
	P		*	*	*	*	*
2	M	16.5	17.3	20.8	21.7	21.4	19.7
	±m	1.7	1.6	3.1	2.7	1.4	1.3
	cV, %	9.8	7.2	14.8	8.4	6.6	6.5
	P		*	*	*	*	*
3	M	19.6	21.9	25.6	25.9	22.9	23.6
	±m	1.5	1.6	1.4	2.8	1.9	3.4
	cV, %	7.5	7.2	5.6	10.7	8.3	14.2
	P		*	*	*	*	*
4	M	8.1	10.6	12.9	14.2	16.3	15.8
	±m	1.2	1.4	1.6	1.3	1.2	1.6
	cV, %	14.5	13.3	12.3	9.1	7.2	10.0
	P		*	*	*	*	*

Note: Group 1 - control, group 2 - low doses, group 3 - medium doses, group 4 - high doses. P≤0.05

The highest values of the SLA in all periods of the experiment were recorded in group 3. By day 14 the described parameter was higher than values in the control group and experimental groups 2, 4 by 1.41; 1.19 and 2.42 times (5.7; 3.1 and

11.5%), by day 30 – 1.42; 1.26 and 2.06 times (by 6.5; 4.6 and 11.3%), by day 45 - 1.4; 1.23 and 1.98 times (by 7.4; 4.8 and 12.7%), by day 60 - 1.58; 1.19 and 1.82 times (by 9.5; 4.2 and 11.7%), by day 90 - 1.34; 1.07 and 1.4 times (by 5.9; 1.5 and 6.6%). By the end of the experiment - day 210, the SLA indicator of quails had no significant changes, compared with its value in the previous experimental period. In this period, the SLA values of the birds in all groups stabilized and remained approximately at the same level as in previous experimental period - day 90.

Parameters of group 3 birds at the end of the experiment continued to remain at the maximum and exceeded the values of birds in groups 1, 2, and 4 by 1.32; 1.19 and 1.49 times (by 5.8; 3.9 and 7.8%).

The data presented in Figure 1 and Table 1 show that different doses of BPE have significant impact not only on the parameters of the humoral immunity (SBA and SLA), but also on the dynamics of the cell-mediated immunity - phagocytic activity (PA) of pseudo-eosinophils in quail blood (table 2).

The changes in PA of pseudo-eosinophils in the blood of quails were observed as early as day 14 of the experiment. By this period, the unequivocal value of this parameter was recorded. The maximum level of PA of pseudo-eosinophils was observed in group 3 quails. This trend continued during the whole experiment.

By day 14 the PA of pseudo-eosinophils was higher than values in groups 1, 2 and 4 by 1.22; 1.14 and 2.09 times (8.1; 5.7 and 23.3%), at day 30. – 1.16; 1.1 and 2.16 times (by 7.1; 4.9 and 26.7%), at day 45.- 1.17; 1.11 and 2.21 times (by 8.0; 5.5 and 29.9%), at day 60.- 1.26; 1.14 and 2.07 times (by 12.3; 7.2 and 30.5%), at day 90 - 1.26; 1.06 and 1.71 times (by 13.0; 3.6 and 25.9%).

Table 2 *Dynamics of the phagocytic activity (PA) of pseudo-eosinophils of quails under the influence of different doses of BPE*

Groups	Stat.	Study periods/age (days)					
		14/28	30/45	45/60	60/75	90/105	210/225
		PA of pseudo-eosinophils					
1	M	36,5	42,6	46,5	47,4	50,2	49,3
	±m	1.5	1.0	5.2	2.0	2.3	3.2
	cV, %	4.0	2.2	11.2	4.2	4.5	6.7
2	M	38,9	44,8	49,0	52,5	55,6	58,7
	±m	3.0	1.7	7.1	1.4	3.5	3.5
	cV, %	7.8	3.8	14.4	2.6	6.3	6.0
	P	***	***	***	*	**	*
3	M	44,6	49,7	54,5	59,7	58,9	62,3
	±m	1.8	2.2	2.0	6.8	4.5	1.8
	cV, %	4.1	4.4	3.7	11.4	7.7	3.0
	P	*	*	**	*	*	*
4	M	21,3	23,0	24,6	28,8	30,2	36,4
	±m	2.4	1.4	1.2	2.1	4.0	2.7
	cV, %	11.1	6.1	5.0	7.5	13.2	7.5
	P	*	*	*	*	*	*

Note: Group 1 - control, group 2 - low doses, group 3 - medium doses, group 4 - high doses.

Conclusions. In order to activate the innate immune system and increase quails' productivity, it is recommended to dissolve medium doses of BPE in their drinking water from the age of 15 days for 30 days at the ratio of 0.1 ml BPE per 100 grams of body weight. With an average live weight, at the beginning of the experiments (15 days old quails), of 55-57 grams, the dose for the quails was 0.1 ml / head. (2 drops per bird, 20 drops per 10 birds per 100 ml of water). From day 1 to 15 (15 - 30 days old quails), the solution should be administered individually from pipettes, and in subsequent periods, in groups using drinking bowls. Recalculation of BPE doses, taking into account the increase in the weight of the birds is done in day 15 of the experiment (30 days old quails) and it does not change until the end of the administering course (30 days - 45 day quails).

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工业设备的可变性有效保护
VARIABILITY EFFECTIVE PROTECTION OF INDUSTRIAL EQUIPMENTS

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抽象。 本文致力于对特殊复合材料衬里方法的应用领域的审查和分析，以及各种主要技术装备和建筑结构保护方法的优缺点，以及侵蚀性生产要素的影响。。

显示了用复合材料衬里的已知方法和实验开发中的方法。

主要结论是，由于不同防护工作方法的可靠性，多功能性和可变性，特殊复合材料在危险生产环境中运行的设备和结构的保护是首选的保护类型。

关键词：衬里，保护系统，技术设备，建筑结构，侵蚀性工作环境，复合材料。

Abstract. *The article is devoted to the review and analysis of the application areas, as well as the advantages and disadvantages of various methods of protection of the main technological equipment and building structures from the impact of aggressive production factors by the methods of lining with special composite materials.*

Both known methods of lining with composites and those that are in experimental development are shown.

The main conclusion is to substance the thesis that the protection of equipment and structures operated in hazardous production environments by special composites is the preferred type of protection due to the reliability, versatility and variability of different methods of protective work.

Keywords: *Lining, protective systems, technological equipment, building structures, aggressive working environment, composite materials.*

Practical task of the development of real economic sector are: to increase stability, durability efficiency of general technological equipment exploitation and building constructions; to update the production and intensify the production processes to handle strategic plans of development of different industrial branches to produce innovative, high-qualified and competitive goods of world-level quality.

One of the components of this task is to solve the problem of equipment and structure protection from the impact of hazardous production factors, namely, protection against corrosion and other types of destruction associated with most technological processes in the mining, processing, engineering and other sectors of the manufacturing sector of the economy.

It is hardly possible to eliminate great losses completely as the base of the corrosive (abrasive, thermal, etc.) processes is objective forces of nature. However, the proper use of existing methods and remedies, as well as the development and implementation of new anti-corrosion materials and technologies for their effective use can reduce corrosion damage, improve the reliability and safety of equipment, machinery and structures.

There are many ways to prevent corrosion (in the broad sense of this problem). We consider only one of the most effective ways of prevention, namely, the lining of technological equipment and building structures with polymer composite materials. We have been studying this subject for over 18 years, and as we have our own experience and opinion about this issue, we try to explain it with this publication.

Fig. 1 shows the scheme of general types of lining materials (LM) which determine the ways of lining the equipment which is in operation in aggressive working environment.

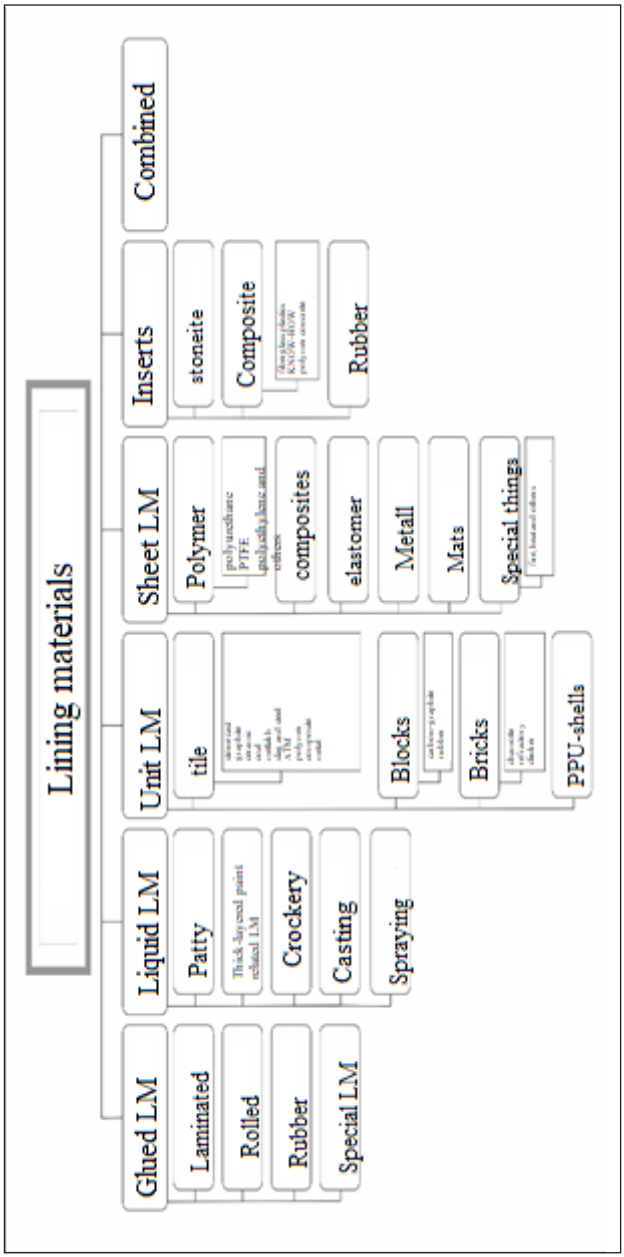
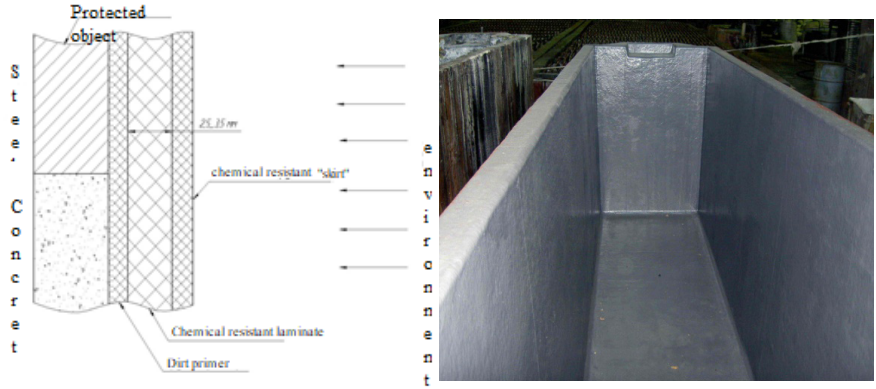


Fig.1 *The main types of lining materials*

A striking example of modern high-performance method of MLM (main lining method) application is the layering of functional layers, as a rule, glass-reinforcing materials (glass wool, fiberglass, veil, etc.) on the prepared surface, covered with a special elastic primer, and impregnated with organic resins, so-called "***lamination".*** This method of protection is described in details in the following sources - [1,2,3,4]. Fig.2 shows the scheme of the laminate protection system and an example of such protection. This method of protection of the equipment has proven itself as a long-term and effective protection against the effects of chemically active liquid and gaseous working environment with an operating temperature of up to + 150 ^{0}C.

There are the advantages of this method of equipment and structures protection in comparison with other methods of protection:

- high chemical resistance of the covering in a wide range of aggressive industrial environments;
- high strength of the covering which allows the protection to perceive vibration and dynamic loads;



a. *b.*

Fig.2. *a. - the scheme of protecting laminate system,*
b. - etching bath laminated by chemically resistant composite.

- the possibility of covering the complex surfaces: spherical, curvilinear, cone-shaped, etc., while the covering is solid and does not have joints and junctions;
- the possibility to vary the thickness of the covering, to strengthen it in the most critical places, while the low weight of the covering does not affect the strength quality of the protected equipment;

- good compatibility with other types of protective coverings allows to optimize the protection system of different materials depending on the types of aggressive effects on the equipment;

- maintainability of the protective covering, while the repair is not fire;

- relative simplicity of application of the protective system, which does not require the use of complex equipment and tooling.

Liquid lining materials are protective systems applied to the surface in a liquid (pasty) state in various ways (manual – spatulas, mechanized – putty guns, aggregates, see Fig. 3.) followed by solidification due to polymerization/polycondensation of the binder, natural drying (at the temperature 23 C or higher) or exposure of energy radiation (e.g. UV).

The advantage of protective putty coverings is, firstly, the possibility of rapid application to complex surfaces and excellent adhesion to concrete. Secondly, it is high abrasion and heat resistance. Thirdly, the maintainability and the possibility of use as a masonry mortar in the lining of piece materials (tile, brick). The disadvantages of putty – is, first of all, low strength of the covering, which does not allow it to be used in conditions of vibration and dynamic loads on the lining equipment.

a. *b.*

Fig.3. *a. - putty aggregate, b. – putty gun.*

Filled with thick-layer paint related covering materials (PRM) in contrast to putty LM are inflicted on the protected surface by air or airless spraying by means of painting aggregates (Fig.4.). The thickness of such coverings, as a rule, does not exceed 2-3 mm. and they belong to the film coverings.

The fillers in thick-layer PRM are: scales glass, mica, graphite/carbon, glass and ash spheres, as well as fine powders of silicon dioxide, aluminum oxide (corundum), quartz, boron nitrate, PVC, etc., and finally, finely chopped glassroving.

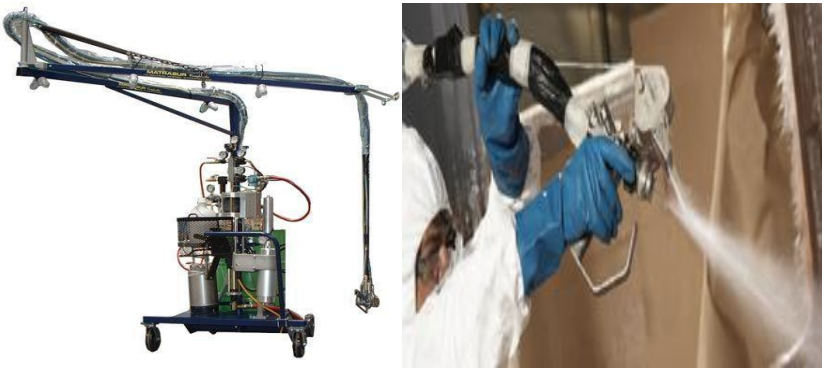
Fig.4. *The infliction of thick-layer fire-resistant covering*

The advantages of thick-layered PRM are, first of all, high productivity of apparatus systems for covering and better protection compared to "normal" chemically resistant PRM. The main disadvantage is the unreliability of protection in the conditions of shock, abrasive and vibration loads.

Spraying (in relation to composites – ***spray method)*** – is widely used for the manufacture of volume products from fiberglass, but it is quite acceptable for the application of protective lining coverings. Spraying is made using a special apparatus so-called – applicators (Fig.5.)

The spray covering method is described in details in [4]. The advantages of this method is its high productivity. The disadvantage is the need for special equipment and highly qualified personnel. In addition,

the applicator can not be operated in closed volumes, for example, when lining containers, tanks, etc.



a. *b.*

Fig. 5. *a. – applicator produced by the French firm Matrasur, b. – work with the applicator*

Unit LM – are widely used for cladding of building structures and lining of technological equipment operating in extremely aggressive working environments. As unit lining composite materials it is expedient to apply lining tiles on vinyl ester binding and mineral fillers developed and tested in OOO SKB "Mysl" [5,6]. The tiles are manufactured by method of pressing with specially selected fillers on the fractional composition. The sizes of tiles are from 300x300 mm. to 500x500 mm., thickness from 5 mm. to 20 mm. (see Fig.6). The customer can request to produce designed tiles.

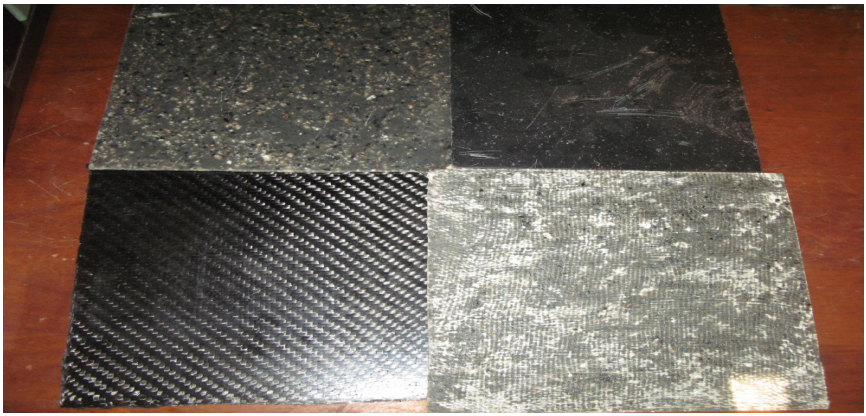


Fig. 6. *Samples of composite tiles from different fillers*

Compared with the well-known unit LM, composite tiles have a number of advantages, namely:

- they are lighter than stonewashed, therefore, do not significantly affect the weight of the lined equipment;
- they are stronger than ceramic tiles and can handle shock loads;
- they are stable in a wide range of aggressive working environments, and can be produced in a special version, for example: chemical-resistant, abrasive-resistant, biostable, heat-resistant, combined, increased mechanical strength, etc.;
- compatibility with other types of lining coverings (not only composite materials).

Considering the ***sheet LM*** we focus on composite sheet materials, specially manufactured for lining process equipment. The design of the sheet is protected by a patent of the Russian Federation [7] and is shown in Fig. 7.

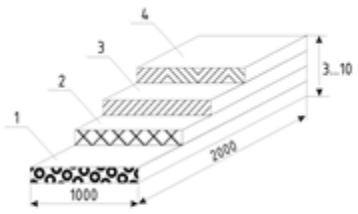


Fig.1 Chemical-resistant sheet

1.Elastic base 2.Power layer 3.Chemical-resistant layer 4.Special layer

Fig.7. *The design of the lining sheet*

There are the advantages of the lining sheet of the multilayer composite:

• high specific strength characteristics of the sheet composite, comparable (and with the adoption of special measures – superior) corresponding parameters of steel;

• the absence of welds between the sheets, which in the sheet thermoplastics are internal stress concentrators, including reducing the strength and chemical protection properties of the covering;

• maintainability and excellent adhesion to the material of the protected object;

• refers to hard-burning materials and is harmless to the environment in the cured state;

• high impact-vibration resistance, damping resonant vibrations of the equipment to be lined;

• the possibility to vary the properties of the composite, depending on the required operating parameters, for example, increased wear resistance, electrical conductivity, heat resistance, anti-adhesiveness, etc.;

• the low proportion of the composite in combination with high strength reduces the thickness of the lining sheet to a minimum – 2.5 mm, which positively influences the conditions of work and does not change the weight and dimensions of the equipment significantly it also makes composit more competitive in price;

• the possibility of using various schemes of fastening of the sheet to the protected surface: on the primer, using screws welded to the steel surface, anchors to the concrete surface, etc.

The most important advantage of sheet composite protection in comparison to other methods of lining is the ability to combine methods of protection – sheet and "wet lamination". If the protected surface consists of rectilinear and curvilinear planes (e.g. spherical), the rectilinear places are lined by sheet composit and the curvilinear - by the methd of "wet lamination". The problems with added flanges, nozzles, etc. are solved similarly.

There are the advantages of lining works with sheet composite compared to the technology of "wet lamination":

- the sheet composite made in workshop conditions considering all requirements of technological regulations corresponds to the ideal strength and protective criteria written in normative documents and taken into account choosing the system of protection in the most full way ;
- some types of special protective layer, giving the composite unique performance parameters (for example, the use of nano-composites, non-thixotropic covering, heat-stabilizing and wear-resistant coverings, etc.) can be applied only in the factory;
- sanitary and hygienic parameters of the air environment at the work place are significantly improved and fire and explosion safety during work increases;
- lining with sheet composite takes less time than "wet lamination".

Sheets are available in three types: lightweight, conventional, reinforced; thickness from 2.5 mm. to 10 mm.; size 1000x2000 mm. (2 sq. m.)
The thickness of the sheet is selected based on the required strength of the covering and the specified service life in the working environment. It is possible to manufacture sheets to meet individual customer requirements.

The detailed information on the described lining material is given in [1,8,9].

Lining inserts are ready-made products to protect the inner surface of the equipment, made of special materials, which are resistant in a particular working environment and repeat the shape of the protected surface and are freely embedded in the workspace (Fig.8).

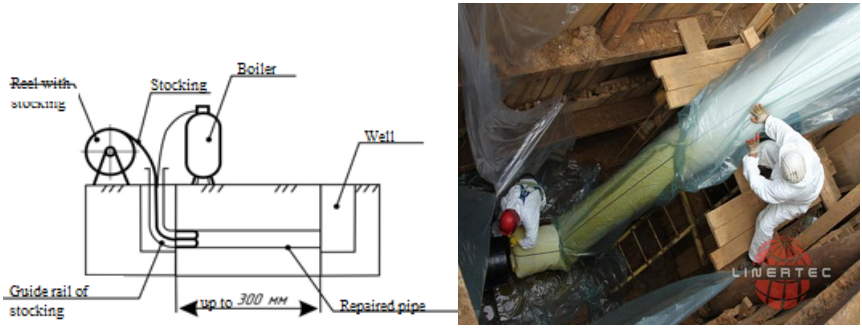
a. *b.*

Fig. 8. *a. – metal etching bath and polymer chemical-resistant insert, b. – fiberglass insert installed into the concrete sewer pipe*

At the moment, there are two well-known types of lining inserts: "hard" and "soft." The hard insert is used for lining equipment of simple geometric shape (rectangular, flat, round, etc.) and is freely installed into the inner space of the protected equipment. Advantages: simple construction and installation, the ability to have a spare set of inserts. Disadvantages: limited space of application which cause inability to protect capacitive equipment and the equipment which has no free access as well as curvilinear equipment (tanks, closed capacitive equipment: measuring tanks, vats, underground tanks, as well as pipelines with different pipe diameters and bends along the route, etc.).

A typical example of the so-called "soft" lining insert is the use of the pipeline protection system *CIPP* (*cured-in-place pipe*) [10].

In fact, the process of the considered technology is that the "stocking" of non-woven glass-reinforcing material is impregnated with a binder and wound up in the pipe. Then the working environment is taken into the "stocking" and press it to the inner surface of the pipe so the binder polymerizes. Compressed air, water, or steam can be used as a working environment. The installation diagram to implement the *CIPP* technology is shown in Fig. 9.



a. *b.*

Fig. 9. *a. – scheme of installation of CIPP, b. – a fragment of the undergroud pipeline lining*

The advantage of the above-described method of lining is the ability to protect underground pipelines without opening trenches. The disadvantage is the complexity of the lining process, need of special equipment, special materials, skilled workers.

Combined lining. In order to make more rational use of the advantages of fibrous materials in thermal construction, combined linings are used. Its working layer is usually made of heat-resistant concrete or shotcrete, and the inner, isolating layers of various fibrous materials and products.

Such linings withstand significant mechanical loads, successfully resist the erosion effects of gas flows, can operate at temperatures exceeding +1000°C, while maintaining the heat-holding capacity. Combined lining have high ability to change forms, they reduce the load on the carcass as they have relatively small weight, they also can be easily transported and repared.

Fastening of the lining is carried out when applying a working layer of heat-resistant concrete, which after a set of sufficient strength, through a system of anchorages holds in a stationary state all the intermediate layers previously laid.

Rubber-ceramic lining represents a new generation of composite panels, combining wear-resistant ceramic elements and high-quality rubber (Fig.11.). Composite plates are highly resistant to abrasion and other types of wear existing in industrial enterprises. The composite panel is made using wear-resistant rubber where ceramic or silicon carbide elements are vulcanized with a special technology.

Wear-resistant panels are often made with a metal substrate, but depending on the purpose and operating conditions, a steel substrate may not be required.

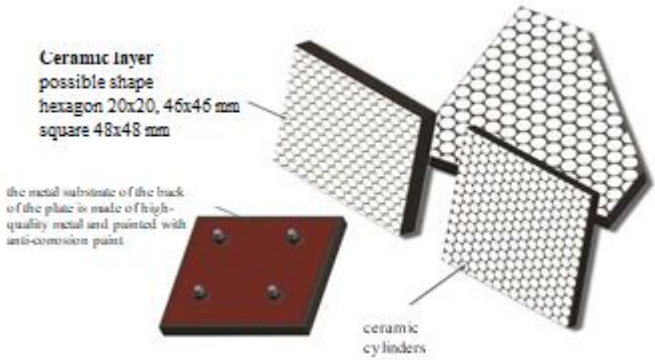


Fig.11. *Elements of rubber-ceramic lining*

Main advantages:

- exceptional abrasion resistance - the service life of ceramics under abrasive loads can reach tens of times greater than the service life of other lining materials;

- low coefficient of surface friction, can improve the flow capacity of various materials (dry and wet) greatly reducing the problems when moving these materials in silos, flows, overload nodes and other types of transport and storage equipment;

- impact resistance - due to the high hardness of the ceramic and the cushioning layer of rubber, the rubber - ceramic lining can experience constant high impact and abrasive loads, for example: when loading ore into the bunker;

- anti-adhesion properties - reduce the sticking of any materials, including wet and clay transported materials on the surface of the equipment, significantly reduce the sticking of the material in the autumn and spring at low temperatures;

- it is an excellent solution for processing of large amounts of materials at different angles of incidence without developing a wear pattern;

- excellent sound and vibration isolation;

- chemical and corrosion resistance - resistant to weakly acidic environment, alkali-resistant.

- the weight is lighter - the ceramic is twice lighter than metal, it makes the installation/dismantling much easier, reduces the overall physical load on the equipment, reduces the time of work. Using the ceramics as a lining of moving constructions the reduction of electricity is reached significantly.

Summary:

Composites are widely represented in all types of lining and are increasingly used to protect technological equipment
and building structures operated in an aggressive working environment.

1. There is a lack of regulatory and technical documentation and the level of R&D and Russian materials on the topic of effective protection of industrial equipment in various ways of its lining is low.

2. Considering the set of features that determine the feasibility of using a particular type of lining material for products operated in particularly hazardous production conditions, it should be noted that at the moment the lining of composite materials is the most preferred type of lining because of its versatility, excellent chemical resistance, manufacturability and the presence of obvious operational advantages.

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从高密度的高浓度能量流中获得碳化钛的可能性

THE POSSIBILITY OF OBTAINING OF TITANIUM CARBIDE FROM RUTILE CONCENTRATED ENERGY FLUX OF HIGH DENSITY

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抽象。 通过合成含钛矿物原料（金红石精矿），使用高密度能量，得到金属钛和碳化钛。 本文介绍了使用高密度能量合成工业用功能材料的可能性的实验结果。

关键词：金红石精矿，高密度能，等离子，钛，碳化钛。

Abstract. *As a result of the synthesis of titanium-containing mineral raw materials (rutile concentrate), using high-density energies, metal titanium and titanium carbide were obtained. The article presents the results of experiments on the possibility of using high-density energies in synthesizing functional materials for industrial use.*

Keywords: *rutile concentrate, high-density energy, plasma, titanium, titanium carbide.*

Introduction

Currently, the production and scope of structural ceramic materials and coatings based on them are expanding. The basis for these compositions are compounds of metals and non-metals with boron, carbon, and nitrogen. Carbides, borides, nitrides, and in particular carbides of refractory metals have found wide application.

The production of such compounds is promising, being conducted in the direction of obtaining them from metal oxides by synthesis or mechanical diffusion. However, the use of multicomponent titanium-containing mineral raw materials

for the production of TiC compounds, without additional processing steps, is not possible or not being made.

Methods for producing TiC have been known for a long time, for example, the preparation by heating powdered titanium oxide and soot in coal-fired furnaces in an atmosphere of hydrogen at 2250 ° C [1], but the productivity of the process is low. For example, the method of mechanical doping [2], involves the initial mixture of powders of titanium and soot grind in a planetary mill at room temperature. Free ash and carbon atoms were not found in the final product, but the disadvantage of this method is the formation of a non-stoichiometric TiC composition. For example, the method of obtaining TiC by self-propagating high-temperature synthesis (HTS), which consists in thorough mixing and forming briquettes, which are used directly in the process of obtaining carbides at temperatures above 1600 °C [3 - 6].

The disadvantages of all these methods are low productivity, the use of quite complex equipment to create high temperature, vacuum, the use of "sealed bombs - reactors", etc.

The problem to be solved is to develop an alternative method of producing functional materials, titanium and its carbide, using simple and sufficiently efficient equipment, which will allow to meet domestic demand in the market, and use dumps as a raw material base and possibly obtain new compounds based on Ti.

The paper proposes a method for producing TiC from a multicomponent mineral oxide-containing raw material, by exposing it to high-density energy of the order of g $>10^3 - 10^4$ w / cm^2.

The initial content of titanium oxide in the material under study, rutile concentrate (RC), was about 75%.

Methods and materials

The prepared mixture of RC and carbon, through the channels of the plasma torch 5 was supplied with transporting gas into the channel of the electrode. Argon was used as a carrier gas. The electrode had a tungsten tip, the diameter of the flow channel was about 0.8-1 mm. A graphite nozzle was installed coaxially with the electrode. The nozzle from graphite was separated by a dielectric, ceramic ring 2 fig. 1. In the process of gas flow through the plasma torch channels into the electrode and nozzle area, fine particles of the charge are transferred by gas from the bunker. An electric discharge is created between the electrode and the plasma torch nozzle in the ionization region. In turn, the charge particles increase the conductivity of the gas-dust flow, since by 30% the mixture consists of finely dispersed graphite powder.

The obtained samples were studied on a scanning electron microscope «VEGA 3 LMH» (TESCAN), equipped with an energy dispersive spectrometer «X-Max 80» (Oxford Instruments). The composition of the synthesized product was studied using a diffractometer "Drone 7" with a tube of Co on *K*α-line X-ray radiation at a speed of two degrees per minute.

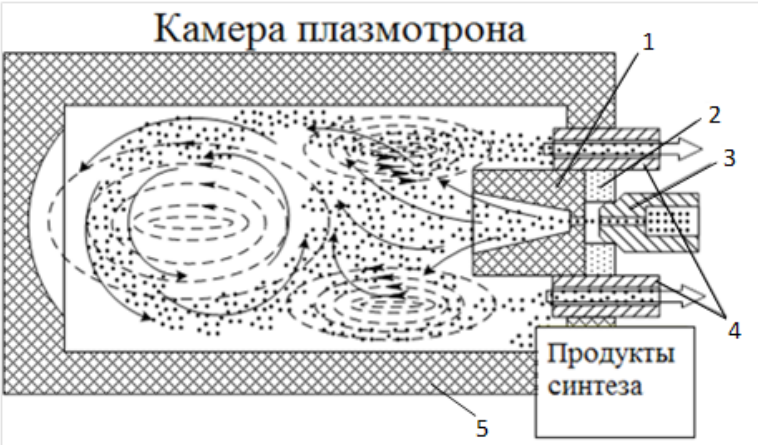


Fig. 1. *Scheme of the process of plasma-chemical synthesis: where, 1 is the nozzle, 2 is the dielectric ring, 3 is the electrode, 4 are the tubes for discharging the gas-vapor phase and finely dispersed residues*

Results and discussion

According to the results of experiments on the reduction of titanium and its carbide from RC, the following dependences were established:

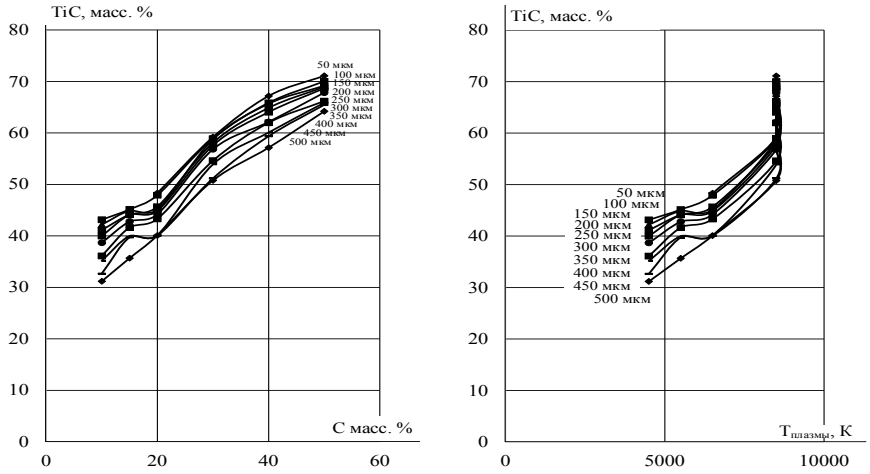
1) the change in the mass of TiC in the synthesis products based on the mass of the carburizer introduced and the size of the charge fraction (Fig. 2, a);

2) the change in the mass of TiC in the synthesis products depending on the temperature of the plasma flow and the size of the charge fraction (Fig. 2, b).

It has been determined that the nature of the processes of plasma-chemical synthesis of TiC from mineral raw materials (RM) differs from that in obtaining WC, since titanium and carbon atoms do not have any other allotropic states other than TiC in the synthesis process, except for the reduction process to oxide.

In addition, it was found that the reduction of Ti from its oxide proceeds along the path of destruction of the crystal lattice, with the subsequent formation of oxides of CO and CO_2 due to their higher activity towards carbon. Further, as a result of an excess of carbon, TiC is formed, but only in the process of the release of the obtained compound from the plasma stream in the form of the germinal phase or particle. If the TiC compound undergoes heating above 4600 K in a plasma stream, then in the compound the decomposition process to simple components will begin again. With further movement of particles and atoms of Ti and C in the plasma field, where the entire process of destructurization proceeds, the chemical ele-

ments at the output again form a stable TiC compound. Such a process is due to the gradual heating, melting and evaporation of particles fed into the plasma field. As a result of this heating, a vapor-droplet phase is formed, and during the quenching process, condensation of particles is formed not only on the inner surface of the reactor and the venting channels, but also on the filter walls.



а *б*

Fig. 2. *Dependences of the change in the mass of TiC in the products of synthesis: a - on the mass of the carburizer C in mass. %; b - from the temperature of the plasma stream T plasma, K*

Based on the experimental data, the following dependences were obtained (Fig. 2), according to which the highest TiC yield was obtained by adding about 50% of the carburizer to the composition of the charge. In addition, the size of the fraction plays an important role, where the most optimal size is from 200 to 50 microns and below. At higher fractions, the process proceeds less qualitatively, with the formation of a larger volume of slag, which may include fused particles of titanium oxide, free carbon in the form of graphite, iron-carbon alloys, etc.

The plasma temperature at which TiC synthesis proceeds using graphite as a carburizer is 3380 ... 7650 K, and in some cases it reached 8500 K. Experiments have shown that with fraction sizes up to 500 μm and temperatures of about 8500 K, almost complete destructurization occurs the volume of the fed charge, which

allows the output to get the maximum mass rate of TiC. The results presented in the form of dependence (Fig. 2, a) are valid only under the condition that the volume of the carburizer introduced into the charge is 30...50 mass. %. Otherwise, the process of TiC synthesis proceeds worse and not the entire volume of TiO_2 interacts with carbon, and most of the free titanium is again reduced to oxide. The changes in the mass of reduced Ti in the synthesis products, the mass of the carburizer introduced, the size of the charge fraction, and the plasma flow temperature are shown in Fig. 3

According to the results of experimental data, it was also established that the highest yield of reduced titanium was 8...9 mass.%, provided that the volume of the carburizer introduced into the mixture is 10...20 mass. %, and the temperature of the plasma stream does not exceed 6000K.

It has been established that with an increase in the size of the charge fraction from 300 μm and higher, the volume of reduced Ti increases, but with an increase in temperature of more than 6000 K and a volume of introduced carburizer of more than 20 mass % regardless of the size of the fraction, the Ti indicator decreases.

This feature is due to the degree of mechanical activation of the mixture before use, since with a fraction size of 300 μm and below, the particles interact more actively. It should be noted that in the process of carrying out mechanical activation, there is a partial reduction of Ti to TiC.

According to the results of studies of TiC, obtained by plasma-chemical synthesis from RC, the average index of fixed carbon was determined.

The microstructure of TiC obtained in the course of plasma-chemical synthesis is shown in Fig. 4. Samples were taken from the region of the transient motion of the plasma flow, where the effect of turbulent flows is the smallest and where the overlap is formed on the inner surface of the reactor chamber. The chemical composition of the samples shown in Fig. 4, a, b and fig.5.

Studies have shown that the samples are represented by the TiC compound in the form of fused large particles up to 150 μm, fine particles up to 1 μm and nanoscale to 1 nm. The ratio of titanium and carbon in the TiC alloy is on average 80 mass. % relative to 20 mass. %

In fig. 5 *a* shows the spectrogram of the samples shown in Fig. 4, where, according to the measurements, the phases of TiC were determined, where the yield was 98.9 mass.%, and the phases of associated chemical elements Al, Fe, Mr, V, etc., the total amount of which is less than 2 mass. %.

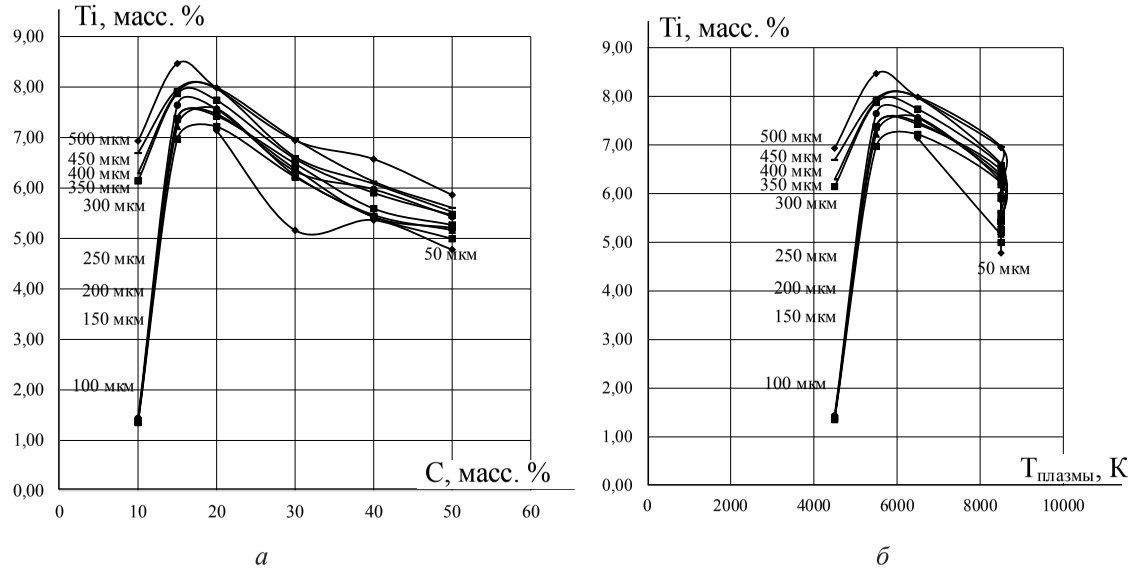


Fig. 3. *Dependences of the change in the mass of reduced TiC in the synthesis products:*
a — on the mass of the carburizer C injected, mass. %;
b - from the temperature of the plasma stream T plasma, K

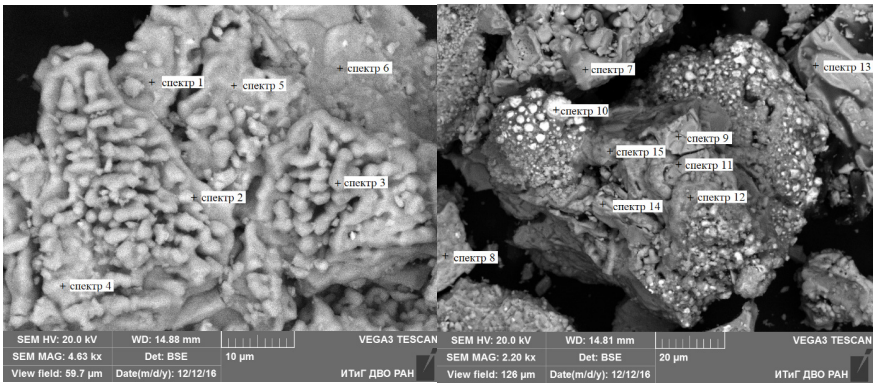


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Fig. 4. *Spectral analysis of titanium carbide samples: a - at 50 μm, taken from the laminar gas motion region; b - at 20 microns, selected from the turbulent region*

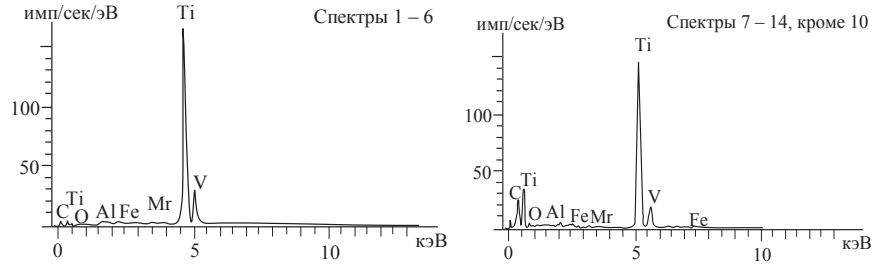

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Fig. 5. *Spectrogram of TiC samples: a - spectrogram from the 1st to the 6th mark, b - spectrogram from the 7th to the 14th mark, except 10*

Conclusion.

1. The use of plasma-chemical synthesis makes it possible to obtain titanium carbides as a semifinished product of high frequency, with a particle size of the order of 1–150 nm, in one technological procedure. With the use of an additional leaching stage, it is possible to obtain 89.5 mass%, TiC, due to the separation in the process of high-temperature synthesis of all components of the charge during their condensation.

2. It was revealed that the high-temperature plasma environment allows to destroy the crystal lattice of the mineral, and to separate all chemical elements, and also to separate Ti from oxide.

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测量发射机与物体之间距离的信息理论研究
INFORMATION-THEORETIC INVESTIGATION OF MEASURING DISTANCE BETWEEN TRANSMITTER AND OBJECT

Silin Denis Mikhailovich
Group Leader, Geyser-Telecom Co. Ltd.

抽象。 考虑了评估复杂系统工作质量的新标准。 当“信号/噪声”比率的计算不可能并且系统的组成是不确定的时，引入的标准是合适的。 该标准基于接收信号和测量参数之间的互信息。

关键词：信息论，测距，不确定性，传递信息，质量标准

Abstract. *New criterion for evaluation of quality of work of complex systems is considered. The introduced criterion is suitable when calculation of «signal/noise» ratio is impossible and the composition of system is indefinite. The criterion is based on the mutual information between received signal and measured parameter.*

Keywords: *information theory, range measurement, uncertainness, transmitted information, quality criterion*

Introduction

In the study of complex systems consisting of many elements, an important role is played by the evaluation of the effectiveness of the system as a whole.

The traditional approach to analyzing the effectiveness of radio systems is to evaluate the quality of work using the signal-to-noise ratio, when exceeded which is a given level, the quality of work is considered to be satisfactory. However, this criterion applies only to one element of the system and therefore there are difficulties in assessing the quality of the system as a whole. In addition, there may be situations in which determining the signal-to-noise ratio is difficult. Also, the signal-to-noise ratio may differ for different elements of the system, for example, in the presence of mutual interference [1].

As a performance criterion, applicable both to individual components of the system and to the system as a whole, an information criterion is proposed, for which the integral indicator of the system is the amount of information transmitted or received by the system per time unit.

Let's look at an example when a system of radio facilities is considered as a system whose main task is to estimate the distance to an object. In this case, we take the quantity of information about the distance to an object, which is extracted by the system per unit of time, as an information quality criterion.

The problem of interest, can be posed as the problem of choosing from a given volume of V_0 space a volume V*, in which an object is localized, with a given accuracy [3].

In [3], an analysis is carried out for the case of perfect coding of information by a Gaussian process by calculating the capacity of a communication channel established between a radio device and an object according to the Shannon theorem [7]. This bandwidth should not be less than the required speed of obtaining information R^*, which is

$$R^* = \frac{\sum P(V^*) \log P(V^*)}{T^*}, \quad (1)$$

if $P(V^*)$ - a priori known probability of finding an object in the volume V*, T* – time required to receive information.

This article assesses the information received about the distance to the object with uncertainty about the presence or absence of the object in the intended area and the received signal energy when using non-ideal signals, which allows to obtain more accurate estimates of the information properties of the system.

Evaluation of the received information about the distance to the object

The amount of extracted information about the distance is equal to the mutual information between the distribution of the distance ξ and the distribution of the received signal η, which can be calculated by the formula [2]:

$$I(\xi,\eta) = \int_X \int_Y f_{\xi,\eta}(x,y) \log_2 \frac{f_{\xi,\eta}(x,y)}{f_\xi(x) \cdot f_\eta(y)} dxdy, \quad (2)$$

if $f_{\xi,\eta}(x,y)$ - joint distribution function of ξ and η, $f_\xi(x)$ - distribution function of ξ, $f_\eta(y)$ - distribution function of η, X and Y – definition areas of η and ξ.

let's assume, that the probability density of the distance to send a signal $f_\xi(x)$ is described by a uniform distribution in the range *[R_1, R_2]* in the presence of an object in a given interval, which occurs with probability of *p*. With probability of *q=1-p* object is not in the specified interval. In this case, the prior distribution of the distance $f_\xi(x)$ is described by the formula

$$f_{\xi}(x) = p\frac{1}{R_2 - R_1} + q\delta(x-b), \quad (3)$$

if $\delta(x-a)$ - Dirac delta function [6] (choice b is arbitrary out of range of $[R_1,R_2]$).

Suppose a radio device sends a pulse of duration T, described by a function $S(t)$. We also assume that the gains of the receiving and transmitting antennas are the same and equal to G. Let us take the signal attenuation function during propagation in space, obtained from the radar distance equation [4]:

$$g(x,a) = \frac{aG\lambda}{x^2}\sqrt{\frac{S_0}{(4\pi)^3}}, \quad (4)$$

if x – distance, a – signal amplitude, G – antenna gain, S_0 – effective surface scattering object, λ - wavelength.

In addition, suppose that, according to [4], the signal amplitude is multiplied by a random factor having the Rayleigh distribution [10].

The expression for the joint distribution of the distance and the received signal is $f_{\xi,\eta,t}(x,y)$ at time t takes the form of

$$f_{\xi,\eta,t}(x,y) = p\cdot\left[u(x,y)+v(x,y)+w(x,y)\right]+q\cdot h(x,y), \quad (5)$$

if

$$u(x,y) = \frac{1}{R_2 - R_1}\left(U(t_1)-U(t_2)\right)\cdot f_{GR}(y, a\cdot g(x,S(T-t)),\sigma), \quad (6)$$

$$v(x,y) = \frac{1}{\sigma\sqrt{2\pi}}\frac{1}{R_2 - R_1}U(t_2)e^{\frac{-y^2}{2\sigma^2}}, \quad (7)$$

$$w(x,y) = \frac{1}{\sigma\sqrt{2\pi}}\frac{1}{R_2 - R_1}U(-t_1)e^{\frac{-y^2}{2\sigma^2}}, \quad (8)$$

$$h(x,y) = \delta(x-b)\frac{1}{\sigma\sqrt{2\pi}}e^{\frac{-y^2}{2\sigma^2}}, \quad (9),$$

$$t_2 = (ct-2x)/c, \quad (10)$$

$$t_1 = t_2 - T \quad (11).$$

if x – distance to the object, y – received signal value, $f_{GR}(y, a\cdot g(x,S(T-t)),\sigma)$ - distribution function of the sum of random variables with Gaussian distribution with parameters $(0,\sigma)$ and Rayleigh distribution with parameter a at y,

g(x,s) – signal attenuation function with amplitude *s* when propagating in space, $S(T-x)$ – the amplitude of the sent signal at the moment $T-x$, $\delta(x-b)$ - Dirac delta function [6] (choice *b* is arbitrary out of range $[R_1,R_2]$), σ - standard deviation of background noise, *c* – speed of light, *T* – the duration of the sent signal, *U(t)* – Heaviside step function [6].

Function f_{GR} is found using the convolution integral [8], and is equal to

$$f_{GR}(y,a,\sigma)=\frac{1}{a^2\sigma\sqrt{2\pi}}e^{y^2\left(w^2-\frac{1}{2\sigma^2}\right)}\cdot\left[y\cdot\left(1+erf\left(x\cdot w\right)\right)+v\cdot e^{-y^2w^2}\right],\quad(12)$$

if

$$v=\frac{1}{\frac{1}{a^2}+\frac{1}{\sigma^2}},\quad(13)$$

$$w=\frac{1}{2\sigma^2}\sqrt{2v}\quad(14)$$

erf - error function [9].

Expressions (6), (7), (8) determine the distribution of the received signal in the presence of the object. Expression (6) corresponds to the period in which the signal reflected from the object is received. This interval is determined by the passage of the signal *2x* distance from the antenna to the object and back (10), and the duration of the signal *T* (11). Signal reception outside this interval $\left[t_1,t_2\right]$ does not give information. Expressions (7), (8) correspond to the period of reception of noise, despite the presence of the object. Expression (9) corresponds to the case of the absence of an object when pure noise is received.

A priori distribution of the received signal $f_\eta(y)$ is found by integrating the expression (5):

$$f_{\eta,t}(y)=\int_{-\infty}^{\infty}f_{\xi,\eta,t}(x,y)dx\,.\quad(15)$$

Mutual information is found by numerical integration of expression (2) with substitution of expressions (3), (5), (15) into it.

Suppose that a linear frequency modulated (LFM) signal is being sent [5]. Consider the dependencies on the conditional source data. (tab. 1):

Parameter	Value
Carrier frequency	9 GHz
Pulse duration	30 ms
LFM signal frequency range	100 kHz
Estimated distance to the object	18 – 30 km
Probability of having an object	0.5
The amplitude of the emitted signal	100 B
Antenna gain	1000
Effective area of the object	10 m^2
Rayleigh distribution parameter	1

Graphs of the amount of information at time t, that is, the signal received as a result of measurement at time t are shown in Fig. 1,2. In the top-down direction, graphs are shown for the standard deviation of noise in the range of -40…-10 dBmV with a step of 2-4 dBmV.

The duration of the informative measurement period is calculated by the formula:

$$T_u = 2R_z/c+T \quad (16)$$

We assume that the signal and noise occupy a limited frequency band *W*. The bandwidth of the considered LFM signal is close to the difference between the initial and final frequencies $f_н$ and $f_в$ [5]:

$$W=f_в-f_н \quad (17)$$

According to Kotelnikov's theorem [6], the amount of information will be equal to the sum of the values calculated by formula (2) at times multiples of *1 / 2W*. Graph of information about the distance obtained for the entire measurement period (16), from the noise level is shown in Fig. 2

The amount of information received by the system as a whole, with independent measurements of the distance by the elements of the system, is obtained by summing the quantities of information received by each element, determined from the dependence shown in Fig. 2

An example of evaluating the effectiveness of the information criterion

The system uses three radio devices that have parameters from the table. 1, and measuring the distance in three non-intersecting sectors in the azimuthal plane. This means that the measurements are independent, and you can use the dependency shown in fig. 2

As a result of the mutual interference evaluation, it was established that the interference has a centered Gaussian distribution with standard deviations of -30, -25, -20 dBmV.

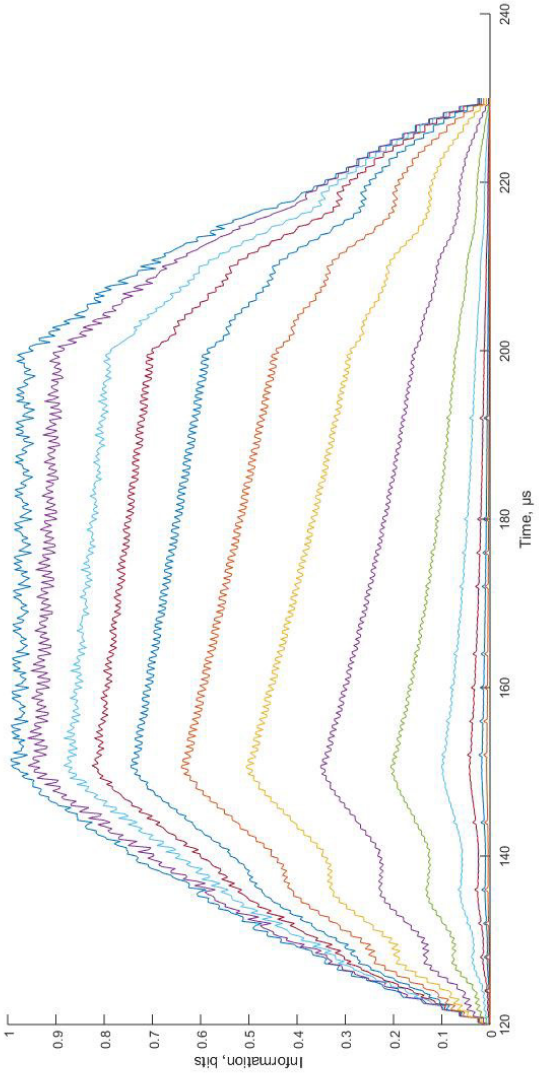
Information, bits
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
120
140
160
180
200
220
240
Time, μs

Fig.1

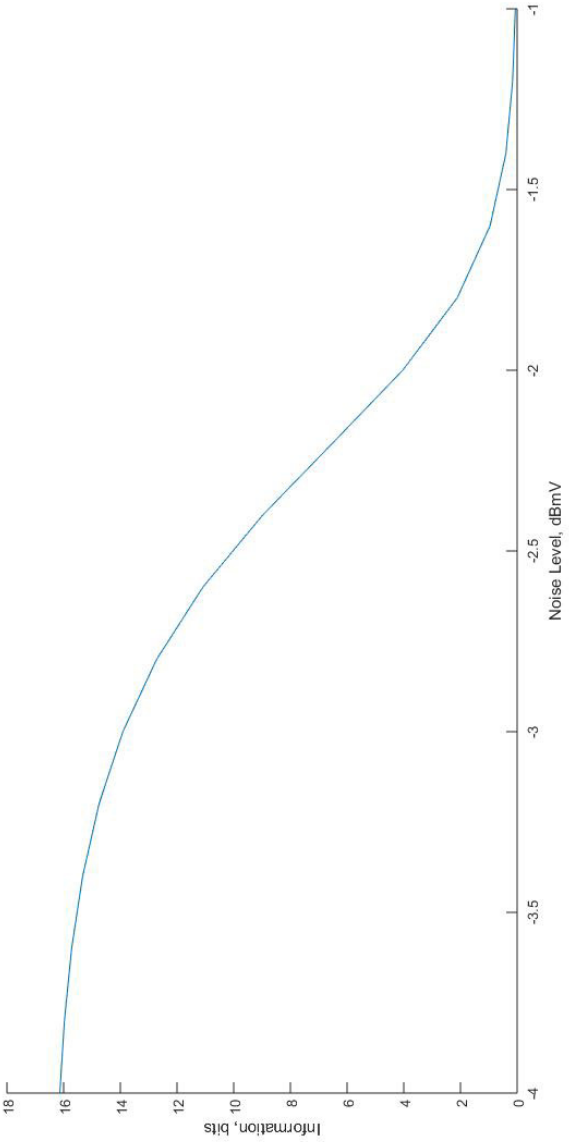
Information, bits
18
16
14
12
10
8
6
4
2
0
-4
-3.5
-3
-2.5
-2
-1.5
-1
Noise Level, dBmV

Fig. 2

Let's assume that, in accordance with the objectives of the system, it is necessary to determine the position of objects with an accuracy of 10 m in a time not exceeding 4 ms. Entropy position of objects in accordance with the adopted uniform distribution of distances and equiprobable presence and absence of the object is equal to $-3\cdot\left(0.5\cdot\log_2(0.5\cdot10/(30000-18000))+0.5\cdot\log_2 0.5\right)\approx18$ bit.

The measurement time according to (16) is

$$\frac{2\cdot30000}{3\cdot10^8}+30\cdot10^{-6}=0.0023\,c.$$

Amount of information for standard deviations -30, -25 and -20 dBmV is, respectively, 13.91, 10.09 and 4.03 bit (see fig. 2). We will get a general indicator - the speed of obtaining information by the system as a whole: I=(13.91+10.09+4.03)/0.0023=12622 bit/s. For a given measurement time of 4 ms, the system can receive $12622\cdot0.004\approx50$ bits of information.

This information is enough in excess to remove the uncertainty of the position of the object, equal to 18 bits. This means that with appropriate signal processing, the system can function successfully.

Conclusion

The amount of information received by the system, by comparing with the entropy of the position of the object, shows the possibility of implementing the system with given requirements for measurement accuracy, and also quantitatively characterizes the information redundancy of the system directly related to noise immunity.

The advantage of the proposed approach is its applicability in the case when the «signal/noise» ratio is unknown and a deliberate presence of an object in the intended area of its appearance is not required, as well as that it applies to both individual components of the system and the system as a whole.

Another advantage of the proposed criterion is that the obtained dependencies using the distortion model of the signal, taking into account its scattering, inversely proportional to the square of the distance to the object, and the multiplicative distortion according to the Rayleigh law, are general in nature and can be easily modified in accordance with more complex models of signal distortion.

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将热量分配到柴油发动机的缸内空间的元件
DISTRIBUTION OF HEAT TO THE ELEMENTS OF THE IN-CYLINDER SPACE OF A DIESEL ENGINE

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注解。了解发动机内部气缸空间元件的比热容 – 气缸盖底部，活塞底部，气缸套的工作部分，基于可靠实验研究测试的任何分析方法的阀板，在设计零件，选择燃烧室的形状和混合方法时非常重要，并将完全或部分地放弃复杂和长期的实验研究。这些研究由Eichelberg，Lefevre，Voshnya，Rosenblit，Plaumf，Orlin，Dyachenko，Chaynov，Kavtaradze和其他研究人员进行。他们主要开发了主要涉及工作缸的各个元件的经验公式。在本文中，作者根据形成工作缸的零件的物理机械和热性能，以及零件与气体的接触时间，考虑了带有燃料的气缸内热量分布的原理。及其尺寸。

关键词：温度;传热和导热系数;压力;柴油发动机;耐热传热。

Annotation. *Knowledge of the specific heat capacity on the elements of the inner cylinder space of the engine - the bottom of the cylinder head, piston bottom, the working part of the cylinder sleeve, valve plates based on any analytical methodology tested by reliable experimental studies, is quite important when designing parts, choosing the shape of the combustion chamber and the method of mixing and will completely or partially abandon the complex and long-term experimental studies. Such studies were carried out by Eichelberg, Lefevre, Voshnya, Rosenblit, Plaumf, Orlin, Dyachenko, Chaynov, Kavtaradze and other researchers. They have developed mainly empirical formulas concerning mainly individual elements of the working cylinder. In this article, the authors consider the principles of the distribution of heat introduced into the cylinder with fuel, depending on the physi-*

comechanical and thermal properties of the parts that form the working cylinder, as well as the time of contact of the part with the gas and its dimensions.

Keywords: *temperatures; heat transfer and thermal conductivity coefficients; pressure; diesel engines; thermal resistance to heat transfer.*

Introduction. On marine diesel 4ЧСП8,5/11, accepted as an object of study (Figure 1) due to its compactness and small size, facilitating work with it on a test bench, a number of experiments were carried out to determine external indicators (effective power, average effective pressure, specific and hourly fuel consumption (effective and instrumental), all types of efficiency and others, which will be discussed below. Using the methods of the authors listed in the annotations for estimating the equivalent gas temperature and heat transfer coefficients, both from gas and water and taking into account the design of parts, their thermophysical characteristics and the nature of interaction with the working body and the coolant were set values of the amount of heat perceived by the elements of the working cylinder.

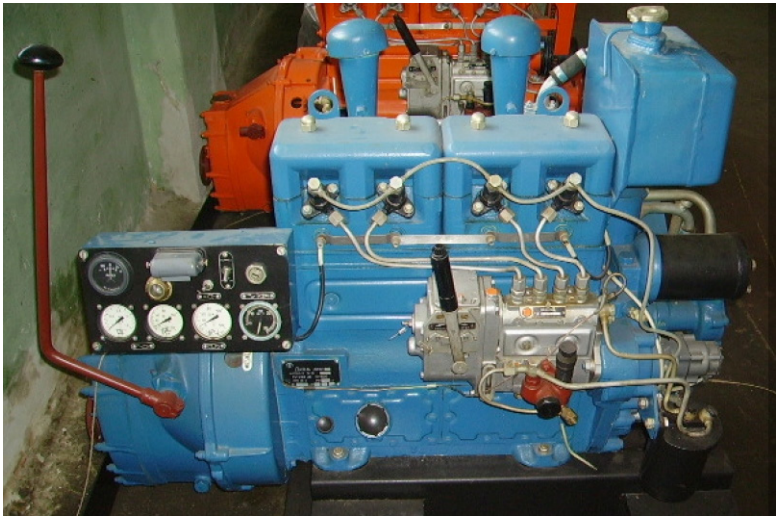

Figure 1. *Diesel 4ЧСП 8,5/11 with reverse gear*

Determination of the equivalent gas temperature and average heat transfer coefficients from gas to water.

In order to determine the thermophysical parameters of the combustion products for the period of the working stroke, it is necessary to estimate the average value of the gas pressure for the same period. Processing part of the indicator diagram of a diesel engine with an average effective pressure p_e=0,575 MPa, have

shown, that p_{av}=2,75 MPa. Then with p_{av}=2,75 and average gas temperature t_d = 900 °C, the gas will take the following parameters /1, 2/:

Density, p = 7,93 kg/m^3, heat capacity, C_p = 1290 J/(kg*degree); thermal conductivity λ = 0,1 W/(m*degree); dynamic viscosity, μ = 45,9*10^{-6} Pa*s; kinematic viscosity, v = 152,5*10^{-6} m/s; thermal diffusivity, a = 0,253*10^{-3} m^2/s; Prandtl number, Pr = 0,59.

The average value of the coefficient of heat transfer from gas = $\alpha_{g.med}$ during the working stroke we will determine according to the formulas of various authors for 4-stroke diesel engines.

1. Eichelberg formula.

$$\alpha_d = (4{,}4 + 0{,}35 * pe) * (T_a)^{\frac{1}{2}} * (C_m)^{1/3}, \quad (1)$$

if: $T_a = 340\ K$, $C_m = 5{,}5\ m/s$;
$p_e = 5{,}75\ kJ/s/sm^2$. Than $\alpha_d = 245{,}33\ W/(m^2 * degree)$

2. Formula Lefebvre.

$$\alpha_d = 0.47 * \lambda^{0{,}67} * C_p^{0{,}33} * \rho^{0{,}33} * r^{0{,}6} * \omega^{0{,}8}/v^{0{,}47} \quad (2)$$

if $r = 0{,}475\ m$; $\omega = 157\ c^{-1}$. Then $\alpha_d = 168{,}5\ W/(m^2 * degree)$

3. Formula Voshni

$$\alpha_z = 110 * \left(P_{av}^{\ 0{,}8} * W^{0{,}8}\right)/\left(T_r^{\ 0{,}53} * D_y^{\ 0{,}2}\right), \quad (3)$$

$if: W = 2{,}28 * C_m + 3{,}24 * 10^{-3} * T_a$.

Then, $\alpha_d = 253{,}5\ W/(m^2 * degree)$.

4. Rosenblit formula.

$$Nu = C_1 * Pe^{0{,}5} * (1 + C_2 * K_s), \quad (4)$$

$if\ C_1 = 4{,}34\ and\ C_2 = 2{,}19 * 10^{-4}$ - are constants;
$K_s = C_{зв} * W_к/W\tau^2$ – Kubansky criterion;

$Pe = W\tau * D/a$ – Pecle criterion. Values of the velocities of the oscillatory motion of charge particles $W_к$ and tangential charge rate in the cylinder $W\tau$ take according to the works / 3, 4 /. Then the value of the Nusselt criterion will be, $Nu = 419{,}4$. Hence, $\alpha_d = 493{,}4\ W/(m^2 * degree)$

The results of calculations using formulas 1–4 are more or less similar to each other, except for the value α_d, obtained according to the Lefevre formula, which can be explained by the specifics of the experiment on the basis of which this formula was obtained. The average value of the heat transfer coefficient obtained by formulas 1, 3, 4 will be $320\ W/(m^2 * degree)$.

Heat transfer to the cooling medium is characterized by a complex mass and heat exchange - the presence of zones of the near-wall layer, where there is a

change in the state of aggregation of water, during its movement and vibration of the heat-transfer surface.

The simplest coefficient of heat transfer to the coolant is determined using the well-known Zonneken formula.

$$\alpha_c = 300 + 1800 * (W)^{1/2}, \quad (5)$$

if W – the speed of the fluid (water) in the cooling casing. However, for a more accurate assessment of the processes occurring at the boundary of heat exchange, we consider the parameters of the water circulating in the cooling system. Damped perimeter contour 42,5 cm, the cross-sectional area through which water circulates - 36 cm ^{2}. Then, the equivalent channel diameter, $d_э = 0{,}03388\ m.$ Capacity of the standard water pump of the internal cooling circuit, $G = 0{,}42 * 10^{-3}\ m^3/s.$ Then the velocity of the coolant will be equal to, $W_c = 0{,}03\ m/s.$ The average values of the temperature of the coolant and the wall of the cylinder on the cooling side will be taken according to the experiment /1/, equal respectively to 80 and 90 ^{o}C. Thermophysical characteristics of water have the following values /2/:

- coefficient of thermal conductivity, $\lambda_ж = 0{,}67\ W/(m * degree);$ – kinematic viscosity coefficient, $\nu_{c=} 0{,}365 * 10^{-6}\ m^2/s;$ - Prandtl number (if T_s), $Pr_s = 2{,}23;$ - Prandtl number (T_{cm}), $Pr_{cm} = 1{,}86;$ - density of water, $\rho_c = 972{,}kJ/m^3;$ - Reynolds number, $Re_ж = 2785;$ - Nusselt number /78/ , $Nu = 27.$ Then $\alpha_c = Nu * \lambda_c/d_э$, $\alpha_c = 534\,W/(m^2 * degree)$. According to the formula 3.16 we get $\alpha_c = 612\,W/(m^2 * degree)$. For further calculations, we take the value $\alpha_c = 600\,W/(m^2 * degree)$.

Calculation of total thermal resistance to heat transfer

Piston.

The total thermal resistance of the piston to heat transfer consists of the thermal resistance of the circuit:

gas - piston - cylinder - coolant. In turn, the thermal resistance of the piston consists of the thermal resistances of its elements: the bottom of the piston; piston skirts and piston rings.

Thermal resistance of the piston bottom is determined by the formula /4/,

$$R_{pb} = 1/\alpha_g + \square_{pb}/\lambda_p + D * \phi_s/\lambda, \quad (6),$$

if $1/\alpha_g = 29{,}412 * 10^{-4}\ (m^2 * degree)/W$ - contact resistance from gas to the surface of the piston. Figure 3 shows a sketch of the piston, which shows its main geometrical parameters necessary to solve the problem, namely $\square_{pb} = 8{,}9\ mm$ – piston bottom thickness; $D = 84{,}45\ mm$ – piston head diameter; $\lambda = 150\ W/(m * degree)$ –thermal conductivity of alloy AK4-1, of which the piston is made, with t = 150 – 200 ^{o}C; $f_{s=} 0{,}255$ – dimensionless thermal characteristics of the piston for the interface point of the bottom with the glass in the absence of oil cooling /77/.

Summing up the components of thermal resistance. get $R_{pb} = 31{,}44 * 10^{-4}\ (m^2 * degree)/W$.

The thermal resistance of the piston skirt is determined by the formula /4/

$$R_{ps} = K_e/(m_1 * \lambda * f_{ю} * t\square\ (m_1 * L_{ps})) \quad (7),$$

if $K_e = 0{,}866$ – coefficient, taking into account the eccentricity of the piston in the cylinder;

$$m_1 = ((\lambda_м/\lambda) * (1/\delta_m * S_{ps}))^{1/2}$$

coefficient taking into account the thermal resistance of the oil membrane;

$\lambda_m = 0{,}115\ W/(m * degree)$ – oil thermal conductivity coefficient at t = 140 – 150 °C; $\delta_m = 0{,}05\ mm$ – oil membrane thickness; $S_{ps} = 7{,}4\ mm$ – skirt wall thickness; $L_{ps} = 74{,}5\ mm$ – length

$f_{ps} = 1{,}97 * 10^{*3}\ m^2$ – cross-sectional area of the skirt and piston.

After the substitution we get, $R_{ps} = 0{,}0645\ (m^2 * degree)/W$.

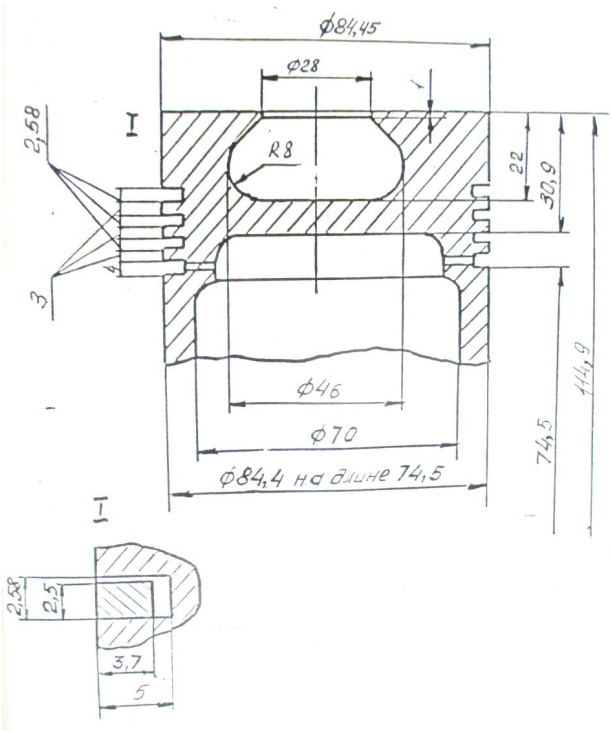

Fig.3. *Sketch of piston and piston ring*

The thermal resistance of a piston ring is expressed by the formula /4/,

$$R_{pr} = (1/(\pi * D)) * \left(\delta_{pr.}/4 * a * S_{pr} * \lambda_{pr}\right) + 1/\lambda_{pr} + \\ + \delta_{nr.}/(\lambda_m * b)) \quad (8)$$

if $a = 1/((2 * 1_{pr}/\delta_{pr.1}) * (\lambda_m/\lambda) + 1)$ – coefficient;

$1_{pr} = 3{,}7\ mm$ – radial width of the ring; $b = 2{,}5\ mm$ – ring height;

$\delta_{pr} = 0{,}5 * (2{,}58 - 2{,}5) = 0{,}04\ mm$ – the average thickness of the oil film between the end of the ring and the ridge grooves;

$\delta_{pr} = 3 * 10^{-3}\ mm$ – average oil membrane thickness between the ring and the cylinder;

$\lambda_x = 48{,}85\ \ W/(m^2 * degree)$ - thermal conductivity coefficient of the ring material (gray iron, special chemical composition);

$S_x = 0{,}5\ (84{,}5 - 36) - 2{,}53 = 21{,}67\ mm$ – thickness of the wall of the cup under the ring;

Substituting the data in formula 8, we get $R_{pr} = 0{,}1329\ (m^2 * degree)/W$. Thermal resistance of the parts of the piston cup between the rings /1/,

$$R_{i\,(i+1)} = (1/\lambda) * l_{i\,(i+1)}/f_{i\,(i+1)}), \quad (9)$$

if $l_{i\,(i+1)}$ and $f_{i\,(i+1)}$ – respectively, the distance along the generatrix between the annular grooves and the cross-sectional area. Since the jumper sizes are the same, $l_{i\,(i+1)} = 3 * 10^{*3}\ m - const$. $f_{i\,(i+1)} = (\pi/4) * (0{,}0845^2 - 0{,}07^2) = 1{,}76 * 10^{*3}\ m^2 - const$; Then $R_{i\,(i+1)} = 0{,}01136\ (m^2 * degree)/W - const$. The total thermal resistance of the piston glass is determined by a chain of thermal resistances interconnected in series and parallel (Fig. 4).

At point 3, the resistance of the 3rd ring is connected to the resistance of the piston skirt. Therefore, for t. 3, resistance (for parallel resistances) is determined from the equality

$1/R_3 = 1/R_{ps} + 1/R_{pr}$, i.e. $1/R_3 = 23{,}03\ W/(m^2 * degree)$.

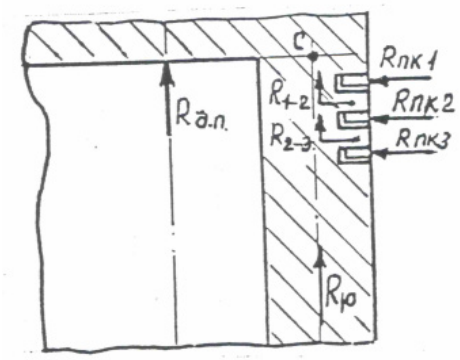

Fig. 4. *Piston skirt thermal resistance chain*

Hence $R_3 = 0{,}043425 \ \ (m^2 * degree)/W$. To resistance R_3 consistently attached resistance is $R_{2-3} = 0{,}01136 \ \ (m^2 * degree)/W$, at the point 2 – parallel resistance 2nd piston ring. Then, the resistance in t.2 will be $R_2 = 0{,}0328 \ \ (m^2 * degree)/W$.

Finally for point 1, i.e. for the glass as a whole, we can write a similar equality $1/R_{gl} = 1/(R_3 + R_{2-3}) + 1/R_{пр}$.

Then, $R_{gl} = 0{,}0364 \ \ (m^2 * degree)/W$. Total thermal resistance of the piston /77/, $R_p = (1 - m) * (R_{pb} + R_{gl}) + R_{cb}$, (10)

if $m = Q_m/Q = (0.05 - 0.15)$ – the proportion of heat given to the oil by the piston in the absence of organized oil cooling;

$R_{cb} = 1/\alpha_c + (D_c/2 * \lambda_c) * (\ln((D + 2 * \delta_c)/D))$ – thermal resistance of the part of the cylinder liner in contact with the piston /77/; $\lambda_c = 48{,}9 \ \ W/(m * degree)$ – the coefficient of thermal conductivity of the material of the sleeve of the cylinder (cast iron special chemical composition); /75/; $\delta_c = 6 \ mm$ – casing wall thickness; $D = 85 \ mm$, cylinder diameter; $\alpha_c = 600 \ W/(m^2 * degree)$ – heat transfer coefficient from the casing to the water. Taking $m = 0{,}12$, get $R_p = 0{,}0366 \ \ (m^2 * degree)/W$.

Cylinder bushing.

The total thermal resistance of the cylinder casing in direct contact with the working fluid is determined by the formula /6/

$$R_{cb} = 1/\alpha_z + D/2 * \lambda_c) * \ln((D + 2 * \delta_c)/D) + 1/\alpha_c. \quad (11).$$

Substituting data into equation 11, we get $R_{cb} = 0{,}000474 \ \ (m^2 * degree)/W$.

The bottom of the cylinder head.

The total thermal resistance of the bottom of the CH will be determined by the formula / 80,86 /, as for a flat wall,

$$R_{pb} = 1/\alpha_g + \delta_{bt}/\lambda_{bt+} \ 1/\alpha_c. \quad (12).$$

It should be borne in mind that the heat transfer surface of the bottom of the CH is not flat. Flat are two sections, 9 mm thick, occupying 40% of the heat-transfer area. 60% of the heat transfer surface is occupied by various structural elements (tides under the nozzle, valves between them), the average thickness of these elements is 27 mm. Then, the average thickness of the fire bottom is taken as 19,8 mm. Since the temperature of the water leaving the diesel engine did not exceed 76 °C. we consider it possible to accept the value $\alpha_c = 600\ W/(m^2 * dergee).$ The coefficient of thermal conductivity of the material of the head is $\lambda = 37\ W/(m^2 * degree)$ /5/ , then $R_{bt} = 0{,}0051\ \ (m^2 * degree)/W.$

The areas of heat-absorbing surfaces forming the volume of the working cylinder of a diesel engine will be:

- piston, $F_p = 0{,}01251\ m^2$; - CH, $F_{bt} = 0{,}00567\ m^2$; - the total area - opening time of the cylinder casing with a piston; when it is working, it will be $F\sum cb = 3.13 * 10^{-4}\ (m^2 * s).$

Calculation of the ratios of the amount of heat between the elements intracylinder space.

The ratios of quantities of heat determined on the basis of previously performed calculations will be as follows.

$$Q_{g-cb} : Q_{g-p} : Q_{g-bt} = F\sum cb/R_{cb} : F_n * \tau/R_p : F_{bt} * \tau/R_{bt} = 0{,}066004 : 0{,}00684 : 0{,}022.$$

The available heat is determined by the formula $Q_g = G_f * H_u = 4.312 * 10200 = 43982{,}4\ kcal/h$ or 51152 W,

if: G_f – hourly fuel consumption; $H_u = 10200\,kcal\ /\ \square$ – over calorific value of diesel fuel (DL).

The heat used for doing useful work,

$$Q_e = 632{,}3 * N_e,\ Q_e = 17640\ W.$$

Effective indicator diesel efficiency, $\eta_e = 0{,}344\eta_i = \eta_e/\eta_f\ ;\eta_i = 0{,}465,$

if: $\eta_m = 0{,}74$ – the value of the mechanical efficiency of a diesel engine, determined experimentally (by the hourly fuel consumption).

The amount of heat equivalent to the done indicator work will be equal to,

$$Q_i = Q_z * \eta_i$$

$$Q_i = 23785\ W.$$

The amount of heat abstracted from the spent combustion products will be determined by the formula,

$Q_z = 0{,}244 * Q_m,\ Q_z = 12481\ Bm$, (24,4 % - percentage of heat ab-

stracted from the SCP. The amount of heat abstracted into the walls is determined by the formula,

$$Q_{g-cs} = Q_f - Q_i - Q_g \, , Q_{g-p} = 14886 \, W.$$

Using the obtained ratios between the quantities of heat transferred from the gases to the cylinder sleeve, the piston, the bottom of the CH, it is possible to determine their absolute values. To do this, consider a system of three linear equations

$$\begin{gathered} Q_{g-cb}/Q_{g-p} = 0{,}066/0{,}00684 = 9{,}65; \\ Q_{g-p}/Q_{g-bt} = 0{,}00684/0{,}022 = 0{,}311; \\ Q_{g-cb} + Q_{g-cs} + Q_{g-bt} = 14886. \end{gathered} \quad (13)$$

From the solution of the system of equations 13 we get $Q_{g-cb} = 10359{,}3 \, W$; $Q_{g-p} = 1073{,}5 \, W$;

$Q_{g-bt} = 3451{,}8 \, W$. In terms of one cylinder, we get $Q_{g-cb} = 2539{,}8 \, W$; $Q_{g-p} = 1268{,}4 \, W$

$Q_{g-Cb} = 862{,}94 \, W$.

The total thermal load on the casing will be

$$Q_{cb} = Q_{g-cb} + Q_{g-} + Q_{fPRS}, \quad (14)$$

Considering that all the heat from the piston, both transferred from the gases, and formed as a result of friction, is transferred to the cylinder casing.

Q_{fPRS} – the heat generated by the friction of the piston and the rings on the casing.

Q_{fPRS} can be set according to the dependencies proposed in the works / 7.9 /, both separately for the ring and piston, and by the percentage ratios of the total friction work in the dielectric.

$$Q_{fPRS} = k * P_e^c \, (1 - \eta_f)/\eta_f \, , W \quad (15)$$

if: $k = 0{,}55$ – the average coefficient taking into account the friction in the PRS in the total work in a diesel engine /2/;

N_e^c – effective diesel power, reduced to one working cylinder. Then $Q_{fPRS} = 850 \, W$. Hence, $Q_W = 3708{,}54 \, W$ or 29% of Q_f.

Conclusion

According to the experiment, heat transfer to the cooling water was 40% (5124 W), of which 9% (1153 W) from the cylinder head and 29% (3715 W) from the cylinder casing (from 29 + 9 = 40, due to the error experiment, when heat loss with cooling water was measured for the total cooling system - 40%, and divided for the casing - 29% and cylinder heads - 9%).

ccording to the calculation and experimental determination of heat transfer through the firing bottom of the cylinder head / 1 /, the heat sink through the bottom was 5.1% (663 W) and there will be less heat removed from the head with the cooling water for the amount that SCP transmitted through walls of gas exhaust channels - 3.9% (see Tables 3.1 and 3.3). Based on the calculation by the proposed method, the amount of heat transferred from the gases to the bottom of the CH will be $Q_{day} = 856\ W$ or 6,6% of Q_f, which is close to the previously obtained data of 5.1%. Moreover, it is not close in absolute values - 5.1 and 6.6% or 653 and 856 watts, but in relative terms, relative to the available heat released from the combustion of fuel.

And now it is difficult to say how accurate were the calculations that led to the results of 653 and 856 W, as well as the calculations of heat transfer through the cylinder sleeve, when the calculated value $Q_w = 3715\ W$ almost exactly coincided with the experimental data on the evaluation of the heat sink with water from the cylinder core - 29% of Q_f, (3715 W).

n this case, the proposed technique makes it possible to determine with sufficient accuracy for practical calculations the amount of heat perceived by the main elements forming the working cylinder of a diesel engine, without complex and lengthy experimental studies.

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活塞式内燃机传热与传热的理论研究
THEORETICAL STUDY OF HEAT TRANSFER AND HEAT DISTRIBUTION IN A PISTON INTERNAL COMBUSTION ENGINE

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注解。为了分析工作圆筒的元件上的热分布过程，将其描述形式化是有用的，例如，如下。由于供给燃料汽缸的循环量的燃烧，工作汽缸的元件所感知的总热量由内部热平衡的结构决定：Qu= Qi +Qr-c+Qr， Qu被热转换为膨胀气体的工作；气 - 热量从气体传递到工作气缸壁；Qr是工作气缸外的废气排出的热量。主要目标是增加齐的价值。

作为假设，我们同意考虑确定活塞冲程期间部件之间的热量分布。在每次工作冲程时，根据气体状态方程，气体状态（主要是温度和压力）在整个体积内是相同的，并且可能，活塞的比热负荷是相同的，气缸和气缸盖的底部。考虑到与气体热接触的时间，这些元素所感知的总热量应仅根据其尺寸确定。然而，比热负荷（以具有相同值的局部热流的形式）显然仅在距受热表面一定距离处是相同的。直接在这些表面上，由于对区域中的热传递的不同热阻，将发生从工作流体传递到部件的总热量的重新分布：热传感表面 - 部件的主体 - 传热表面。

关键词：温暖;热平衡;比热负荷；Onsager理论。

Annotation. *To analyze the processes of heat distribution over the elements of the working cylinder, it would be useful to formalize their description, for example, as follows. The total amount of heat perceived by the elements of the working cyl-*

inder as a result of the combustion of the cycle quantity supplied to the cylinder of fuel is determined by the structure of the internal heat ***balance:*** $Q_ц = Q_i + Q_{г-с} + Q_г$, $Q_ц$ *is heat converted to the work of expanding gases;* Q_i *- heat transferred from gases to the walls of the working cylinder;* $Q_г$ *is the heat removed with the exhaust gases outside the working cylinder. The main objective is to increase the value of* Q_i.

As an assumption we agree to consider determining the distribution of heat between parts for the period of the piston stroke. At each time of the working stroke, the state of the gas (primarily temperature and pressure) will be the same throughout the volume, in accordance with the equation of gas state and, presumably, the specific thermal load will be the same for the piston, cylinder and bottom of the cylinder head. The total amount of heat perceived by these elements should be determined only by their size, taking into account the time of thermal contact with the gas. However, the specific heat load (in the form of local heat flows with the same value) will be the same, apparently, only at a certain distance from the heat-receiving surfaces. Directly at these surfaces a redistribution of the total amount of heat transferred from the working fluid to the part will occur due to different thermal resistances to heat transfer in the areas: the heat-sensing surface - the part's body - the heat-transfer surface.

Keywords*: warmth; heat balance; specific heat load; Onsager theory.*

Introduction. The determination of the quantities of heat perceived by the elements of the working cylinder is proposed to be seen in the following form,

$$Q_{cs} : Q_p : Q_{bt} = (F_{\Sigma cs} / R_{cs}) : (F_p \tau / R_p) : (F_{bt} \tau / R_{bt}), \quad (1)$$

if Q_{cs}, Q_p, Q_{bt} – the total amount of heat perceived during the period of the operating cycle, respectively, the cylinder sleeve, the bottom of the piston and the bottom of the cylinder cover from gases, W; F_p, F_{bt} – the area of the heat-receiving surfaces of the bottom of the piston and the bottom of the cover, m^2, $F_{\Sigma cs}$ - total area - opening time of the sleeve mirror per working stroke, m^2 s; R_{cs}, R_p, R_{bt} – total thermal resistance to heat transfer, respectively, bushings, pistons and bottom of the cover (m^2 deg)/W; τ - piston stroke time, s. It was considered that the following conditions occur. The heat transfer process through the walls of the working cyl-inder is assumed to be quasi-stationary, taking into account the fact that in the established en-gine operation modes, the temperatures of the working cylinder elements are unchanged, and the heat transfer coefficients from gases and to water are taken as their average integral values on the surfaces of parts and of time. The bottom of the cylinder head and the piston perceive heat only from the working fluid (gases). Cylinder sleeve receives the total heat from the gases and

from the piston. In addition to the heat from the bottom, the water that cools the cylinder covers also absorbs some of the heat from the exhaust combustion products through the walls of the gas exhaust ducts.

Analytical and experimental studies. Analytical calculations and experimental studies were performed on a diesel engine 4Ч9,5/11 with a combustion chamber in a piston of a conusotoroidal type, carried out in accordance with the methods [1 - 3], and allowed us to ob-tain the values of the components of the right side of equation (1) and, respectively, to estab-lish the values of the components of its left side. According to numerous experimental studies [3, 4, 5] values Q_g for different types of engines can be determined with sufficiently high ac-curacy. From here the proportion of heat Q_i can be determined. Obviously, to increase the share of $Q_{i,}$ it is necessary to strive to reduce the free heat transfer surface, that is, to an in-crease in the total thermal resistance R in all directions of heat transfer to the environment, which is widely promoted by advanced technologies [6]. This path is quite realistic, but re-quires for its wide use solutions of responsible theoretical, design, and technological problems. Many research organizations and manufacturing companies are ready, in the course of solving these tasks, to completely abandon the cooling system and switch to turbo-compound motor systems, including multi-stage units with power turbines in their composition. The initial stages of these works and the expected prospects are described in works [7, 8].

It should be noted that this approach requires not only a careful selection of materials and design of parts of the cylinder-piston group, which is emphasized in [9]. It will be expedi-ent in the transition to the new principle of converting the main movement (reciprocating - translational movement of the piston) into the power take-off movement (rotational movement of the power take-off flange). This is due to the fact that the provision of organized lubrication of the cylinder, with the temperature level that will take place in an adiabatic engine, is impossible. Consequently, in the alignment of forces acting on the piston, there should be no com-ponent, receiving the piston to the cylinder mirror, and the piston should perceive only the dis-tributed load from the gas pressure forces and the concentrated load from the inertia forces, the resultant of which will be directed strictly along its axis. For piston rings, it will be possible to provide the necessary lubrication conditions by including active minerals or friction geomodifiers into the surface layers of the sleeve and rings [9]. Mechanisms for the transfor-mation of the movement of so-called. "Cordless" type are known, starting with the design of S.S. Balandin and other authors who can be used not only in boxer engines, but also in in-line engines [10].

The processes of heat transfer (or heat distribution) in different directions in the engine cylinder at each moment of time undergo constant changes under the influence of constantly changing heat exchange conditions at the «gas - solid (part)

- cooling medium» borders. Let us analyze this question from the point of view of applying the Onsager theory to it (as stated in [11]). The thermodynamics of heat transfer is based on the fundamental laws of nature - the law of conservation of mass, the law of conservation and transformation of energy, as well as the principle of increasing entropy within the framework of the second law of classical ther-modynamics. Reciprocating internal combustion engines (ICE) are thermodynamic systems with irreversible (and periodically repeated) processes of heat transfer from a hot body (gas) to a cold (cooling medium) occurring in them. In this case, the entropy of the system will increase ($\Delta S > 0$), and performance decrease. This is true if we consider only one cycle of the internal combustion engine, as a system, and its basic element, which determines the thermal state of the system as a whole (with periodically repeated cycles) - combustion and expansion.

Analysis of the thermodynamic system. The state of this thermodynamic system is characterized by a number of indicators: a1, a2, …, an (amount of heat, temperature, pressure, etc.). At the end of the expansion period, almost all of the heat released in the cylinder is con-verted into mechanical work, transferred to the cooling medium, and will also be removed from the cylinder along with the spent combustion products. In this case, the values of temper-atures and pressures in the cylinder will decrease, while the temperatures of the cooling and external environment will slightly increase and work will be done. Here we can assume that for the system an equilibrium period will occur at which the said indicators will take on the values a_1^0, a_2^0, …, a_n^0 if S = max.

The deviations of these indicators from the equilibrium state (at the beginning of the expansion or in its course) can be denoted by $\vartheta i = ai - ai0$ (i = 1,2,3,…, n). At the equilibrium of the system, the entropy will have a maximum value, and $\vartheta i = 0$.

For the nonequilibrium state of the system, the entropy deviation is ΔS from its value in equilibrium are written in the form of a series of ratios [12 - 14], as a result of which concepts on energy flows are introduced: I_i ($I_i = d\vartheta_i / d\tau$), if τ - non-equilibrium state of the system, and thermodynamic driving forces (TDS) $X_i = \partial(\Delta S)/\partial\vartheta_i$. Based on the formulated provisions, it is stated that the rate of entropy increase is equal to the sum of the products of flows for the corresponding TDS, that is, $dS/ d\tau = \Sigma I_i X_i$. TDS are non-Newutov forces and cause such irreversible phenomena as energy transfer (including heat) and mass. Then, if we consider the two-component system “working medium (gas) - cooling medium (liquid)”, divided by a wall through which heat transfer takes place (by heat transfer), some amount of energy U. Then the entropy change in one of the subsystems can be obtained by using the Gibbs equation - $T\,dS = dU + pdV$. Then TDS of energy transfer U will be $X_u = - (1/T)\,\Delta T$, if ΔT – temperature gradient between the working fluid and the cooling medium, and T is the absolute temperature value in the

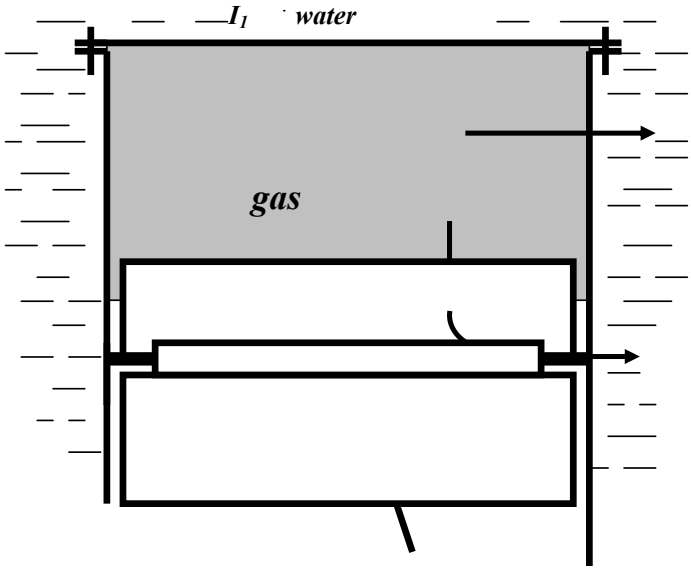
subsystem. The transfer of heat, as well as other types of energy, is determined by the action of not only by one corresponding TDS (working in this direction), but their joint action in all directions of heat transfer

$$I_i = \sum_{\kappa=1}^{n} L_{i,k} X_\kappa, \ , \ i=1,2,3,\ldots, n \ . \qquad (2)$$

The relation (2) is known as the Onsager system of linear equations [12], where the values of Li, k are kinematic coefficients. The Gibbs equation, together with the Onsager theo-rem, is the basis for the choice of flows and TDS. The Gibbs equation representing the second law of thermodynamics can be represented for the specific values of entropy, internal energy, volume (s = S/M, u = U/M, v = V/M), Tds = du + pdv. Then it is advisable to write the main Onsager relation in a similar form, i.e. $Tds/d\tau = \Sigma$ YiXi.

As an example, consider the transfer of heat from the working fluid to the cooling me-dium through the walls of the working cylinder of the internal combustion engine. Here, the heat transfer through the walls is determined by the action of TDS heat transfer carried out in 3 directions: I1 « gas - cooling medium (through the bottom of the lid)»; I2 « gas - cooling medium (through the wall of the cylinder sleeve)»; I3 « gas - cooling medium (through the piston and cylinder liner)», see figure.

Fig. *The distribution of heat on the elements of the working cylinder*



Then you can write the following expression for the stream: $I = I_1 + I_2 + I_3$,

the terms which we represent in form of

$$I_1 = L_{11}X_1,\ I_2 = L_{21}X_1,\ I_3 = L_{31}X_1 \quad (3)$$

if L_{11}, L_{21}, L_{31} – coefficients proportional to the generalized heat transfer coefficients in the respective directions of heat transfer: gas - bottom of the cover - water; gas - sleeve wall - water; gas - piston - sleeve wall - water. Record (3) can be represented as $I_1 = -L_{11}(\Delta T/T)$, $I_2 = -L_{21}(\Delta T/T)$, $I_3 = -L_{31}(\Delta T/T)$.

From this form of recording, it is possible to make a paradoxical, at first glance, conclusion that the TDS of heat transfer is uniform and equal for all three flow directions, and the absolute temperature gradients ΔT, for any direction of heat transfer, are identical [13].

Conclusions. The paradox is that the theoretical foundations of heat distribution and heat transfer in heat engines are based on methods for determining temperatures, heat fluxes, temperature stresses, heat transfer coefficients, whereas the values of temperature pressures were obtained in the end, were as they were. However, the fundamental impossibility of equal temperature pressures in all directions of heat transfer was not considered a dogma, since the issues of heat transfer and heat exchange were simply not considered in this formulation. Hy-pothetically, the equality of temperature pressures in all directions of heat transfer can be for-malized as a series $q_1 R_{\Sigma 1} = q_2 R_{\Sigma 2} = \ldots = q_n R_{\Sigma n}$ = idem, if q_i – heat flow of i – that direction of heat transfer; $R_{\Sigma i}$ – total thermal resistance to heat transfer of i – to that direction.

It should be noted that in foreign fundamental literature on the issues of heat and ther-modynamics of heat and mass transfer [14], without affecting the basic concepts of the On-sager theory, some doubts are expressed about the reciprocity relations of kinetic coefficients (principle of symmetry of kinetic coefficients, $L_{ik} = L_{ki}$).

This analysis has shown that there are still enough questions in the problem that need to be theoretically, analytically, experimentally or even comprehensively resolved. This is not only a matter for researchers of various scientific fields, but also a common cause for specialists working in the field of improving heat engines.

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使用WordPress插件创建网站时出现问题
PROBLEMS WHEN CREATING A WEBSITE USING WORDPRESS PLUGINS

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注解。 WordPress精美工具本身，但如果需要为您的网站添加更多功能，您必须使用插件。 多亏了他们，您可以轻松控制平台，而无需了解代码中的任何内容。但并非所有插件都能正常工作。 其中许多都可能导致潜在问题：页面加载速度较慢，菜单项消失，图像未加载等。本文讨论了在网站上使用大量插件的主要问题以及解决方法。

关键字：插件，WordPress，网站开发，问题。

Annotation. *WordPress fine tool itself, but if need add more features to your web site, you have to use plugins. Thanks to them, you can easily control the platform without understanding anything in the code. But not all plugins work correct. Many of them can cause potential problems: pages load more slowly, menu items disappear, the image is not loaded, etc. This article discusses the main problems of using large number of plugins on the site and ways to solve them.*

Keyword: *plugins, WordPress, site development, problems.*

Introduction

There are many tools to create websites. A content management system is a tool that makes it easy to control important aspects of a site, for example content, no need know anything about programming. The most popular content management system is WordPress. This CMS is a tool for creating open source websites written in PHP. Easy to use and powerful, the most popular platform on the Internet.

Without many of WordPress plugins, it would be a simple platform for blogging. Fortunately it allow users to add a lot of new features to WordPress – from online store modules to improvements in the control panel itself. Thousands of free and premium plugins allow you to customize WordPress to suit every needs.

Plugins are parts of software that you can download to extend and add functionality to your WordPress site. Plugins offer user-defined features and capabilities so that everyone can adapt the site as they need [1].

There are over 40,000 free plugins in the WordPress repository and you want to install as many as possible. WordPress works fine without plugins, but if you need to add additional features and capabilities to the site, you will have to add a plugin. Without plugins, WordPress would not be such a functional platform. Therefore, choosing the right plug-ins plays a big role in the success of the site.

Thanks to many developers, there are many free and commercial plugins you can choose. By creating these plugins, developers were able to give WordPress users more control over their website and all this with no need to understand the code. Install the plugin is very simple, just find the right and activate it. In result: an instant update of functionality on the site, without the need for technical knowledge.

Risks when adding a plugin to the site

The one who'd worked long enough with WordPress, usually face problems with plugins that cause crashes of the website, i.e. the pages load slowly, the menu items disappear or are not loaded image.

Plugins are good for creating a website, but the more plugins you have on your website, the higher the risk of problems.

Problem # 1: Increasing HTTP requests.

Many plugins offer a lot of functionality for the site interface. For example, you can make an appointment or view and purchase products.

Plugins require additional styles, images, and JavaScript to work properly. This causes additional HTTP requests, which are request-response protocols that a visitor's browser sends to your site's server to request data to load the page they are visiting. The server retrieves the requested data and passes it to the browser [2].

Each time an HTTP request is sent, it uses the resources of the server that hosts the site. The more requests sent, the more resources used. If all server resources are used up, the server and site crashes.

Another problem is that it takes time to process each request. The more HTTP requests, the longer it takes to execute them, resulting in a slower site load.

This is definitely will not attract customers to the site, as visitors will not be able to view anything until the developer returns the site to a working state.

Problem # 2: Too much information in the database.

The more plugins installed, the more data you need to store in the site database. Because the database and server have a strict limit on the amount of disk space, the more information is collected in the database, the more it becomes until it is full. This problem leads to the fact that the database begins to work inefficiently and the site is running slow. Active, deactivated and even some remote plugins store information in the database and clog it.

Problem # 3: compatibility Issues.

The more plugins installed on your site, the higher your chances of face a compatibility issue where the code in two or more plugins doesn't work well together and causes each other to crash.

Since all plugins are written by different developers, it is hard to understand which plugins will work well together.

Problem # 4: security Vulnerabilities.

It's easy to assume a security vulnerability in your code. Even the best developers can leave a security loophole when writing and viewing code, because it's not always obvious right away.

The more plugins installed on the site, the higher the risk that one of these plugins has a

security loophole that a hacker can use to infiltrate or infect the site.

Problem #6: Poorly coded plugins.

As much as I would like, but no one is perfect and mistakes happen. Plugins are no exception. No matter who is developer that written a plugin, the chances that the code is perfect and written without errors are zero [3].

Each plugin has its share of bugs, but there are also a lot of plugins that are very poorly coded, and lead to chaos on the site and the problems that were mentioned above. If the site uses a poorly coded plugin, problems are almost inevitable.

Fortunately, there are many ways to prevent the problems mentioned above:

• Reduce the number of plugins on web site. Using fewer plugins reduces the chance of problems.

• Check if plugin functionality is not duplicated. Before installing, you need to carefully examine the extensions already installed on the site. If the functionality of plug-ins is duplicated, you need to choose which to leave and which to remove.

• Install multifunctional plugins. It is possible to reduce the number of plugins used by installing plugins that include more than one required function.

• Decide what is really needed and remove the rest. You need to view installed and deactivated plugins. If they have not been used for a long time and will not be used at all, it is better to remove them.

• Clear the database. You should regularly check the database for unnecessary files to avoid clogging.

• Use reliable hosting for the site. Not all website hosts are reliable. Having considered the different options, you need to choose the one that will be reliable and help the site to work as quickly as possible.

• Site backup. This will help not to lose everything in case problems happens. With a copy, you can always restore the site to an earlier state.

• Use plugins that are regularly updated and maintained. This will reduce the chances of encountering plugins that do not have bug fixes.

It is also very important to use a reliable caching plugin, such as WPRocket, to speed up the site, as well as to compensate for the performance costs of other installed plugins [4].

Each new plugin is a block of code that can potentially "inflate" the site and make it more resource-intensive. But if this code is well written, don't worry. Also, when choosing a plugin, you should pay attention to its developer and rating. Plugin with a good rating and a well-known Creator will work properly.

An important aspect of a good plugin is its ease of use, because no one wants to read tons of documentation to properly use any extension [5].

Conclusion

Summarizing all the above, it should be noted that a lot of installed plugins can seriously affect the stable and fast operation of the entire site. But it is also important to remember about the quality of additions. It is clear that a dozen simultaneously working stable plugins will show a better result than a few poor quality and conflicting with each other, which will slow down the site or even "break" it. If the site needs additional functionality, you can safely add the necessary plugins, carefully checking before lunch. At the same time look for conflicts and check the performance of the entire site.

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改性磷酸盐涂层对钢材耐蚀性的影响
THE EFFECT OF MODIFIED PHOSPHATE COATINGS ON THE CORROSION RESISTANCE OF STEELS

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抽象。所提供的材料致力于研究不同品牌的钢的冷磷化过程的机理以及适用于建筑业的保护涂层技术的发展。考虑了冷法制备的改性磷酸盐薄膜的结构和性能对钢的耐腐蚀性的影响。得到了极化图，其分析允许计算不同等级钢的腐蚀速率的主要指标。对没有保护膜的研究样品和冷磷化液中形成的涂层的腐蚀速率进行了对比分析。确定了合金中含碳相在不同等级钢的腐蚀行为中的作用。获得的数据允许根据介质的侵蚀程度和合金的等级选择冷磷化溶液的组成，以确定对所得磷酸盐膜的质量和保护性能具有积极影响的组分浓度。 。

关键词：钢的腐蚀;磷化;磷酸盐薄膜;保护涂层;腐蚀指标。

Abstract. *The presented material is devoted to the study of the mechanism of cold phosphating processes of steels of different brands and the development of protective coating technology adapted for the construction industry. The influence of the structure and properties of modified phosphate films obtained by the cold method on the corrosion resistance of steels is considered. Polarization diagrams were obtained, the analysis of which allowed to calculate the main indicators of corrosion rates of steels of different grades. A comparative analysis of the corrosion rate of the studied samples without protective films and with coatings formed in cold phosphating solutions was carried out. The role of the carbon-containing*

phase of alloys in the corrosion behavior of steels of different grades is determined. The obtained data allow to select the composition of cold phosphating solutions depending on the degree of aggressiveness of the medium and the grade of the alloy, to establish the concentration of components that have a positive effect on the quality and protective properties of the resulting phosphate films.

Key words: *corrosion of steel; phosphating; phosphate films; protective coatings; corrosion indicators.*

Steels are the most commonly used materials in the construction industry for the manufacture of tools, fasteners, building products, pipelines, structural elements, metal structures and for the reinforcement of concrete [1]. Corrosion of metals is the main cause of failure of products and structures made of them.

In order to protect the steel reinforcement from corrosion and its further spread over the entire surface, it is advisable to apply protective phosphate coatings on it, which prevent the interaction of the alloy with the corrosive environment. It has been established that phosphate films provide mechanical protection of the steel surface against corrosion, therefore, it is necessary to obtain films of uniform thickness and structure with the lowest internal stresses. In corrosive conditions, fine-crystalline films due to lower porosity have a higher protective ability than large-crystal films of greater thickness. The thickness, properties and structure of the films are influenced by both the method of surface pretreatment and the nature of the alloy, and the phosphating conditions. One of the determining factors is the composition of the phosphating solution, which should be modified by the introduction of various special additives [2].

In earlier works [3-5] it was mentioned about possible modifiers introduced into cold phosphating solutions in order to change the properties of the obtained protective films. It is established that the use of additives such as saccharin, glucose and glycerin in the solution improves the anti-corrosion properties of phosphate films and reduces the duration of the phosphating process. The introduction of nitrilotriacetic and ethylenediaminetetraacetic acids reduces the precipitation of insoluble iron phosphates, which provides an increase in the efficiency of the solution while maintaining the protective properties of the phosphate film. On this basis, several optimal solution compositions were selected based on the traditional cold phosphating solution containing the drug “Mazhef”, zinc nitrate and sodium nitrite. The modified solution No. 1 includes as additives saccharin, Trilon A and preparation OS-20; the modified solution No. 2 – glucose, EDTA and preparations OP-4, OP-7, OP-10; the modified solution No. 3 – glycerin, EDTA and preparation OS – 20. Carbon and low-alloyed iron-carbon alloys were phosphated from the studied solutions. Films on high-alloy steels are obtained uneven in thickness and structure with low quality.

According to the established procedure [6] corrosion tests were carried out in 10 % NaCl solution at steel samples of various grades without film and with phosphate coatings. For the graphical method of calculating the speed and characteristics of the corrosion process, polarization diagrams φ, B – I, mkA were obtained, the analysis of which allowed to calculate such corrosion indicators as the degree of anode and cathode control, the negative mass change index and the deep corrosion index according to the above formulas:

$$C_a = \frac{\Delta\varphi_a}{\varphi_{e_a} - \varphi_{e_k}} \cdot 100\%, \quad (1)$$

$$C_k = \frac{\Delta\varphi_k}{\varphi_{e_a} - \varphi_{e_k}} \cdot 100\%, \quad (2)$$

$$K_m^- = \frac{I \cdot A}{z \cdot S \cdot 26.8}, \quad (3)$$

$$K_h = K_m^- \frac{8.76}{\rho_{me}}. \quad (4)$$

where: C_a – degree of anode control, %; C_k – degree of cathodic control, %;
K^-_m - negative index of mass change, g/m²·h; I – corrosion current, A;
A – atomic mass of metal, g; z – valence of metal ion passing into solution;
S – anode surface, m²; K_h – deep corrosion index, mm/year;
ρ_{me} – metal density, g/cm³.

Corrosion resistance of steel samples, both unprotected and treated in traditional and developed phosphating solutions, is shown in diagrams (Fig. 1-4). The choice of grades of iron-carbon alloys is due to the fact that the amount of cementite increases accordingly to the increase in the carbon content, and the metallographic structure changes from ferrite to ferrite-cementite [7].

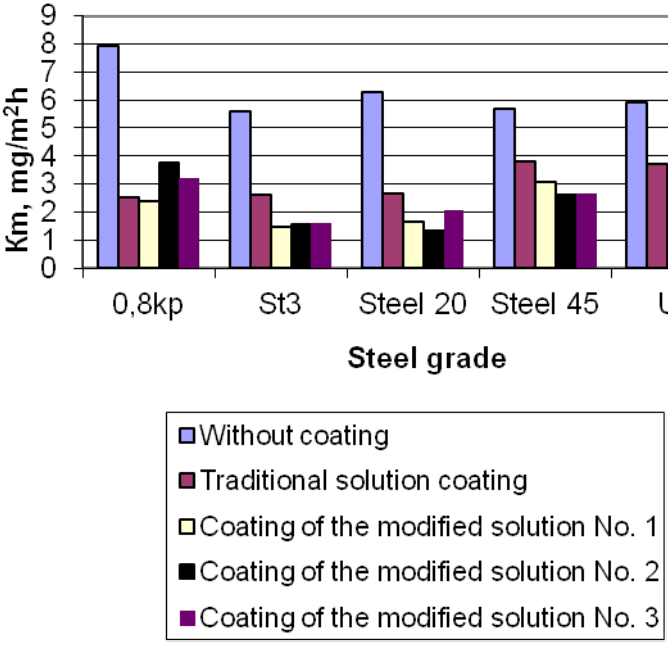

Fig. 1. *Comparison of the negative index of change in the mass of samples*

In general, as can be seen from the diagrams, the corrosion resistance of samples of different steel grades protected by phosphate films is much higher than without coatings. The observed differences in corrosion rates are not too large, however, for phosphate films formed from modified solutions No. 1 and No. 2 the results are slightly higher. No fundamental differences in the appearance, crystal structure, density and adhesive strength of the films were found for all the systems studied.

Based on the above results, phosphate films obtained from solutions containing saccharin and glucose as modifiers can be recommended as coatings that meet the requirements for increased corrosion resistance. However, taking into account the good results that the modified solution No. 3 shows, it is advisable to continue the optimization of the composition of this solution.

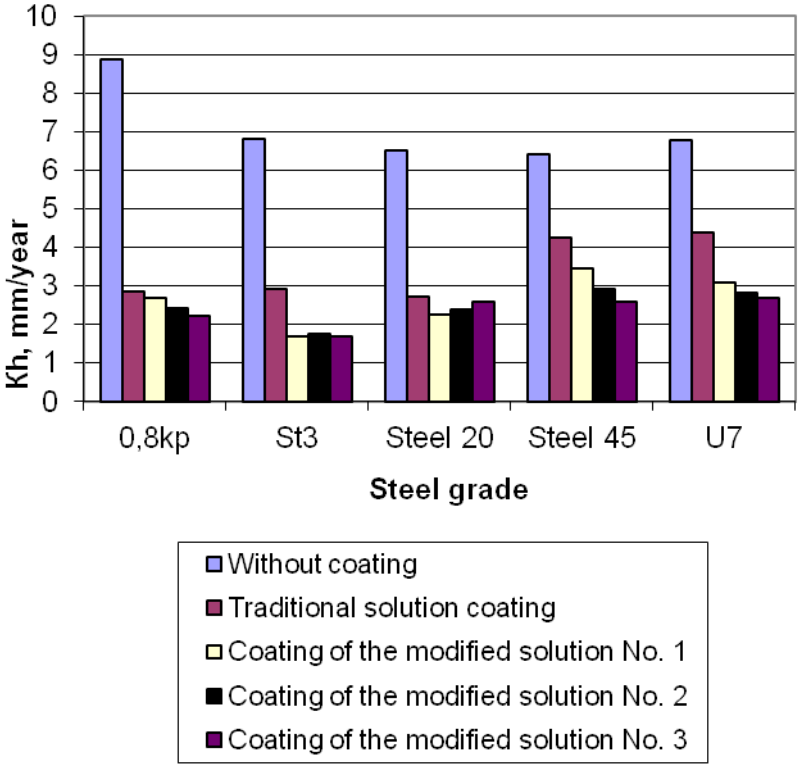

Fig. 2. *Comparison of the deep corrosion index of samples*

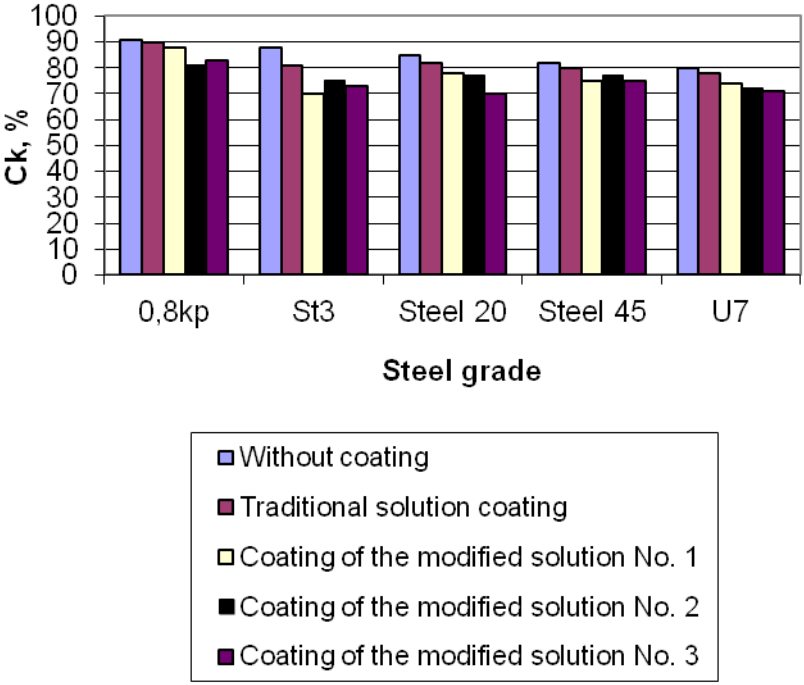

Fig. 3. *Comparison of the degree of cathodic control*

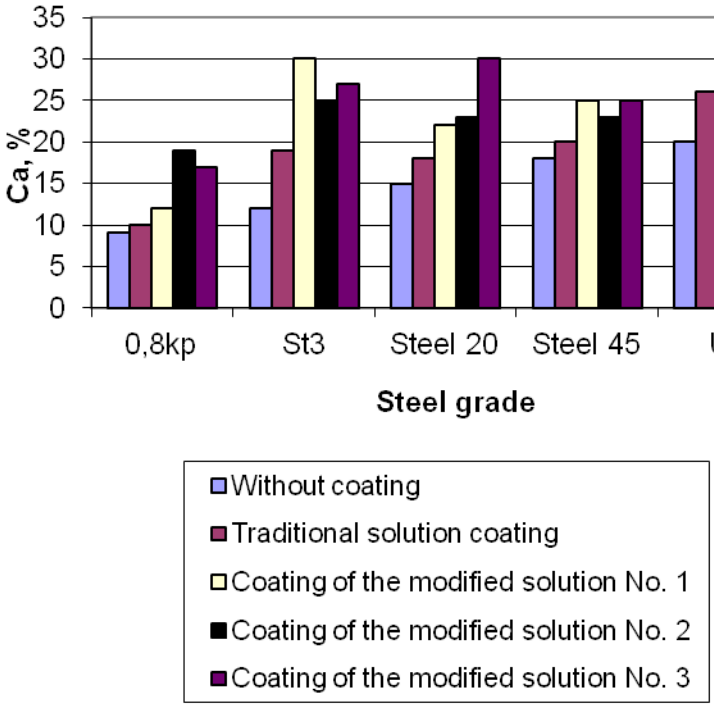

Fig. 4. *Comparison of the degree of anodic control*

Thus, the article attempts to determine the role of the carbon-containing phase of alloys in the corrosion behavior of steels protected by phosphate films. Given the fact that with increasing carbon content in steels their corrosion resistance decreases [7], it is possible to increase the corrosion properties of the material by means of modified cold phosphating solutions.

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宇宙扩张的某些方面
SOME ASPECTS OF THE EXPANSION OF THE UNIVERSE

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抽象。 本文介绍了大爆炸假说和宇宙膨胀的矛盾，以及遥远星系和量子纠缠的光速超速特征。

Abstract. *The contradictions in the hypotheses of the Big Bang and the expansion of the Universe and the features of the speeding of light by distant galaxies and quantum entanglement are covered in this article.*

Introduction

Extreme cases of GTR and quantum mechanics require philosophical reflection. On the other hand, these limiting cases generate new hypotheses.

The early universe is like a black hole

It is claimed that the initial state of the Universe is a singularity. At the same time, the initial dimensions of the universe are declared Planck. Planck size is $r = 1,6 \cdot 10^{-35}$, Planck mass is $m_{pl} = 2,176 \cdot 10^{-8}$. Gravitational constant $G = 6,67 \cdot 10^{-11}$. Schwarzschild radius $r_g = 2Gm / c^2$. If we substitute the values, we obtain that for the Planck mass the Schwarzschild radius is $r_g^{pl} = 3,23 \cdot 10^{-35}$. Consequently, the Planck Universe is a black hole. It is unclear how from the state of singularity with a huge force of gravity a Big Bang could occur. On the other hand, since black holes have no hair, they are structureless. Structureless objects cannot transform, i.e. Big bang is impossible. Otherwise, there would be a lot of big explosions. Structureless substances cannot possess qualities, i.e. a black hole cannot have a gravitational field.

Cosmological Speeds of Light

The phenomenon of the expansion of the universe in a number of explanations loses its physical meaning. For example, they say that the scattering of galaxies is not related to the actual speed of bodies moving relative to each other, not galaxies move, but space expands. Some people are attracted to the magic word “information”: “The apparent superluminal expansion of the horizon of particles of the Universe does not contradict the theory of relativity, since this speed cannot

be used for superluminal information transfer and is not the speed of movement in the inertial reference frame of any observer" [1]. That is, the galaxies scatter so that the source of the scatter are physical factors, the result of the scattering is the observed physical effect, the red shift - but the speed is not the speed. Anyway, it is accepted in the community of physicists that the speed of distant galaxies may well exceed s, and this does not contradict the special theory of relativity (STR). There is an explanation of this kind: at such great distances, the meaning of the concept of "speed" is lost. One way or another, reaching and exceeding the speed of light by distant galaxies, in the conventional wisdom, does not lead to divergence in the energy of $T = mc^2 / \sqrt{1 - v^2 / c^2}$. Exceeding the speed of light during the expansion of the Universe is not the only one. In thin slits of 1 nm, the speed of light in Casimir vacuum according to the theoretical calculations of C. Scharnhorst is 10-24 times higher than the speed of light in a conventional vacuum without disturbing causality [2].

It is argued that galaxies can be seen traveling at a speed greater than c - "as the expansion rate changes with time. First, the photon is "demolished" by the expansion, but the Hubble distance increases, and finally, the photon can fall into the Hubble sphere. As soon as this happens, the photon will move faster than the Earth moves away, and it will be able to reach us" [3]. It is argued that in the future we "will no longer be able to see as many galaxies as they are now, because they will fly away from us faster than the speed of light (due to the expansion of space), so their light will not be able to reach us" [4]. But the last two statements are incorrect. Just look at the relativistic law of velocity transformation: $\omega = \omega_0 \sqrt{(1 - v / c) / 1 + v / c)}$. And in those explanations that are given, only STR is used. Let us show that these explanations are erroneous in STR.

If one photon velocity is c, and the speed of a runaway galaxy, say, 1.1 s, then the sum of the velocities will still be c. Electromagnetic radiation is "all the same" at what speed a galaxy moves, the speed of light does not depend on the speed of the light source, the light of distant galaxies should move from the direction of our galaxy at the speed of light, not at all reduced speed of a distant galaxy. As it would seem. However, consider the expression for the frequency in the relativistic Doppler effect: $\omega = \omega_0 \sqrt{(1 - v / c) / 1 + v / c)}$. If $v > c$ the frequency becomes imaginary, therefore, the amplitudes of electromagnetic disturbances will attenuate without oscillations exponentially: $A \square e^{-\beta t}$, if $\beta = \omega_0 \sqrt{v / c - 1} / \sqrt{v / c + 1}$.

That is: at the light line, signals from distant galaxies will stop flowing. But this does not mean that such galaxies stop interacting with our galaxy. Because they interact with distant light galaxies, and they, in turn, interact with our galaxy (gravitational, not wave or electrostatic interactions are questionable). If there existed a device transmitting information from a superluminal galaxy to our galaxy

through a subluminal galaxy, we could receive superluminal electromagnetic signals, but traveling at the speed of light. Similarly, we can observe in a telescope an explosion excited by the rattling of glasses in the windows of houses, without seeing or hearing the explosion itself. The natural candidate can be the hydrogen lines observed in the course of 2-3 weeks of subluminal hydrogen clouds or the O, N, S lines excited by radiation during superluminal supernova explosions that are invisible to us.

How relevant is the question? Let us estimate the speed of the most distant galaxies. As of January 2013, the proto-galaxy UDFj-39546284 was considered an object with a maximum redshift of about 11.9.

In 2015, the astrophysicists of the Keck Observatory in Hawaii registered the radiation from the most distant Earth from the galaxy EGSY8p7. It is located at a distance of 13.1 billion light years. We see it as it was after 585 million after the Big Bang. It's speed is light.

At very large distances, when the speeds of galaxies begin to play the role of space-time curvature, nonstationarity, in general, the definition of such distances depends on the accepted model of the Universe. Therefore, the speed is usually estimated by the redshift coefficient *z*: $v = c[(1+z)^2 - 1] / [(1+z)^2 + 1]$. But the presence of superluminal galaxies can be estimated by the radius of the universe. There are estimates of 78 billion light years, we will use the better known - 46 billion light years [5]. Substituting this value and the current value of the Hubble constant $H = 2,2 \cdot 10^{-18}$ into the hubble law $v = Hr$, get speed $v = 0,96 \cdot 10^9$, which is almost three times the speed of light.

The contradiction of the expansion of the universe

According to the cosmological principle, any observer at the same moment of time, regardless of the place and direction of observation, finds in the Universe an average of the same picture. It is argued that independence from the place of observation, that is, the equality of all points in space, is the homogeneity of the Universe. However, homogeneity is something else. If observers see the same inhomogeneous Universe at different points, this is not uniformity. The cosmological principle is a nontrivial statement about the equality of various reference systems, which deprives the Universe of boundaries. Homogeneity is the same density at different points in the observable universe.

With the expansion of gas into the void there is a center of expansion. When expanding, the gas remains homogeneous, which means that the molecules that are closer to the center move faster from the center than the molecules on the surface of the volume. There is mixing, movement from areas with a higher concentration to areas with a lower concentration of particles. To imagine this, you need to understand that, for example, the surface density with rising an increasing vol-

ume of its surface remains the same as that on the selected sphere near the center of the volume. Given that with increasing surface area density should decrease. To do this, the molecules in the volume need to catch up with the molecules on the moving surface. The same logic is for bulk density. An example is an explosion of a projectile, the density of the fragments decreases with distance. Expansion of the universe is different, mixing does not occur.

First, in some way, due to the cosmological principle, the center of expansion disappeared after the Big Bang - although there is a real radius of the Universe. Secondly, in contrast to a continuous medium, the expansion occurs substantially non-uniformly, similarly to some phase transitions. Hubble constant in inflation is $H = \sqrt{8\pi\rho_{vac} / 3m_{pl}^2}$. In the stage of radiation dominance $H = 1/2t$. In the dust stage $H = 2/3t$. In the stage of Λ - dominance $H = \sqrt{8\pi G\rho_{\Lambda} / 3}$. However, in a continuous medium, phase transitions with decreasing temperature lead to an increase in density. Moreover, as A. Sandige pointed out, the Hubble law acts even inside the cell of heterogeneity, at distances of about 2 Mpc, while the transition to uniformity of the Universe occurs at distances 150 times larger. This means that it cannot play the role at what stage the Universe is, dust or radiation dominance, since heterogeneities have no effect on the Hubble constant. Dark energy would have to determine the dynamics already at distances of 1.5-2 Mpc and distributed with a much greater degree of homogeneity than ordinary matter. But in this case, phase transitions would not take place. Thirdly, on a remote galactic runaway sphere there is exactly the same scale factor, only azimuth. But due to the symmetry of the galaxy in azimuth do not scatter, but only move away from each other in mind radial expansion. Fourth, according to Hubble's law, distant galaxies move faster in the accompanying system, on the contrary. From this it follows that the Universe should be heterogeneous, its density in remote sectors should be less. Usually they reason as follows: any geometric figure formed by several galaxies increases with time so as to remain similar to itself, otherwise the distances in one direction would grow faster than in the other, which contradicts the isotropy of the Universe. Therefore, at the same time, the distance to each galaxy must increase by the same number of times. Let galaxy 1 be located k times farther from our galaxy than galaxy 2. Therefore, 1 should move k times faster than 2. That is, the speed of the galaxy should be proportional to the distance to it, and this is the Hubble law. In this argument, we see that 1) only isotropy is considered, 2) only linear homogeneity. But already in two dimensions, it can be seen that as the radius increases, the density of galaxies should fall, regardless of the background radiation or dark matter - for the lengths of the arcs between galaxies that are on the same radii grow. Even if the expansion occurs so that the speed of galaxies does not depend on the distance to them.

An analogue of a homogeneous expansion of the Universe can be the expansion of a sphere consisting of a multitude of crystals: with the energy of interparticle interactions of the Van der Waals type $U \sim r^{-6}$, c Madelung energy in ionic crystals $U_{ij} = c_1 \exp(-c_2 r_{ij}) \pm q^2 / r_{ij}$ with empirical constants, covalent, metallic or with hydrogen bonds - with weak, slow and uniform heating. Or the model of heated pudding with raisins can serve as an analogue; locally all the raisins are removed from each other. But such models 1) cannot be formed from the early Universe, 2) do not correspond to the binding energy in the Universe and its cooling, 3) contradict the Hubble law.

In [6], in the last chapter, superluminal galaxies are not considered, the light cone is considered, and integrating the interval, the STR equation is obtained (ibid., F. 114.2). The book considers homogeneity as the uniformity of metric properties at all points in space (ibid., P. 482). Therefore, no questions arise in the framework of the UTO. It also considers homogeneity as an experimental fact, as the same density observed almost everywhere on large scales. This is where the questions arise, quite understandable. If the homogeneity is preserved as if the gas has expanded into a vacuum, then it must be assumed that there is intense diffusion from large concentrations of matter to small ones. But this is contrary to the Hubble law. Consequently, the preservation of homogeneity can be only in one case - if in remote sectors the elementary particles are “pumped out” from vacuum, from which stars form incredibly quickly. Moreover, by virtue of the principle of relativity, exactly the same process should be observed in the sector of our galaxy - from the point of view of the observer in a remote galaxy. From our point of view, this process does not occur. Such a construction goes back to the theory of the stationary Universe F. Hoyle, T. Golda, G. Bondi, and others (1948), according to which as the Universe expands, new matter is constantly created between the expanding galaxies. Unlike the theory of Hoyle et al., This model does not claim to be an alternative to the Big Bang version. Nevertheless, such a construction is rather artificial. It is also possible that the point is the concept of simultaneity for measuring the density of galaxies: since the observer sees the light of galaxies emitted billions of years ago, it is likely that the Universe is actually heterogeneous, as it moves away from the observer, it becomes less dense. Cosmological models based on the principle of homogeneity, can lose value. The fact that the universe is isotropic at any point means that it is flat or almost flat. That is curvature is only a local characteristic. Or: for 3-space to be isotropic at any point, it must either be infinite, or there must be an additional spatial dimension, and since 5th measure cannot be, then at least 6 spatial dimensions.

Cosmological Quantum Entanglement

If it is possible to smash entangled photons hundreds of kilometers away, why is there no general confusion? Why, when an electron and a proton come together

(nucleosynthesis epoch), their wave functions are reduced, and when ionization does not occur entanglement? In various areas of physics and biophysics, a variety of entanglement phenomena are considered. In cosmology, quantum gravity and quantum informatics, the phenomenon of "entanglement" is investigated, these are specific entangled quantum correlations that were also studied by Einstein, Podolsky, Rosen. Different models are being developed when space-time, Einstein's equations and dark matter physics are derived from quantum entanglement. One of the hypotheses (E. Verlinde) is that in thermodynamics the laws of gravity and dark matter are derived from a certain entropic force in the classical form.

In order to obtain entanglement, it is necessary, for example, that an electron fly through a resonator with an electromagnetic field. After leaving the resonator, the electron is entangled with the field [7].

Can particles in the Universe be quantum entangled from the moment they appear in the early Universe? A measurement made on one particle instantly affects the state of another, remote to an arbitrary state. In popular literature, it is suggested that entanglement can be between electrons located in different galaxies, but this does not allow the transmission of light signals. Perhaps you need to solve some system of nonlinear Einstein-Dirac type equations, choose some physically based solutions, say, with a relativistic, probabilistic and causal orientation, and then the nonlinearity will eliminate exotic solutions, etc. But in principle, light signals are not needed, for example, if you believe in intergalactic entanglement, you can turn the spin of one electron on Earth, and the spin of the electron in another galaxy should roll over. However, for example, spin systems cannot correspond as entangled to similarly distant spin systems due to mixing entangled particles.

The system of Einstein-Dirac equations can also be investigated, but, probably, entanglement with remote particles is destroyed by thermodynamic averaging. But even in this case, total entanglement would have led, for example, to an additional "jitter" of an electron of the Lamb shift type.

In [7] it is shown that entanglement cannot spread over long distances. Consequently, in the modern universe it is not. But in that era, when the radius of the universe was hundreds of kilometers, quantum entanglement could be significant.

As for the EPR paradox itself. It is clear that in quantum mechanics a substantially different time.

It is clear that there is no information without a carrier, therefore quantum entanglement violates causality. However, most likely, quantum mechanics by itself cannot violate causality. But causality is not classic. For, as Lenin said, "the causality, which we usually understand, is only part of the universal connection." On the other hand, it is possible that if the EPR paradox is considered in the framework of QFT, with vacuum corrections, then the vacuum can act as a medium with absolute rigidity. For example, the vacuum has a gravitational mass, not having an inert mass, respectively, without the possibility of being a reference system.

Time machine

The fact that the Einstein equations have many cosmological solutions does not mean that the world exists in many universes at the same time. Consequently, of all cosmological models in each separate epoch of the development of the Universe, only one is realistic.

This means that at present there is neither the Gödel Universe, nor the Minkowski cylinder, nor Minzer's space (Minkowski's orbifolds), nor Van Stokum's dust - there is no infinite cylinder, a cylindrical-symmetric configuration of dust, no Universe with two parallel moving relative to each other Jr. Gotta, a friend of the cosmic strings, neither the anti-de Sitter space, nor the transposable acausal retrograde region in the space of time. That is, those solutions of the Einstein equations that allow for the existence of closed time-like geodesics are not implemented.

There is only a Kerr solution for a zero-charge rotating black hole with closed time-like lines below the horizon, a Banyados-Teitelboim-Zanelli three-dimensional black hole metric and a Bonnor-Steadman solution describing the condition of a laboratory experiment with two rotating balls, and a solution of the Einstein B. Tillett and D. Tsang, admitting the possibility of the existence of a closed time-like curve outside the event horizon of a black hole, for the existence of which, like for the Alcubierre Bubble, an exotic mater is necessary iya [8]. In 1961, Chandrasekhar and Wright showed the impossibility of a closed time-like geodesic in the Gödel metric [9]. S. Howard (1970) questioned the results of these authors, but in 1972 Hutz proved that Chandrasekhar's result was correct [10]. Guz also proposed estimates of the substance density, time intervals, and lengths corresponding to the minimum area of the time loop. In 1996, he repeated these estimates [11]. In particular, with a density of 10-31 and a time of 1 year, the distance is 8000 parsecs (distance from the Sun to the center of the Galaxy; if the distance is 1000 km, the time is 10-23 seconds. If the time is 1 year and the distance is 1000 km, then the density is 1028 g / cm3. If the time is 1 year, the distance is 1000 km, and the density is 10-31, then there will be a huge deviation from Euclidean geometry. "This means that the time machine is in the area of action of giant gravitational fields that destroy the human body."

In fact, it would seem, we are talking about technical difficulties that still exist. In addition, instead of a person in a time machine, you can put a robot that will kill the unfortunate grandfather, report the theorem Weierstraße to the student, etc. But this is impossible. And not yet, but in general. Those. tidal forces, which are not less than the black hole, will extend any object, incl. the robot along with the time machine, in hair is as thick as an atom.

It is clear that in nature there can be no return to what has already disappeared. The disappeared is "stored" only on paper, where a temporary loop is drawn.

Roughly speaking, the real movement of a particle from point A to point B happens with the destruction of point A and the ones following it to point B. Time travel is just an abstraction. This can be illustrated using the Hutz formula, which was used to make estimates: $\tau \approx 2 \cdot 10^{-24} l^2 \sqrt{\rho}$. If we substitute the Planck parameters here, then the equation in orders of magnitude becomes an identity.

That is: the Planck Universe is a time loop. In this connection, its extension is impossible.

Conclusion.

These contradictions in theoretical models do not deny the models themselves. The same hypotheses require comprehensive testing.

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铝及其合金的表面张力
SURFACE TENSION OF ALUMINUM AND ITS ALLOYS

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注解。本文提出了估算纯铝及其某些合金表面张力和表面层厚度的模型。厚度为h = d的层称为层d(I)，层为h≈10d – 层为d(II)的原子级光滑晶体。如果h≈10d，则材料的物理性质的尺寸依赖性开始出现。如果h = d，则表面层中发生相变。在本文中，获得了一种关系，使我们能够在接近熔点的温度下以良好的精度估算金属及其化合物的表面张力。还获得了确定金属及其化合物表面层厚度的比率。该厚度由一个参数决定 – 物质的原子体积，其起着基本作用。这个厚度给出了：原子光滑晶体表面有多少原子 – 这个问题以前从未得到过回答。

关键词：表面，表面张力，表面层，纳米结构，铝，熔点，尺寸，原子数，相变，原子体积，原子光滑晶体。

Annotation. *This article proposes models for estimating the surface tension and the thickness of the surface layer of pure aluminum and some of its alloys. A layer with thickness h=d is called a layer d(I), and a layer with h≈10 d – layer d(II) of atomically smooth crystal. If h≈10 d the size dependence of the physical properties of the material begins to appear. If h=d a phase transition occurs in the surface layer. In this paper, a relationship is obtained that allows us to estimate the surface tension of metals and their compounds with good accuracy at temperatures close to the melting point. Also obtained a ratio that determines the thickness of the surface layer of metals and their compounds. This thickness is determined by one parameter - the atomic volume of the substance, which plays a fundamental role. This thickness gives: how many atoms are from the surface of atomically smooth crystals — a question that has never been answered before.*

Keywords: *surface, surface tension, surface layer, nanostructure, aluminum, melting point, dimension, number of atoms, phase transition, atomic volume, atomically smooth crystal.*

Analysis of literature data on the surface tension of aluminum show a significant variation in the range of values of 850-1100 mJ /m^2 [1, 2]. According to the intersection of the straight line in the "recumbent" drop method with the axis of ordinates, work [[2] determine the initial value of the surface tension of aluminum σ_0, wich is equal to 1070 mJ /m^2. It agrees well with the experimental data obtained in work [3]. A value of σ_0 = 890 mJ /m^2, shown in work [4], also obtained by the method of "lying" drop, but excluding adsorption.

In work [5], the temperature dependence of the surface tension of pure aluminum and aluminum alloys was studied. For comparison, there are data for pure aluminum, also obtained by the "big drop" method. Extrapolation of polytherm, carried out to the melting point of aluminum, gives a value for pure aluminum what is σ = 861 mN/m, what is within the measurement errors for this method (1%) is consistent with the literature data [6].

In [7], a critical analysis of experiments on the measurement of wetting angles and surface tension forces was carried out. It shows that the wetting angles of a solid surface with a liquid are not constants. They are not related to surface tension and should be determined separately.

For pure metals, the "zero creep" method is used. The idea of the method is as follows. At high temperatures, under the influence of surface tension forces, an arbitrary shape of a solid must be transformed in the direction of decreasing the total surface energy. Thus, in particular, a freely suspended sample of thin wire or foil should be reduced in length. On the other hand, under the influence of an applied force (F) from outside, the foil (or thread) may be lengthened due to a viscous flow. Obviously, at some value of F=F*, the surface tension forces will be compensated and the creep rate will stop. ЭExperimentally determined F * can be a source of information about the magnitude of surface tension. In work [8], this method gave at T = 700 K value σ = 850 mJ/m^2. In a later paper [9] a net result was obtained $\sigma(T) = 860\text{-}0{,}115(T\text{-}T_m)$ mJ/m^2, T_m – melting temperature.

In work [10], the results of calculations of theoretical values are given σ = 1253 mJ/m^2 if T = 453 K. The specific free surface energy of aluminum was calculated on the basis of thermodynamic perturbation theory. These values were compared with the data of [11] σ = 1140 mJ/m^2.

In the present work, evaluation models are proposed with good accuracy of the surface tension and the thickness of the surface layer of pure aluminum and some of its alloys.

For the dimensional dependence of a certain physical property of a solid A(r), we obtained the relations [12]:

$$A(r) = A_0 \cdot \left(1 - \frac{d}{r}\right), \qquad r >> d$$
$$A(r) = A_0 \cdot \left(1 - \frac{d}{d+r}\right), \quad r \le d. \qquad (1)$$

Parameter d is associated with surface tension σ by formula:

$$d = \frac{2\sigma\upsilon}{RT}. \qquad (2)$$

Here, σ–surface tension of a massive sample; υ– atomic volume; R– gas constant; T– temperature. Equations (1) and (2) were used by us to develop a method for determining the surface tension of solids [13–15]. In this article, empirical laws are obtained that can be used not only for metals, but also for nanostructures of various compounds. To assess the surface tension, you can use the relation:

$$\sigma = 0.92 \cdot 10^{-3} \cdot T_m, \qquad (3)$$

if T_m – melting temperature.

In work[16], experimental data for 54 elements of the periodic table are indicated, and a straight line - the calculation by the formula gives:

$$\sigma = 0.7016 \cdot 10^{-3} \cdot T_m, \qquad (4)$$

where the numerical coefficient is obtained by the method of regression analysis.

The correlation coefficient for the experimental data is 0.91. The scatter of points on the graph is obviously related to the unevenness of the corresponding experimental conditions. Formulas (3) and (4) practically coincide. Calculation by the formula (3) surface tension for pure aluminum (melting point of ultra-pure aluminum is 99,996 %: 660,37 °C) will be:

$$\sigma = 0.92 \cdot 10^{-3} \cdot T_m = 0.92 \cdot 10^{-3} \cdot 933.52 = 858.84 \ \ мДж/м^2 \qquad (5)$$

At aluminum concentration 99,5 % melting starts at 657 °C, and with an aluminum content of 99.0%, melting begins at 643 °C).

As follows from formula (5), the value of the surface tension of ultrapure aluminum almost coincides with the works [5, 6, 8, 9].

As follows from formula (5), the value of the surface tension of aluminum alloys is presented in table 1. From table 1 it can be seen that aluminum alloys AlN, Al_4C_3, Al_2O_3, $AlPO_4$ have large surface tension values and mean large hardness values (fracture work) A = σ·S.

Table 1 - *Surface tension of some aluminum alloys*

Compound Al	T_m, K	σ, mJ / m ²	Compound Al	T_m, K	σ, mJ / m ²
AlN	2473	2275.16	$Al_2(SO_4)_3$	853	784.76
Al_4C_3	2373	2183.16	$AlBr_3$	371	341.32
Al_2O_3	2323	2137.16	$AlCl_3$	465	427.8
$AlPO_4$	2073	1907.16	AlI_3	462	425.04
Al_2S_3	1373	1263.16			

If in equation (2) to substitute equation (3) at $T = T_m$, we get the equation:

$$d(I) = 0.22 \cdot 10^{-6} \cdot \upsilon \text{ (îì).} \quad (6)$$

If υ = M/ρ (kg / m ³) - atomic volume. Layer with thickness h =d we'll call d(I), and layer at h≈10 d – layer d(II) of atomically smooth crystal [12]. If h≈10 d t he size dependence of the physical properties of the material begins to appear. With h=d a phase transition occurs in the surface layer. It is accompanied by abrupt changes in physical properties, for example, the direct Hall-Petch effect is reversed [17]. The first size corresponds to the processes of relaxation and surface reconstruction [18].

If we take the size dependence of a property as a basis (the mean free path of an electron, phonon, magnon, etc.), then we will have many size effects. However, all these effects are played in the area of size d(I) or d(II), which are determined by one parameter - atomic volume of substance υ (formula (6)), which plays a fundamental role and periodically changes in accordance with the periodic law of D.I. Mendeleev.

Calculate the thickness of the surface layer of some aluminum alloys (table 2).

From table 2 it can be seen that the thickness of the surface layer d (I) pure aluminum and compound AlN is changing from 2.1-2.2 nm and for $AlCl_3$, $AlPO_4$, Al_4C_3 to 9.1 -10.4 nm.

From table 2 it can be seen that the thickness of the surface layer d (II) for aluminum alloys does not exceed 50 nm. Such structures are called mesoscopic structures and are assigned in a special area. [19, 20].

Table 2 - *The thickness of the surface layer of some aluminum alloys*

Compound Al	d(I), nm	d(II), nm	Compound Al	d(I), nm	d(II), nm
AlN	2.1	21	Al_2S_3	12.6	126
Al	2.2	22	$Al_2(SO_4)_3$	21.5	215
Al_2O_3	25.5	255	$AlBr_3$	14.2	142
$AlPO_4$	10.1	101	$AlCl_3$	9.1	91
Al_4C_3	10.4	104	AlI_3	17.4	174

Table 2 shows that the surface layer d (II) of most aluminum alloys exceed 100 nm, which is typical of Glueter nanostructures [21]. But the size dependence of physical properties is also observed in this area. Surface layer d(II) ≈ 10d we refer to the size effects of the first kind. Phase size effects (size effects of the second kind) are observed in region d (I). This area is very different from d (II). Phase transition at h=d can be described in terms of the Landau mean field theory using the order parameter [22].

According to modern concepts [18], the surface layer is understood to be an ultra-thin membrane that is in thermodynamic equilibrium with a crystalline substrate, whose properties, structure and composition are different from bulk ones.

However, the question of thickness of the surface layer remains open. It is not clear in advance how far from the surface of the crystals should be taken into account the displacement of atoms. In this paper, we consider a model of the surface layer of atomically smooth crystals, neglecting the roughness of the surface, which is of the order of 0.05 nm or more near the cleavage surface in vacuum of semiconductors.

Using the lattice parameter [23], we calculate the number of monolayers H in the aluminum layer d (I). If Lattice parameter a = 0.405 nm, then the rounded number of atoms which is from the surface of atomically smooth aluminum is equal to H = 5.

Surface Al(110) (with size H = 5 atoms) represents a typical example of relaxation of a low-index metal surface [18]. This is purely normal relaxation. Like most metals, the first interlayer distance d_{12} is compressed. The magnitude of this compression, normalized by the value of the interlayer distance in the bulk of the crystal, $\Delta_{12} = (d_{12} — d_{bulk})/d_{bulk}$, is - 8,6%. In general, for gk and ok.ts.k. metals this value is in the range from zero to several tens of percent, and it is higher for surfaces with a low packing density of atoms. Deviations of the interlayer distance from the bulk value decrease with depth, and often oscillatorily. In particular, in the case of surface A1(110) the second interlayer distance is stretched to +5,0%, and the third is again compressed, albeit slightly, on - 1, 6%.

Experimental thickness d(I) can be determined by the method of moving x-rays. So for gold and silicon is obtained [24] d(I) = 2.4 and 3.4 nm accordingly, which almost coincides with the table. 1 [12]. Calculate - how many atoms are from the surface of atomically smooth aluminum compounds in table 3.

Table 3 - *How many atoms are from the surface of aluminum compounds*

Compound Al	Number of atoms, H	Compound Al	Number of atoms, H
Al	*a* =5	α-$AlPO_4$	*a/b/c* =13/45/25
Al_4C_3	*a* =12	α-Al_2O_3	*a/b/c* =29/50/26
AlN	*a/c* = 7/4	Al_2S_3	*a/b/c* =20/17/6
$Al_2(SO_4)_3$	*a/c* =27/10	-	-

From table 3 it follows that the number of atoms on the surface differs significantly from their crystallographic direction, which indicates their anisotropy.

Conclusion

We have obtained the ratio $\sigma = (0.7016 - 0.9200) \cdot 10^{-3} \cdot T_m$, allowing to estimate with good accuracy the surface tension of metals and their compounds at temperatures close to the melting point.

We have obtained the ratio $d(I) = (0.17 - 0.22) \cdot 10^{-6} \cdot \upsilon$ (îì), which determines the thickness of the surface layer of metals and their compounds. This thickness is determined by one parameter - the atomic volume of substance υ, which plays a fundamental role and periodically changes in accordance with the periodic law D.I. Mendeleev. This thickness gives: how many atoms are from the surface of atomically smooth crystals — a question that has never been answered before.

Gratitude

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具有松弛特性的杆纵向振动积分微分方程的构造

CONSTRUCTION OF THE INTEGRO-DIFFERENTIAL EQUATION OF LONGITUDINAL OSCILLATIONS OF A ROD ENDOWED WITH RELAXATION PROPERTIES

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注解。 这项工作致力于分析机械系统“盘 – 开尔文流变体”的运动。 盘的运动方程以第一类拉格朗日方程，非完整耦合方程和杆的纵向振动的积分微分方程的形式构造。

关键词：非完整约束，拉普拉斯变换，开尔文模型

Annotation. *The work is devoted to the analysis of the motion of the mechanical system “disk - Kelvin rheological body”. The equations of motion of the disk are constructed in the form of the Lagrange equations of the first kind, the equations of nonholonomic coupling, and the integro-differential equation of the longitudinal vibrations of the rod.*

Keywords: *nonholonomic constraints, Laplace transforms, Kelvin model*

The task of this work was to build an integro-differential equation with regard to the influence of longitudinal vibrations on a rod of a given length, the material of which is modeled by a Kelvin relaxation body [1,2].

The position of the disk was determined by the Lagrange coordinates $\xi(t)$ and $\varphi(t)$, $u(x.t)$ - absolute deformation of a certain part of the rod. $l(t)$ - point of tangency of the disk, which is determined using the geometric ratio

$$\xi(t) = l(t) + u(l(t), t) \tag{1}$$

The ratio representing the nonholonomic relation follows from the equality of the velocities at the point of contact of the disk with the rod

$$\dot{\xi}(t) = R\dot{\varphi}(t) + \frac{\partial u(x,t)}{\partial t} \tag{2}$$

To build the equation of longitudinal oscillations of a rheological rod, the equation is written, which determines the stress - strain state of the rod in integral, relaxation form [2]

$$\sigma(x,t) = E\left[\varepsilon_x(x,t) - \int_0^t \Re(t-\tau)\varepsilon_x(x,\tau)d\tau\right], \quad (3)$$

if $\sigma(x,t)$ - normal stress in cross section, $\varepsilon_x(x,t)$ - rod elongation, $\Re(t-\tau)$ - core of relaxation material.

Given the constant cross section of the rod and $\frac{\partial N}{\partial x} = \rho A \frac{\partial^2 u(x,t)}{\partial x t^2}$, get the beam motion equation:

$$\frac{\partial^2 u(x,t)}{\partial x^2} - \int_0^t \Re(t-\tau)\frac{\partial^2 u(x,t)}{\partial x^2}d\tau - \frac{1}{c^2}\frac{\partial^2 u(x,t)}{\partial t^2} = \frac{1}{EA}\delta\left(x - l(t)\right)\cdot\lambda(t) \quad (4)$$

Turning to the Lagrange equations of the 1st kind, we obtain the equations of motion of the disk

$$m\ddot{\zeta}(t) = H(t) - \lambda(t),\ I\ddot{\varphi}(t) = \lambda(t)\cdot R. \quad (5)$$

Given these equations, as well as assuming the value $i\frac{\partial u}{\partial x}$ is small, which can be valid at low speed i, equation (4) takes the form:

$$\frac{\partial^2 u(x,t)}{\partial x^2} - \int_0^t \Re(t-\tau)\frac{\partial^2 u(x,t)}{\partial x^2}d\tau - \frac{1}{c^2}\frac{\partial^2 u(x,t)}{\partial t^2} = \frac{1}{EA}\delta\left(x - \xi + u(x,t)\right)(H(t) - m\ddot{\xi}) \quad (6)$$

From equation (6) it follows that the force factors acting on the disk are the active force $H(t)$ and Dalamber's inertia force $m\ddot{\xi}$.

Further, the paper considers the mode of uniform motion of a disk under the assumption that the nonlinear term is small ($\xi = \upsilon t$, $\ddot{\xi} = 0$, $H = const$ and $\lambda = H$), which corresponds to the low velocity of the center of mass. This simplifying premise leads to the elimination of the nonholonomic coupling and the transfer of the mechanical system to the holonomic class.

Writing an equation describing the free oscillations of a rheological rod:

$$\frac{\partial^2 u_0(x,t)}{\partial x^2} - \int_0^t \Re(t-\tau)\frac{\partial^2 u_0(x,\tau)}{\partial x^2}d\tau - \frac{1}{c^2}\frac{\partial^2 u_0(x,t)}{\partial t^2} = 0 \quad (7)$$

and assuming that the end of the rod is rigidly embedded and at the initial moment of time there are perturbations, taking: $u_{|x=0} = 0$, $\frac{\partial u_0(x,t)}{\partial x}\Big|_{x=l} = 0$ (8)

and initial conditions $u_{0|t=0} = f_1(x), \frac{\partial u(x,t)}{\partial t}\Big|_{t=0} = f_2(x).$ (9)

The solution of equation (10) satisfying the above given conditions is sought as a series

$$u_0(x,t) = \sum_{m=1}^{\infty} X_m(x) T_m(t), \tag{10}$$

substituting, which in equation (9) we get the equations

$$\frac{d^2 X_m(x)}{dX^2} + \lambda_m^2 X_m(x) = 0, \tag{11}$$

$$\frac{d^2 T_m(t)}{dt^2} + p_m^2 T_m(t) = p_m^2 \int_0^t \Re(t-\tau) T_m(\tau) d\tau \tag{12}$$

($m = 1,2,3.....$). Here $p_m = \lambda_m \cdot c$ - unknown frequency of free oscillations. From (11) we define eigenfunctions $X_m(x)$, wich satisfy the boundary conditions derived from (7):

$$X_m(x)_{|x=0} = 0, \frac{dX_m(x)}{dx}\Big|_{x=l} = 0, (m = 1,2,3.....) \tag{13}$$

and find from the obtained boundary value problems (11), (13) eigenvalues λ_m. The solution is found in the form: $X_m(x) = C \sin \lambda_m x + D \cos \lambda_m x$. (14)

Substituting alternately the boundary conditions (13) into the solution (14), we determine the eigenvalues

$$\lambda_m = \frac{(2m+1)\pi}{2l} \quad (m = 0,1,2.....) \tag{15}$$

The solution corresponding to some fixed value of m, is denoted by:

$$X_m(x) = B_m \sin \frac{(2m+1)\pi}{2l} x, \tag{16}$$

if B_m - arbitrary constant. Solution of equation (13) with initial conditions is

$$T_m(t)_{|t=0} = f_1(x), \frac{dT_m(t)}{dt}\Big|_{t=0} = f_2(x). \tag{17}$$

we find using the Laplace transform. Earlier in [2], this problem was solved when considering free vibrations of a rod, but the solution took into account the boundary values of the relaxation time ($n = 0, n = \infty$).This virtually eliminates the possibility to take into account the rheological properties of the hereditary material of the rod, i.e. the decision does not include factors that give the oscillations a fading character.

We write the transformant as:

$$t(s)=\frac{\left[sT(0)+\dot{T}(0)\right]\left(\frac{1}{n}+s\right)}{s^3+\frac{1}{n}s^2+p_m^2 s+\frac{\widetilde{E}}{E}\frac{p_m^2}{n}},\ \text{где}\ T(0)=f_1(0)\ \dot{T}(0)=f_2(0) \quad (18)$$

When analyzing the rheological standard hereditary bodies (like foam rubber), the roots have the form of one real and two complex conjugate $s_1=-\delta_1$, $s_{2,3}=-\delta_2\pm ip_m$. In this case, the original $T_m(t)$ solution of equation (12) is:

$$T_m(t)=S_m e^{-\delta_1 t}+C_m e^{-\delta_2 t}\left(\cos p_m t+\sin p_m t\right).$$

Coefficients S_m, C_m with zero initial conditions, turn to zero. As a result, we obtain a solution to the initial-boundary value problem:

$$u_0(x,t)=\sum_{m=1}^{\infty}\left(b_m e^{-\delta_1 t}+C_m e^{-\delta_2 t}\left(\cos p_m t+\sin p_m t\right)\right)\sin\frac{(2m+1)\pi}{2l}x,$$

$$(m=0,1,2....), \quad (19)$$

Coefficient values b_m, c_m we define from the initial conditions (8) using the orthogonality property of eigenfunctions.

Investigate the forced vibrations. Find a solution in the form of a series

$$u_н(x,t)=\sum_{k=1}^{\infty}\gamma_k(t)\sin\frac{(2k+1)\pi}{2l}x. \quad (20)$$

Substitute it to conditions

$$u_н\big|_{t=0}=0,\ \frac{\partial u_н}{\partial t}\big|_{t=0}=0,\ u_н\big|_{x=0}=0,\ \frac{\partial u_н}{\partial x}\big|_{t=0}=0. \quad (21)$$

Substituting series (20) into equation (6) and decomposing functions $\frac{H}{EA}\delta(x-u_0(x,t)_{|x=vt})$ in a row in sine by argument x in the interval $(0,l)$, we get to an integrodifferential equation:

$$\frac{\partial^2\gamma_k(t)}{\partial t^2}-\omega_k^2\int_0^t\Re(t-\tau)\gamma_k(\tau)d\tau+\omega_k^2\gamma_k(t)=q_k(t) \quad (22)$$

$$q_k(t)=\frac{2Hc^2}{EAl}\int_0^l\delta(x-vt-u_0(x,t)_{|x=vt})\sin\frac{(2k+1)\pi}{2l}xdx=\frac{2Hc^2}{EAl}\sin(\frac{(2k+1)\pi}{2l})\big|_{x=vt}$$

(k=0,1,2…) (23)

The presence of secular terms generated by the right side of the equation $\frac{\partial^2 \gamma_k(t)}{\partial t^2} - \omega_k^2 \int_0^t \Re(t-\tau)\gamma_k(\tau)d\tau + \omega_k^2 \gamma_k(t) = q_k(t)$, give vibrations of the rod a resonant character. Disc movement will be unstable. This result can be considered expected, since the authors of [2] showed the instability of the mode of rectilinear motion of the disk along the rheological base of the Kelvin body.

Draw a numerical analysis with the following data $n = 50c$, $E = 1 \, H/см^2$, $\tilde{E} = 0,7 \cdot E \, H/см^2$, $L = 100см$, $\rho = 0,05 \, г/см^3$, $\upsilon = 100 \frac{см}{c}$, $R = 10см$, $c = \sqrt{\frac{E}{\rho}} \frac{см}{c}$, $\omega_1 = \frac{3\pi c}{2L} c^{-1}$, $p_1 = \frac{\pi}{2L}\sqrt{\frac{E}{\rho}} \; c^{-1}$, $H(t) = 2H$, $F = 1см^2$, $\delta_1 = h_1 = 0,014c^{-1}$, $\delta_2 = h_2 = 0,003c^{-1}$, $b_1 = 809см$, $c_1 = -803см$, $d_1 = 9759см$, $k = 1, x = 10$.

Using the method of the first approximation, we can draw conclusions about the stability of the movement of the disk along the time coordinate.

As follows from the graph, it is possible to implement the stationary mode of high-frequency forced oscillations of a rheological beam supported by a periodic driving force generated by the filtering action of the Dirac function and a variable generalized sliding friction force caused by a weakly elastic field of the beam material.

The reliability of the obtained results is confirmed by their coincidence with the results of the numerical integration of integrodifferential equations with the relaxation core of a standard hereditary body and the weakly singular model core proposed by A.P. Rzhanitsyn [5].

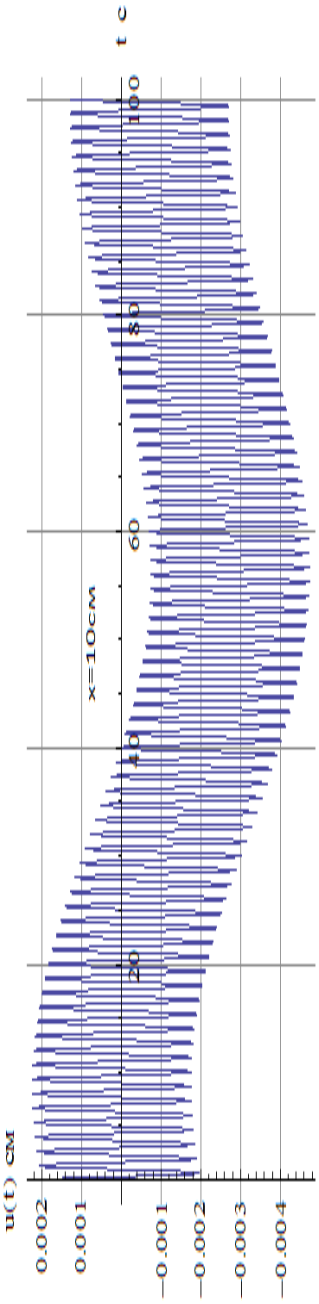

Fig. 1. *Fragment of the establishment of the oscillatory process*

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