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

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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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创新背景下人力资源管理技术的发展
DEVELOPMENT OF HUMAN RESOURCES MANAGEMENT TECHNOLOGIES IN THE CONTEXT OF INNOVATION

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注解。 本文讨论了这一紧迫主题的理论和实践基础，因为现代组织必须做好不断变化和适应新条件的准备。 创新可以包括技术突破、新的管理方法、劳动力市场的变化等等

关键词：创新、培训方法、劳动潜力、人力资源管理、能力、人员发展、人力资源、人力资源潜力、人力资源评估指标、员工敬业度、人力资源管理体系效率。

Annotation. *The article discusses the theoretical and practical foundations it is an urgent topic, as modern organizations must be ready for constant changes and adaptation to new conditions. Innovations can include technological breakthroughs, new management methods, changes in the labor market, and more*

Keywords: *innovations, training methods, labor potential, human resource management, competencies, personnel development, human resources, human potential, human resource assessment indicators, employee engagement, efficiency of the human resource management system.*

HR management technologies include a variety of tools and techniques that help organizations optimize the processes of hiring, developing, motivating and retaining employees. Here are some of the main HR management technologies:

1. Automation of HR processes: Using software to automate routine tasks such as recruiting, payroll administration, vacation management, etc.

2. Online resources for learning and development: Creating online platforms or using external resources to provide employees with access to educational materials, training and professional development courses.

3. Talent Management: Develop strategies and programs aimed at attracting, retaining and developing talented employees, including career planning, loyalty programs and rewards.

4. Performance assessment: Implementation of employee performance assessment systems to determine their level of competence and contribution to achieving corporate goals.

5. Motivation and stimulation: Development of motivation programs, including tangible and intangible incentives, to increase employee satisfaction and loyalty.

6. Communication and feedback: Creating effective channels of communication within the organization and between management and employees to ensure transparency and accessibility of information.

7. Performance assessment: Implementation of employee performance assessment systems to determine their level of competence and contribution to achieving corporate goals Performance assessment is an important personnel management tool that allows you to determine the level of productivity of each employee and his contribution to achieving corporate goals. Various methods and tools can be used for this, such as:

8. Evaluation of work results: Analysis of quantitative and qualitative indicators of an employee's performance over a certain period of time

9. Evaluation of work results: Analysis of quantitative and qualitative indicators of an employee's performance over a certain period of time.

Competence assessment: Determining the level of development of professional and personal qualities of an employee that are necessary for the successful performance of their duties.

– 360-degree assessment: Receiving feedback from colleagues, subordinates and management about the employee's work, his strengths and weaknesses.

– Personnel certification: Regular assessment of the qualifications and professional skills of employees in order to determine their suitability for the position and career opportunities.

– The system of key performance indicators (KPIs): The definition of quantitative indicators that reflect the degree of achievement of corporate goals and the contribution of each employee to the overall result.

– Customer feedback: Evaluation of the quality of employees' work by customers and consumers of the company's services.

Performance evaluation should be objective, regular and confidential. It allows you to identify the strengths and weaknesses of employees, determine their development and training needs, as well as develop individual career growth and motivation plans.

let's study the foreign experience of evaluating the effectiveness of work.

Foreign experience in evaluating performance includes various approaches and methods that can be adapted for use in Russian companies. For example, in the USA and Canada, the KPIs system is widely used, which allows you to evaluate the contribution of each employee to achieving the overall goals of the company. In Europe and Japan, much attention is paid to the assessment of employee competencies and the development of their professional skills.

In addition, feedback methods from clients and colleagues are actively used abroad, which allows you to get an objective assessment of the work of employees. Also, in some countries, for example in Germany, regular personnel certification is carried out, which helps to determine the level of professional qualifications of employees and their compliance with their positions.

In general, foreign experience in evaluating performance can be useful for Russian companies, but requires adaptation to local conditions and business specifics.

Talent management includes next things. Develop strategies and programs aimed at attracting, retaining and developing talented employees, including career planning, loyalty programs and rewards.

– Assessment of competencies: Determining the level of development of professional and personal qualities of an employee that are necessary for the successful performance of their duties.

– 360-degree assessment: Receiving feedback from colleagues, subordinates and management about the employee's work, his strengths and weaknesses.

– Personnel certification: Regular assessment of the qualifications and professional skills of employees in order to determine their suitability for the position and career opportunities.

– A system of key indicators.

Talent management is an important aspect of any organization, as talented employees are a key factor in the success of the company. Effective talent management can help increase productivity, improve job quality, and reduce staff turnover.

One of the key aspects of talent management is to attract talented employees. To do this, companies can use various methods, such as holding open job contests, attracting university graduates and using social networks to find candidates.

Retaining talented employees is also an important task. Companies can use loyalty programs such as bonuses, bonuses, and extra vacation days to motivate employees to stay with the company. In addition, companies can offer opportunities for professional development and career growth, which will help retain talented employees.

The development of talented employees is also important for the success of the company. Companies can develop career development plans for their employees and provide training and development opportunities. This will help employees develop and achieve their goals, as well as increase their job satisfaction.

In general, talent management is a complex process that requires constant monitoring and adaptation to changing market conditions. However, effective talent management can significantly increase a company's productivity and success.

The development of human resources management technologies in the context of innovation is an important aspect for improving the efficiency of the company and improving the quality of work of employees. In this context, the following technologies and approaches may be useful:

Automation of personnel management processes: the use of software and automated systems for data processing, reporting, planning and monitoring of employees' work. This reduces the time required to perform routine operations and improves the accuracy and efficiency of management.

The introduction of artificial intelligence and machine learning technologies: AI can help analyze large amounts of data about employees, their productivity and needs. Machine learning can be used to predict training needs, determine the optimal work schedule, identify potential problems in the work of employees, etc.

The use of virtual and augmented reality technologies: the use of VR and AR for training, professional development and skills development of employees. These technologies allow you to create realistic simulations of work situations and conduct training without risk to employees or the environment.

Development and use of blockchain technologies: the use of blockchain technologies to simplify and accelerate the recruitment process, track the work history of each employee, as well as to ensure data security and transparency.

The introduction of automated personnel management systems (HRMS) can significantly improve the efficiency and productivity of working with employees. This may include simplifying hiring processes, salary and benefits management, tracking working hours, employee training and development, and communication between employees and management. Automated HRMS systems can help organizations reduce personnel management costs, improve the quality of employee service and ensure more efficient use of resources.

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卫生机构的绩效和结果管理
PERFORMANCE AND RESULTS MANAGEMENT IN HEALTH INSTITUTIONS

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抽象的。 本文探讨了卫生机构绩效和结果管理的关键方面。 它深入探讨了有效管理医疗保健服务以确保最佳患者护理和机构效率的重要性。 本文首先回顾了历史，重点介绍了医疗保健管理策略的演变。 然后讨论绩效和结果管理的关键组成部分，强调它们的相互依赖性和对医疗保健服务的影响。 审查了卫生机构在实施这些系统时面临的挑战，以及取得成功成果的最佳实践和战略。 提供了现实世界的例子和案例研究来说明这些概念的实际应用。 此外，本文还探讨了技术和创新在增强这些管理系统方面的作用。 分析了有效的绩效管理对患者护理和整体机构绩效的影响。 本文最后对医疗保健领域的绩效和结果管理的未来进行了预测，提供了对新兴趋势和潜在进步的见解。 本文为医疗保健管理者、政策制定者和寻求通过有效管理实践改善医疗保健服务的专业人士提供了综合资源。

关键词：医疗保健绩效管理、医疗保健结果管理、患者护理质量、医疗保健管理、健康管理策略、医疗服务效率、医疗保健组织绩效、医疗保健管理技术、医疗保健创新、医疗保健案例研究、卫生政策和管理、 医疗保健趋势、健康结果衡量、医疗保健最佳实践、医疗保健管理的未来。

Abstract. *This article explores the critical aspects of performance and results management in health institutions. It delves into the significance of effectively managing healthcare services to ensure optimal patient care and institutional efficiency. The paper begins with a historical overview, highlighting the evolution of management strategies in healthcare. It then discusses the key components of performance and results management, emphasizing their interdependence and impact on healthcare delivery. The challenges faced by health institutions in implementing these systems are examined, alongside best practices and strategies that have led to successful outcomes. Real-world examples and case studies are provided to illustrate the practical application of these concepts. Furthermore, the article explores the role of technology and innovation in enhancing these management systems. The impact of effective performance management on patient*

care and overall institutional performance is analyzed. The article concludes with future predictions for performance and results management in healthcare, offering insights into emerging trends and potential advancements. This piece serves as a comprehensive resource for healthcare administrators, policymakers, and professionals seeking to improve healthcare delivery through effective management practices.

***Keywords**: performance management in healthcare, healthcare results management, patient care quality, healthcare administration, management strategies in health, health services efficiency, organizational performance in healthcare, technology in healthcare management, healthcare innovation, case studies in healthcare, health policy and management, healthcare trends, outcome measurement in health, best practices in healthcare, future of healthcare management.*

Introduction

In today's rapidly evolving healthcare landscape, the significance of performance and results management within health institutions cannot be overstated. This pivotal aspect of healthcare administration is essential for ensuring that healthcare providers not only meet but exceed the ever-increasing standards of patient care and institutional efficiency. Performance management in healthcare involves a systematic process by which health institutions and their staff aim to improve the quality of healthcare services they provide. It encompasses a range of activities, including setting organizational goals, monitoring and evaluating progress, and implementing continuous improvement strategies. Results management, a closely related concept, focuses on the outcomes achieved through these efforts. It involves measuring, analyzing, and interpreting various metrics related to patient care, operational efficiency, and overall institutional performance. The integration of performance and results management is crucial in facilitating a culture of excellence in healthcare services, ultimately leading to enhanced patient satisfaction and improved health outcomes. However, implementing effective performance and results management systems in health institutions is not without its challenges. These range from logistical issues, such as the integration of advanced technology and data management systems, to more complex human resource challenges, including staff training and maintaining high levels of employee engagement. Additionally, healthcare providers must navigate a landscape of ever-changing regulations and expectations, making adaptability and continuous learning essential components of effective management. Despite these challenges, there are significant opportunities in this field. Advancements in technology, for instance, offer new tools for data collection and analysis, facilitating more precise and efficient management practices. Moreover, a growing focus on patient-centered care

provides a framework for health institutions to align their performance objectives more closely with patient needs and expectations, leading to both increased patient satisfaction and institutional success. Performance and results management are critical components of modern healthcare administration. They offer a pathway to not only meet the challenges of today's healthcare environment but to anticipate and successfully navigate those of the future. This article aims to provide a comprehensive exploration of these themes, underscoring the importance of these practices in enhancing the quality and effectiveness of healthcare delivery. The historical perspective on performance management in healthcare reveals a significant evolution in approaches and methodologies. Traditionally, healthcare performance management was predominantly focused on input-based measures, such as the number of staff, availability of resources, and infrastructure. These measures were reflective of a system primarily concerned with the scale of service delivery rather than the quality of care or patient outcomes. Over time, with advancements in medical knowledge and technology, the focus shifted towards more outcome-based measures, emphasizing the quality of patient care, treatment effectiveness, and patient satisfaction. In the latter part of the 20th century, particularly with the advent of evidence-based medicine, there was a paradigm shift in healthcare performance management. This period marked the beginning of a more data-driven approach, where decision-making was increasingly informed by empirical evidence. The introduction of quality improvement frameworks, such as the Six Sigma and Lean methodologies, borrowed from the manufacturing sector, further refined performance management practices in healthcare. Currently, the trends and changes in health institutions' management strategies are being shaped by several key factors. One of the most influential is the integration of digital technologies. Electronic health records (EHRs), big data analytics, and telemedicine are transforming how healthcare data is collected, analyzed, and used for decision-making. These technologies enable more precise and real-time monitoring of performance metrics, leading to more proactive and predictive management.

Another current trend is the growing emphasis on patient-centered care. This approach places the patient's experience and satisfaction at the forefront of performance evaluation. As a result, health institutions are increasingly adopting patient satisfaction scores and experience reports as critical performance indicators. Furthermore, the ongoing global health challenges, such as the COVID-19 pandemic, have underscored the need for resilience and adaptability in healthcare systems. This has led to a renewed focus on agile management strategies that can rapidly respond to changing circumstances, emphasizing flexibility, staff well-being, and sustainable healthcare delivery. the evolution of performance management in healthcare from a resource-focused approach to a quality and outcome-centric model reflects the sector's ongoing commitment to improving patient care.

Current trends, shaped by technological innovation and a greater emphasis on patient-centricity, are steering health institutions towards more dynamic and responsive management strategies. This background sets the stage for a deeper exploration of the specific components, challenges, and strategies of performance and results management in modern healthcare institutions.

Future Directions and Innovations

The landscape of health institution management is continuously evolving, driven by technological advancements, shifting patient expectations, and changing healthcare dynamics. The future of this field is likely to be shaped by several emerging trends and innovations, presenting both challenges and opportunities.

1. Increased Digitalization and Interconnectivity: The future will see an even greater reliance on digital technologies in health management. Electronic Health Records (EHRs) will become more sophisticated, integrating data from various sources including wearable health devices, thus providing a more comprehensive view of patient health. Interconnectivity through health information exchanges will facilitate better coordination of care across different providers.
2. Advanced Data Analytics and AI: The use of artificial intelligence and machine learning in healthcare will expand significantly. These technologies will aid in predictive analytics, providing insights that can preempt health issues and optimize treatment plans. AI will also play a significant role in operational management, from resource allocation to patient flow optimization.
3. Personalized and Precision Medicine: Tailoring healthcare to individual patient's genetic makeup, lifestyle, and environment will become more prevalent. This approach will not only enhance the effectiveness of treatments but also reduce the occurrence of adverse drug reactions, contributing to more effective health management.
4. Focus on Population Health Management: There will be a shift towards a more holistic approach to health, focusing on the broader determinants of health and well-being. Population health management strategies will aim to improve health outcomes at a community level, utilizing data analytics to address health disparities and improve access to care.
5. Telehealth and Remote Care Expansion: The use of telehealth services, which saw a significant uptick due to the COVID-19 pandemic, is expected to continue growing. This will not only improve access to healthcare services, especially in underserved areas but also enable continuous monitoring and management of chronic conditions.
6. Integration of Wellness and Mental Health: There will be a stronger emphasis on integrating mental health and wellness into overall health man-

agement. This holistic approach recognizes the interconnectivity between physical and mental health and the importance of addressing both for overall well-being.

7. Emphasis on Sustainability and Resilience: Future health management strategies will increasingly need to consider environmental sustainability and resilience, particularly in the face of climate change and potential global health crises.
8. Challenges and Opportunities: One of the main challenges will be ensuring data privacy and security, especially with the increased use of digital technologies. Furthermore, the rapid pace of technological change will require ongoing staff training and adaptation. However, these challenges also present opportunities for innovation and improvement in healthcare delivery and management.
9. Patient-Centric Models and Community Engagement: Future trends will likely emphasize more patient-centric care models, involving patients more actively in their healthcare decisions. There will also be a focus on community engagement and education, empowering populations to take a proactive role in their health.

The future of health institution management is poised for transformative changes, driven by technological innovations and a shift in healthcare paradigms. While these changes will present challenges, they also offer significant opportunities to enhance the quality, efficiency, and accessibility of healthcare.

In summarizing the key points of this article, it's clear that performance and results management are integral to the advancement and efficacy of health institutions. The journey from input-based measures to outcome-focused strategies marks a significant evolution in healthcare management. The integration of strategic planning, data-driven decision-making, continuous quality improvement, and patient-centered care models represents the best practices in this field. These strategies are enhanced by the innovative use of technology, including electronic health records, telehealth, and advanced data analytics.However, these advancements come with their own set of challenges, such as data security, the need for staff training in new technologies, and adapting to changing healthcare landscapes. Yet, these challenges also present unique opportunities for growth and improvement. Looking forward, health institutions are poised to experience transformative changes driven by digitalization, the shift towards personalized medicine, and a greater focus on holistic health management. The role of technology will be increasingly central in this evolution, offering new ways to enhance healthcare delivery and management.

As a call to action, health institutions and policymakers are urged to embrace these changes proactively. Institutions should invest in the necessary technolo-

gies and training to stay at the forefront of healthcare management. Policymakers should foster environments that support innovation in healthcare, ensuring regulations and policies are conducive to the adoption of new technologies and practices. Together, their collaborative efforts can ensure the healthcare system is not only efficient and effective but also resilient and adaptable to the needs of the future. the path to achieving excellence in healthcare is ongoing and requires a commitment to continuous improvement and adaptation. By staying informed of emerging trends and embracing innovative strategies, health institutions and policymakers can lead the way in creating a healthcare system that meets the demands of the present and is prepared for the challenges of the future.

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各国在人工智能技术发展领域的国家政策：技术发展的机遇、风险和伦理方面
STATE POLICIES OF COUNTRIES IN THE FIELD OF DEVELOPMENT OF ARTIFICIAL INTELLIGENCE TECHNOLOGY: OPPORTUNITIES, RISKS AND ETHICAL ASPECT OF TECHNOLOGY DEVELOPMENT

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抽象的。 本文探讨了各国关于人工智能技术在公民生活活动中的发展和实施前景的公共政策。 以美国、中国和俄罗斯为例，分析了该技术在监管层面的发展方法。 强调了人工智能技术广泛引入所带来的风险和机遇。

关键词：人工智能、公共政策、监管框架、软件、经济学、创新。

Abstract. *This article examines the public policy of individual countries regarding the prospects for the development and implementation of artificial intelligence technologies in the life activities of citizens. An analysis of approaches to the development of this technology at the regulatory level is carried out using the example of the USA, China and Russia. The risks and opportunities associated with the widespread introduction of artificial intelligence technologies are highlighted.*

Keywords: *artificial intelligence, public policy, regulatory framework, software, economics, innovation.*

The issue of introducing artificial language into the processes of not only companies, but also areas of people's lives in general has become very popular in recent years; it is believed that this tool can automate many processes and reducing human participation, thereby increasing productivity, and freeing up people's resources for more important tasks.

The relevance of the introduction of artificial intelligence has been confirmed in many countries, such as China, Russia, the USA, and others. The concept of artificial intelligence is understood in two ways - as a field of study of the special behavior of machines and as this behavior itself, the distinctive feature of which is "the performance of tasks usually associated with the use of human intelligence" [1]. Domestic authors, such as Borovskaya E. V., refer to the following definition

of artificial intelligence - this is a software system that simulates the human thinking process on a computer [2].

If we consider the historical aspect, the term “artificial intelligence” (AI; English AI - “Artificial Intelligence”) was proposed in 1956 at a seminar with the same name at Dartmouth College (USA). This seminar was devoted to the development of methods for solving logical (rather than computational) problems. After artificial intelligence was recognized as a special field of science, it was divided into two areas: neurocybernetic and “black box” cybernetics.

Now, the development of “Artificial Intelligence” is a promising direction for many countries, this is confirmed by regulatory documents; since 2013, the Chinese government has published a few official documents at the national level, to one degree or another affecting research and development in the field of AI:

– “Internet +”
– “Made in China 2025”
– 13th Five-Year Socio-Economic Development Plan.

The most relevant document is the program for the development of next-generation artificial intelligence, presented in 2017 [3]. This Program defines three main strategic goals of China, the time frame for their achievement, as well as sources of financing and bureaucratic support tools:

1. By 2020, China should reach the level of developed countries in terms of the development and application of AI, and the artificial intelligence industry should become a new important point of economic growth.

2. By 2025, China should reach the world level in some AI technologies, and artificial intelligence should become the main driving force in the modernization of industry and other sectors in China.

3. By 2030, China should become the world’s AI innovation center, which will lay a strong foundation for China to become a leading economic power.

In the United States, special attention was paid to the development of the AI (artificial intelligence) industry from the very beginning of the formation of AI as a separate discipline and technology. An analysis of American federal legislation shows the demand for the development of the industry; in 2021, about 131 bills were proposed, but nevertheless, the political situation imposes internal barriers to the development of the industry, since only 2% of the proposed bills received the status of law [4]. According to the OECD database, 20 of 36 policy initiatives aimed at developing AI in the US do not have status above a directive or funding guideline [5]. When assessing the degree of state participation in the development of this industry, it is important to consider the amount of funding, based on open sources it is known that:

– In the USA for the period 2000 – 2021. The government allocated a total of about $8 billion for projects in the field of AI, most of which were related to military developments [6];

– In China, government spending in 2018 alone ranged from $2 billion to $8.4 billion [7].

Based on the analyzed information, it can be concluded that both states accept the importance of developing the AI industry at the state level, however, in development methods they rely on different tools. In the United States, the development of artificial intelligence is based on commercial enterprises, and government interests are largely tied to the development of AI for military purposes. In China, on the contrary, the basis for the development of AI is the public sector, which stimulates the introduction and development of AI in industry and other most important sectors of the economy, seeking to ensure a leading position in this area on the world stage.

In recent years, Russia has not lagged in the development of Artificial Intelligence and has made it one of its important priorities along with other countries. Decree of the President of the Russian Federation dated October 10, 2019, No. 490 "On the development of artificial intelligence in the Russian Federation" approved the National Strategy for the Development of Artificial Intelligence for the period until 2030. The strategy is the main program document aimed at the development and implementation of domestic solutions that shape the introduction of innovations in all areas of economic activity and the daily lives of citizens. In development of the National Strategy, the federal project "Artificial Intelligence" was approved for implementation until the end of 2024. Budgetary funding in the amount of 24.1 billion rubles is provided, operating within the framework of the National Program "Digital Economy" [8].

One of the support operators in this area is the Innovation Promotion Fund, which, when selecting projects and determining the relationship of a solution to projects in the field of artificial intelligence, operates on criteria approved by the Ministry of Economic Development of the Russian Federation, namely:

– criteria for the subject of the project;
– basic technology criterion;
– criterion for the result of project implementation.

The main task of government support for projects in the field of AI is the creation of solutions that allow simulating human cognitive functions (including self-learning and searching for solutions without a predetermined algorithm) and obtaining results when performing specific tasks that are comparable, at a minimum, to the results of human intellectual activity [9]. The priority areas in the direction of development of Artificial Intelligence are:

– computer vision;
– natural language processing;
– speech recognition and synthesis;
– intelligent decision support systems;
– promising methods of artificial intelligence.

When studying the development of artificial intelligence, it is necessary to consider two components - on the one hand, these are opportunities, and on the other, the risks of widespread implementation of this technology in areas of human activity; the main risks and opportunities are presented in Fig. 1.

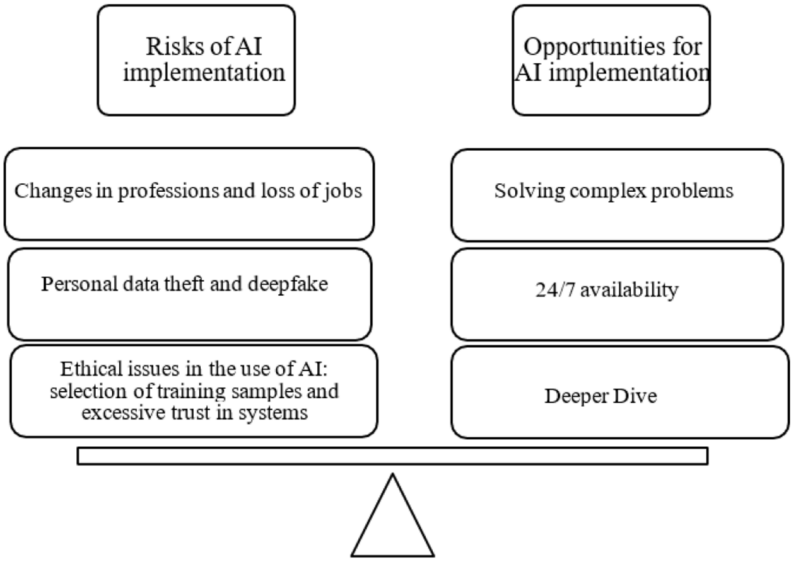

Figure 1. *Risks and opportunities of introducing AI*

Compiled by the author based on data from [Electronic resource] – Access mode: https://sales-generator.ru/blog/vnedrenie-iskusstvennogo-intellekta/#3 (Date of access: 12/15/2023)

Solving complex problems. AI technology can use machine learning and deep learning to solve complex problems in a similar way to humans. Artificial intelligence can process large amounts of data, identify patterns, identify information, and provide answers. It can also be used to solve problems in various areas, such as fraud detection, medical diagnostics, and business analysis.

24/7 availability. Unlike humans, artificial intelligence can work around the clock and without loss of productivity. In other words, it can perform manual tasks without errors. This allows AI to be tasked with performing repetitive, tedious tasks so that human resources can be used for other activities that require a lot of attention.

Deeper Dive. Artificial intelligence can use machine learning to analyze large amounts of data faster than any human. AI platforms can identify trends, analyze

data, and make recommendations, and by predicting data, AI can help you choose the best course of action.

Changes in professions and job losses. Automation of processes reduces the need for resources, which entails the complete destruction of certain professions; in addition, the widespread use of new technologies increases the requirements of employers for applicants when selecting for work; therefore, obtaining a basic job will require additional skills that were not previously required.

Identity theft and Deepfake. The development of new technologies and their implementation provides new tools not only for law-abiding citizens, but also for various types of fraudsters who use new approaches to steal personal data, as well as to falsify biometrics and other types of verification data, which significantly increases the risks and requirements for increasing the general level of information security of the population.

Ethical issues in the use of AI: selection of training samples and excessive trust in systems. The development of AI is largely based on its training on certain data, the so-called Datasets, which in turn creates the risks of incorrectly selected training samples and, therefore, errors in the results, so it is important to clearly distinguish between areas where the use of artificial intelligence and the result of its activities does not entail critical negative decisions affecting people's lives. Examples are the following industries: judicial, medical, transport and others. An example is the "Compas system", which was used by an American court to assess the risk of recidivism in violation of the law, which unreasonably assessed the risk of re-entry into prison for black people 2 times more often than for light-skinned people. The risk of excessive trust in AI systems can also lead to unfavorable consequences when decisions made are based on the results of the software without a deeper examination, for example, a doctor will study a patient's X-ray and miss a malignant tumor because the AI reported its absence. It is important to regulate that now Artificial Intelligence is of a recommendatory (reference) nature, since the system makes decisions on certain parameters on which training took place, while a person can study the problem more deeply and make a more informed decision.

In conclusion, I would like to note that now it is necessary to pay more attention to regulating the use of artificial intelligence in areas of human life; now, the issue of ethics in the use of AI is open and many countries are striving to consolidate specific norms regulating the use of artificial intelligence. It is important to highlight the industries in which the application.

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健身条件下女性心身健康状态的矫正
CORRECTION OF PSYCHOSOMATIC HEALTH STATE WOMEN IN FITNESS CONDITIONS

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注解。 这篇文章介绍了作者们自己的长期观察结果，这些作者研究了参加健身俱乐部的女性的心理状态及其变化。 研究表明，对女性采取综合方法，将心理治疗方法纳入健身过程中，可以稳定降低精神压力水平，从而在训练期间和训练后提高工作状态。 完成培训。

关键词：负荷、健身、身体适应、训练、精神压力。

Annotation. *The article presents the results of their own, long-term observations of the authors who studied the psychological status and its changes in women who attended fitness clubs. It is established that an integrated approach to women, with the inclusion in the process of psychotherapeutic methods in fitness, lead to a steady decrease in the level of mental stress, which in turn leads to a more working state, both during training and after the completion of training.*

Keywords: *load, fitness, adaptation of the body, training, mental stress.*

It is known that training is a multifaceted process that includes mental functions, such as memory, attention, will. The attention of the trainee, his perception of the proposed skills and abilities is, in essence, training; this means that a person most often cannot learn anything until he fully perceives the information and comprehends it. Along with this, training is often an activity that is not conscious or understood by us; those involved do not know and do not understand how this happens. As a result, “psychological dissonance” is created. At the same time, long-term training loads often cause psychological fatigue, which leads the student to a state of apathy and even contributes to the development of chronic fatigue syndrome [8,9,10]. Psychological fatigue is caused not only by the volume or intensity of the load; An equally significant factor in overloading the nervous system is the systematic monotony of the training process [1,2,6,7]. In the structure of fitness clubs, in group classes, this is a common phenomenon, indicating

the relevance of the problem of correcting the mental and psychosomatic status of trainees. A high degree of mental stress is often associated with symptoms such as: insomnia, increased irritation in communication, loss of motivation during the training process, poor concentration in performing exercises and perceiving the material in class, sudden mood changes, general fatigue of the body, apathy, etc. This determined the purpose of this study - to develop a method for correcting the health status of women in fitness conditions, in an aerobic mode. To achieve this goal, we conducted a pedagogical experiment in a fitness club, in which practically healthy women aged 25-40 years voluntarily took part. The participants were divided into 2 groups (control and main) of 17 people in each. Aerobic fitness training was carried out 3 times a week. A circuit training technique was used for 60 minutes each, including warm-up, main part of the session and cool-down, for 7 months [3,4]. In addition to physical training before fitness classes, the main group received psychological preparation twice a week. In this case, psychomuscular training (PMT) and ideomotor training (IT) were used [5]. The control group trained as usual. At the beginning and at the end of the experiment, the Hamilton test was performed with each student [11]. As a result of the studies, it was found that fitness training has a positive effect on the psycho-emotional status of those involved (Table 1).

Table 1.

Changes in the psychosomatic state of women control group (n=17)

Indicator (points)	**Before experiment**	**After experiment**
Anxious affect	2,1 ± 0,2	0,9 ± 0,01*
Voltages	2,6 ± 0,1	1,9 ± 0,1*
Fears	0,9 ± 0,1	0,4 ± 0,01*
Insomnia	2,3 ± 0,4	1,3 ± 0,1*
Cognitive disorders	1,9 ± 0,2	1,5 ± 0,09
Depression	3,2 ± 0,3	1,8 ± 0,2*
Somatic signs	1,8 ± 0,2	1,4 ± 0,15
Sensory disorders	2,4 ± 0,3	2,1 ± 0,2
Respiratory symptoms	1,9 ± 0,2	1,2 ± 0,2
Gastrointestinal disorders	1,6 ±0,2	1,4 ±0,1
Cardiovascular disorders	0,4 ±0,05	0,2 ±0,01*
Genitourinary disorders	0,6 ± 0,09	0,5 ± 0,1
Vegetative signs	1,4 ± 0,1	1,1 ± 0,2
Behavior during examination	0,6 ± 0,1	0,4 ± 0,1

Note *– significant at $p<0.05$

However, in the main group of people with whom psychogenic training was carried out, i.e. the impact was complex, positive changes in psycho-emotional status were expressed significantly more clearly, as evidenced by the data in (Table 2).

Table 2.

Changes in the psychosomatic state of women main (experimental) group (n=17)

Indicator (points)	Before experiment	After Experiment
Anxious affect	2,1 ± 0,2	0,5 ± 0,04*
Voltages	2,6 ± 0,1	1,1 ± 0,09*
Fears	0,9 ± 0,1	0,2 ± 0,02*
Insomnia	2,3 ± 0,4	0,8 ± 0,07*
Cognitive disorders	1,9 ± 0,2	1,2 ± 0,08*
Depression	3,2 ± 0,3	0,8 ± 0,04*
Somatic signs	1,8 ± 0,2	1,1 ± 0,1*
Sensory disorders	2,4 ± 0,3	1,8 ± 0,15
Respiratory symptoms	1,9 ± 0,2	1,0 ± 0,2*
Gastrointestinal disorders	1,6 ±0,2	1,2 ±0,15*
Cardiovascular disorders	0,4 ±0,05	0,1 ±0,01*
Genitourinary disorders	0,6 ± 0,09	0,4 ± 0,1
Vegetative signs	1,4 ± 0,1	1,0 ± 0,2
Behavior during examination	0,6 ± 0,1	0,3 ± 0,1*

Note *– significant at $p<0.05$

It can be assumed that the complex effect on the body, a properly selected training load, a proper nutrition system, and recovery procedures, can reduce the time interval to reach the goal by several times. And increasing training loads provides results only at the initial stage of the training path, which in the future will certainly lead to physical stagnation and the accumulation of psychological tension. In this case, there are two main cases of manifestation of mental stress:

a) before any important process, for example, training or competitions.

b) during training or during competitions.

In the first case, the help of a professional specialist is acceptable, but in the second, students will have to rely only on their own strength, i.e. control your mental state with the help of self-regulatory training. Psychological preparation of a student for competitions or other specific goals is a comprehensive approach and cannot be considered separately from the process, but it is often considered by specialists as one of the types of preparation. It is assigned a certain role, with its own goals, forms and methods. In fitness, sports psychologists use exactly the

same methods and tools, adapting them to the capabilities of a particular practitioner. They help not only to find weaknesses in the student's condition, but also teach him how to motivate himself, tune himself, and recover psychologically. The complex effect on the body, a properly selected training load, a proper nutrition system, and recovery procedures can significantly reduce the time to achieve your goal. At the same time, mental stress for the body is often a positive factor in its existence. Thus, the presented data indicate the need for an integrated approach in working with women training in fitness clubs. It does not matter in what sport or physical education the training is carried out. This model is suitable everywhere, helping to determine the quality of the training process.

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物理教学中的实验任务
EXPERIMENTAL TASKS IN TEACHING PHYSICS

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Our country needs highly qualified technicians and engineers. The importance of physical education in school is difficult to overestimate. In today's rapidly developing world, the requirements for the level of knowledge and skills of school graduates are constantly growing. Graduates must be prepared for systematic, continuous professional education. School education should be based on knowledge of the basic fundamental scientific achievements in the field of engineering, technology, machinery and equipment, as well as fundamentally new knowledge of a practical applied nature.

Antonina Vasilyevna Usova paid great attention to the formation of experimental skills of students and professional competencies of the teacher in the preparation and implementation of training in techniques and skills for solving experimental problems. The book "Formation of educational skills of students in physics lessons" [1] examines the main stages of the formation of experimental skills and provides methodological recommendations for the entire period of the process of teaching physics at school.

In recent years, the Olympic movement has been growing and developing. Currently, in order to enter top universities in our country, in addition to high Unified State Exam scores, an applicant must show his achievements at Olympiads of various levels. An analysis of the literature showed that there are many methods and manuals for preparing for the Unified State Exam and for the theoretical rounds of the Olympiads. And there are much fewer methods and manuals for preparing for the practical rounds of the Olympiads. During the analysis of infor-

mation sources [2-8], it was found that the main part of the information is archives [2;3] and collections of problems [4-8]. They include a description of the problem conditions, a list of equipment, a brief description of the main stages of solving the problem and evaluation criteria (not everywhere). Familiarization with such a description gives a general idea of the progress of solving the problem, but when trying to reproduce the problem, a person encounters a number of difficulties, namely, there are not enough recommendations for selecting equipment components, and an insufficiently detailed description of the solution. The presence of control data in task descriptions is also very rare; in a number of cases [8] they are present, but there is no comprehensive information about the equipment used and this data has no practical significance. Among the information sources considered, works [9-10] deserve attention; they illustrate the use of techniques and skills for solving experimental problems. In addition, the teacher is faced with the problem of selecting equipment and the need to install installations.

In our opinion, the problem posed can be solved through continuous exchange of experience between physics teachers, attending advanced training courses for teachers in the direction of "Methodology for solving experimental problems in physics" (for example, in Sirius) and the creation of methodological manuals on the selection and practical implementation of experimental problems, where in detail the process of selecting available equipment is described (pencil cases, gum, paper, syringes, etc.), options for solving problems and evaluation criteria are considered.

Criteria for assessing the performance of the experimental task.

Kind of activity	**Maximum score**	**Average score**			**Low score**			**0**
Schematic drawing of the experimental setup	+	+	+	-	-	-	+	-
Formula for calculating the required value	+	-	+	+	-	+	-	-
Correctly recorded direct measurements taking into account specified absolute measurement errors	+	+	+	+	+	+	+ -	-
The resulting correct numerical value of the desired quantity	+	+	-	+	-	-	-	-

These criteria are included in the evaluation of experimental tasks of the main state exam.

A necessary condition for the successful performance of schoolchildren at Olympiads in physics is the development of skills in solving experimental round problems and their consolidation. The methodology for solving the Olympiad problem, as well as various options for using equipment, turn out to be quite non-standard and beyond the scope of a school physics course. There is currently no comprehensive system for preparing schoolchildren to solve experimental prob-

lems. There is practically no methodological literature. Information can only be gleaned from the archives of Olympiad problems. It is not enough to reproduce the problems under consideration by teachers who do not have experience working with tasks in the Olympiad format.

We can conclude that the participation of schoolchildren in experimental rounds of physics Olympiads requires special, targeted training, and this in turn requires special training of the teacher.

The teacher's task in physics lessons is to develop the ability and skills to perform experimental tasks. Since there are no detailed descriptions on the selection of equipment and methods of conducting experiments, you have to rely on information sources, your imagination, experience and interest in the process of selecting tasks and equipment for them.

In April of this year, an experimental Olympiad "Physics Forward!" was held on the basis of the State Autonomous Educational Institution of Tomsk Physics and Mechanics School. The main goals of this Olympiad: 1) To identify talented schoolchildren in the field of solving experimental problems; 2) To train students in solving experimental problems; 3) To provide physics teachers with the opportunity to gain experience in drawing up conditions for experimental problems, in preparing and assembling experimental setups, in formulating evaluation criteria, and in testing solutions.

For this Olympiad, we chose the "Grey Box" problem to determine the stiffness of springs connected in series and parallel [11]. The criteria for choosing such a task were the ability to test knowledge of Hooke's laws, the ability to calculate the stiffness of a system of springs connected in series and parallel, skills in measuring elastic force and processing measurements. When developing the technical part of the training manual, it was taken into account that the set should provide:

- reliable manifestation of physical effects predicted by the theoretical model used to solve the problem;
- obtaining results that correspond to control data;
- reliable reproduction of the results of the task, excluding the possibility of unexpected scatter of results.

One of the important criteria for selecting equipment components was their prevalence and accessibility. We used plastic pencil cases, springs for door closers of varying stiffness, bolts, nuts, metal rings and wire. First, we made a prototype, performed measurements, processed the results, and developed evaluation criteria. Then we made 15 identical sets. After the Olympiad, we began to use these kits in elective classes in preparation for the experimental rounds of the Olympiad. This execution task is very cost effective. However, there are difficulties with assembling equipment sets, namely with assembly technology.

“Mechanical gray box.”

Inside the gray box there is a system of three springs connected to each other (Fig. 1). External to this spring system are hooks 1 and 2, which can move longitudinally. At point A, two springs are attached to the body of the box. Stops B and C limit the possible movements of the hooks. At the initial moment, the springs are slightly stretched, their initial deformations are unknown. Determine the stiffness of each spring at small deformations.

This problem does not require error estimation.

Equipment. Researchable gray box, two dynamometers (measurement limit 5N), clamp, graph paper, tape. Note: due to the high stiffness of the springs and the small measuring range of the dynamometers, use 2 dynamometers in parallel to measure the stretch of the springs. Make sure that hooks 1 and 2 move freely without getting stuck.

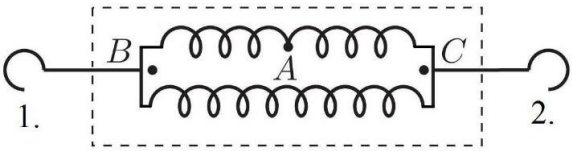

Figure 1. *Diagram of the internal structure of a gray box.*

This was our first experience in the development and technical implementation of an experimental task for the Olympiad. We spent a lot of time and effort on this, but based on the results of the decisions, many participants in the Olympiad coped with this task and received high scores.

Let us give examples of experimental problems at the Olympiad level.

Exercise 1. Determine the amount of heat released when a body slides along an inclined plane without an initial speed.

Equipment: inclined plane, body of known mass, ruler, stopwatch.

Task 2

A wooden cube floats on the surface of the water. To calculate the work A that needs to be done to completely slowly immerse a cube in water? Cube edge length a, wood density $\rho_д$. Density of water $\rho_в$=1g/sm³

Equipment: vessel with water, wooden cube, scales, ruler.

In March 2023, advanced training courses were held at Sirius "Teaching physics in the context of modern pedagogical technologies: an experimental approach," in which I took part. Experienced teachers shared their experience [12] and knowledge, we learned and revealed our creative potential. The final work of our mini-group was the project "A series of problems in which a mathematical pendulum is used as a ruler", within the framework of which we developed a series of several problems related to each other with a common "plot". We compiled an original solution and criteria for assessing this problem

"Perfect Ball"

Late one night, Professor Gluck was going to conduct a series of experiments and prepared for this two nuts and several pieces of multi-colored plasticine. In the process of thinking, without even noticing it, Gluck rolled pieces of plasticine into one ball of stunningly beautiful color and perfectly round shape. However, Professor Gluck discovered with horror that one of the nuts that he needed so much in the future had gone missing somewhere and now on the table there are only a plasticine ball, one nut and some laboratory equipment. He immediately figured out how to check if the nut was inside the plasticine ball. How to do this?

Task: determine whether there is a nut inside the plasticine ball. It is prohibited to deform the ball.

Equipment: Tripod with clutch and foot, thread (about 1 meter), plasticine ball from which a small piece of thread sticks out, stopwatch, electronic scales. The density of plasticine is considered equal to 1.20–0.05 g/cm

"Wrench scales"

After Professor Gluck discovered that there was no nut inside the plasticine ball, he remembered that he had put it in his pocket. Taking a nut out of his pocket, he decided to make sure that it was THE SAME nut, because he remembered the ratio of the masses of the nuts he needed. By this time, the battery of the electronic scales had run out, so Professor Gluck measured the ratio of the masses of the nuts using improvised means. How did he do it?

Task: Select two nuts (one of which is marked) so that their mass ratio is 3.5.

Equipment: a strip with a hole in the middle, a clerical nail (3 pcs.), a thread of about 1 meter, 1 marked nut, 3 unmarked nuts, a stopwatch, scissors.

«Schrödinger's Cat»

During the previous experiment, when the professor was conducting experiments, one of the nuts broke one of the lenses of his glasses. He had spare lenses in the lab so he could replace the broken one. But Professor Gluck's cat named Schrödinger made a mess in the laboratory, and all the lenses were mixed up on the floor. Using the equipment provided, help the professor determine which lens is right for him.

Assignment: find among the proposed lenses one whose optical power is 3 diopters.

Equipment: a thread about 1 m long, a set of lenses, a tripod with a coupling and a foot, a stopwatch, THAT SAME nut, a screen, a light source, a cat pendant with a carved letter "W", an optical bench with a closed scale

Of course, these are only the first steps to solve the problem of the lack of an integral methodological system for teaching solving experimental problems at the Olympiad level. It is necessary to create methodological manuals for the selection of experimental tasks with a detailed description of the criteria for selecting tasks and options for selecting equipment, several options for solving the same problem, and differentiated evaluation criteria. I plan further research in this area of physics teaching methods and writing a thesis on this topic.

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游泳配速策略分析的国际经验
INTERNATIONAL EXPERIENCE IN ANALYZE OF SWIMMING PACING STRATEGY

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抽象的。 游泳配速策略的发展及其在训练过程中的应用并不是一种新的方法论技巧。 但现阶段，随着信息技术的出现，记录游泳的任何参数已经成为可能，任何动态过程都可以转化为数学公式和统计数据。 在竞技活动研究中使用最新的视频记录方法，可以获得提高游泳运动员运动形态的有效工具，并可以确定这项运动的下一个指数级飞跃。

在本文中，我们将分析游泳比赛距离配速策略的国际经验。 我们将参观专门分析游泳竞技活动的科学中心。

关键世界：训练、配速策略、游泳比赛； 游泳中的划频、划长、速度、游泳战术竞赛模型。

Abstract*. The development of swimming pace strategy and its application in the training process is not a new methodological technique. However, at the present stage, with the advent of IT, it has become possible to record any parameters of swimming, and any dynamic process has become possible to translate into mathematical formulas and statistics. The use of the latest video recording methods in the study of competitive activity makes it possible to obtain an effective tool for improving a swimmer's athletic form and can determine the next exponential leap in this sport.*

In this article we will analyze the international experience of working with swimming pacing strategy in competition distances. We will observe scientific centers, which specialize in analyze of competitive activity in swimming.

Keyworlds: *Training, pace strategy, swimming competition; stroke rate, stoke length, velocity in swimming, tactic competition model in swimming.*

Much attention has been paid to the study of the tactic structure of competitive distance in swimming over the last 50 years (*Absalyamov T.M., 2012).* Analyze of swimming distance appeared with the ability to record swimming competitions on video. The first specialists on the analyze of competitive swimming were T.M. Absalyamov, E.V. Lipsky, V.N. Platonov, Palmer G.S., Miller J.A., Willson B.D., Chow J.W.C., Hay J.G., Chengalur S.M., Brown P.L., Chollet D, Sidney M., Foster C., Thompson N.N., Tourney-Chollet C., Arellano R., MacLaren D.P., Coyle E.F. All these authors worked on this issue in the 1980s and 1990s.

Analysis of a swimming competition distance shows us the ability of swimmer to distribute his efforts over the distance with the most affective result in competitions. By analyzing the distance parameters a specialist can see individual efforts of swimming distance in the tactical, technical and functional parameters of training. D. Salo and S. Riewold (2007) suggest swimmers pay more attention to the dynamics of their performance. "When comparing yourself with leaders in swimming, remember that each swimmer is unique in his own way and no two athletes will swim exactly the same" (*Salo D., 2007*).

You can analyze a swimming distance in two ways: during the competition and in training course. During competitions, we get the whole picture with all factors which affect the swimmer, including psychological ones, at the same time during training we can get a more detailed analysis, focusing on the functional aspects of the athlete, his tactical and technical parameters (*Tor E., 2014*).

The first method for analyzing competitive velocity is builds on studying the final competition protocols. There are several specialists, who make their analyze according the final competitive protocols: Craig A.B. (1985), Robertson E. (2013), Lipinska P. (2009), Rybin R.E. (2017), Pilipko O.A. (2012). This method of competitive analyze also productive, although it does not provide a detailed picture of the competitive distance (*Craig A. B., 1985, Robertson E., 2013, Lipinska P., 2009, Rybin R.E., 2017, Pilipko O.A., 2012*).

To study international experience in swimming pace strategy, we search for scientific publication, we used the platforms eLibrary.Ru, PubMed and Scholar. A total of 90 scientific articles were processed, as well as 2 monographs on this topic. We use chronological period of scientific research in the range 1965 – 2022 years. The number of publications by year is presented in Figure 2.

It should be noted that over the past 10 years, interest in the analyzing of pace strategy in swimming has increased. So in the period 1980 – 1989 years it was 4 publications, in 1990 – 1999 years their number reached, it was over 12, in 2000 – 2009 years the number of publications increased to 23, and in the last 12 years 52 publications have been appeared.

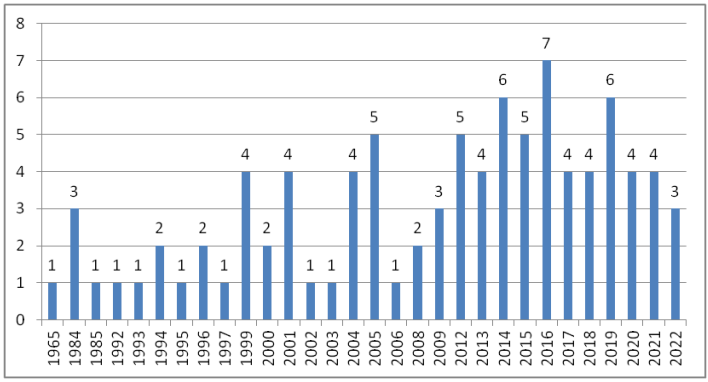

Figure 2. *Publications on pace strategy in swimming by year of publication*

Another trend that can be noted is the increase of publications before or after the Olympic Games. This happened after the games in 1984, 2000, 2004, 2012, 2016, which indicates a great interest in a pace strategy strongest swimmers around the world.

The geography of these publications is significant. More than 100 specialists from 65 institutions in 22 countries studied the pace strategy in swimming at different times.

The leaders by the largest number of publications are: Australia, Russia, Spain, Great Britain, Ukraine and France.

The largest number of institutions is represented by countries: Australia, Great Britain, Spain, USA, France and Portugal. The largest number of specialists on this topic works in countries: Russia, Australia, Spain, France, USA and Great Britain.

The leading positions among scientific centers for analyzing of swimming pace are occupied by universities from Australia, Russia, Great Britain, Spain, France, Portugal, Chile, Poland, and South Africa. The number of works they published is 86% of the total number of publications we reviewed. These centers employ 43% of all specialists involved in the analysis pace structure. It should also be noted that countries with deep scientific traditions in the study of sports have high results in competitions.

Table 1

Rating of universities engaged in studying the analysis swimming pace

Universities	Publications	Researchers	Coefficient
Siberian State University of Physical Culture and Sports (Russia)	9	9	18

Technical University of Madrid (Spain)	8	5	13
New South Wales Institute of Sport (Australia)	8	1	9
University of Rouen (France)	4	3	7
University of Granada (Spain)	4	2	6

In this article we try to give an overview of the main directions of scientific research in these universities on the topic of pacing strategy in swimming.

Siberian State University of Physical Culture and Sports (Russia).

A large number of works are devoted to the analysis of competitions based on the results of the final competition protocols. A team of authors R.E. Rybin and G.D. Babushkin (2017) introduced into scientific circulation the concept – "time corridors" between the first and second parts of distance, which help to form tactical model of swimming distance (*Rybin R.E., 2017*).

E.S. Zhukova (2021) and V.E. Novoselov (2022) specialize in the tactical training of age group swimmers. The choice of the age group of 12-14 years is not typical for pace analyze (*Novoselov V.E., 2022; Zhukova E.S., 2021*). The authors propose several strategy models for practicing pacing skills in middle and long distances (400, 800, 1500 m), in particular: *total strategy*, *positive at the beginning with acceleration at the end of the distance* and *acceleration at the beginning with a transition of velocity in the middle and at the end of the distance*. Unfortunately, such a model does not answer the question of what resources should be used to maintain or increase distance velocity. The article discusses changes in velocity, without reference to stroke length and stroke rate of the distance, although these parameters of pace strategy. Zhukova E.S. (2021) proposed a set of technical exercises to improve tactical training, based on video analysis of the 2016 Olympic Games (*Zhukova E.S., 2021*).

In general, the university has several teams that analyze pace in swimming and they works independently to each other. The research topics are extensive: from analyzing the final protocols and creating a competitive distance model, to creating a universal model that can correct pace strategy of swimmers based on a video of distance.

Technical University of Madrid (Spain)

In Spain, after the World Swimming Championships in 2013 (Barcelona), appeared scientific team of specialists in swimming pace and tactic (*Viega S., 2014; Viega S., 2013; Perez – Tejero J., 2017*). They are represented the Technical University of Madrid (Spain), together with the University of Chile (*Viega S., 2014*). This grope of specialists use one of the most automatically system of pace analyze in a world.

S. Viega and et al. (2016) propose concept of two types of video recording. They called the first method "fixed", the second "individual". With the fixed method, several cameras are positioned and transmit information about the average velocity of the swimmer at pre-marked sections of the distance. The second is an "individual", in which there are no fixed marks for passing the turn, and the end of the turning segment is considered to be an individual point at which the athlete's head breaks the surface of the water. It has been shown that applying calibration using the 2D Direct Linear Transformation algorithm (2D – DLT©) provides the reconstruction of 2D coordinate data (*Viega S., 2016*). Such a biomechanical reconstruction of a swimmer's movements can be carried out in the Kinovea© program (Free Software Foundation, Inc., USA). The second method is a little more accurate because it gives us more information regarding the swimmer's kinematics. The authors suggest that coaches pay attention to how athletes pass turning sections, as this helps improve their performance without unnecessary physical effort.

The joint work of specialists from two scientific centers has established themselves as pioneers in the field of individual video analysis method. The system they proposed for analyzing the pace strategy of swimmers has a sufficient level of autonomy, which affects the velocity of data processing and its quantity.

New South Wales Institute of Sport (Australia)

One of the most published authors on the topic of pace analyze in swimming is K.G. Thompson, represent this institute. Kevin Thompson has published a monograph devoted to a review of modern techniques for working with the pace of swimmers at a competitive distance (*Thompson K.G., 2015*). K. Thompson et al. (2000) believe that in modern swimming little attention is paid to kinematic components in training. In particular, little attention is paid to practicing the start, turn and finish segments, while at the same time, these components make up 40% of the entire distance (*Thompson K. G., 2000*).

In his monograph K.G. Thompson gives his own vision of pace in swimming (*Thompson K.G., 2015*). Pace, according to Thompson, is the distribution of energy during a swimming distance. The purpose of pacing is to achieve the desired result without fatigue interfering with the training task or the athlete's health. With the correct calculation of the pace, the athlete distributes the efforts that should be enough to finish. In this sense, the concept of "pace" includes not only the velocity of the athlete's movement, but also his produced power output. Thus, the stroke length and the stroke rate all together indicate the possibility of distributing the athlete's power over a distance and, in fact, is a competitive pace.

K.G. Thompson (2004) suggests paying special attention to tactical training of the swimming pace. This is relevant in many cyclic sports, especially swimming, given the resistive properties of water and the low mechanical efficiency of the

swimming action. He also notes that for short and medium distances, in practicing pace are necessary to work on maintaining speed, and when practicing long distances, it is worth focusing on evenly swimming the distance with a jerk at the end. To improve the training effect, the authors suggest practicing tactical skills in the form of working on pace systematically, since only this method of training can have a positive competitive result (*McGobbon K.E., 2018; Pyne D.B., 2004; Thompson K.G., 2004*).

Thus, K. Thompson and his colleagues defined the concept of tactic model of swimming distance as a competitive pace, when working on which a swimmer increases his technical level, and therefore his velocity level due to the economy of swimming.

University of Rouen (France)

A team of specialists from the University of Rouen has been conducting research on the swimming pace for thirty years. The team of authors is headed by Professor Didier Chollet , the working group includes specialists S. Hugi, L. Seifert , C. Tourney-Chollet and others (1996, 1997, 2002, 2016). The team specializes in the kinetic aspects of swimmers technique. Since 1996, they have been conducting video analysis of international and national championships in swimming (*Chollet D., 1997*).

To process video recordings of competitions, D. Chollet et al. use the following components: velocity (V), stroke length (SL), and stroke rate (SR) (*Chollet D., 1997; Tourney-Chollet C., 2002*). These components of swimming pace have become generally accepted in foreign scientific literature. Experts from the University of Rouen in 1996 concluded that there is a relationship between speed, stroke length and stroke rate, and this relationship does not differ by gender. This means that it is possible to determine general patterns in competitive activity. Accordingly, it is relevant to develop tactical layouts that help a swimmer cover a competitive distance with energy savings. Specialists from Rouen University suggest collecting results from leading swimmers in different competition to build a statistic model of swimming competition distance. D. Chollet (1997) believes that many sports teams resort to compiling tables of velocity, stroke rate and stroke length. The purpose of this work is to compile the parameters by which the athlete and coach should navigate the competitive and training process. (*Chollet D., 1996; Chollet D., 1997*).

Professional swimmers use tactical strategy in which the longer stroke and less stroke rate gives better results (*Chollet D., 1996*).

To confirm D. Chollet's hypothesis, it is necessary to study inter-cycle variability, since this parameter indicates the level of performance and motor skills of the swimmer.

University of Grenada (Spain)

This team of specialists from Spain and Portugal is represented by several scientific centers: Navarre People's University (Spain), Bayera Interior University (Portugal), Polytechnic University of Bragança (Portugal). These universities jointly carry out statistical analysis of major international competitions and work closely with the European Aquatics (LEN), in particular, at the end of the competition they receive all video recordings of the races. In addition, they specialize in kinetic analysis of starts and turns (*Morais J.E., 2019; Morales Ortiz E., 2019; Arellano R., 1994; Saavedra J.M., 2012*).

The results of the competitive activity of swimmers were translated by components: velocity, stroke length, stroke rates. The authors introduced the "stroke index", which is the product of velocity, stroke length, and stroke rates (*Morais J.E., 2019*). This index allows you to determine the value of stroke length in swimming velocity. The team of R. Arellano (1994), analyzing swimming competitions since the 1992 Olympic Games in Barcelona, used the stroke index in combination with anthropometric data of participating swimmers in the 50, 100, 200 m freestyle. In addition, the authors expanded the components of the competitive distance for the convenience of analyzing the starting and turning segments: stroke length (SL), stroke rate (SR), distance time (ST), time before turn (TI), time after turn (TO), finish time (FT), and start time (ST) (*Arellano R., 1994*).

J.M. Saavedra (2012) with colleagues in 2012, having processed a large array of distances – 821 men's and 822 women's swimming participants, collecting all international starts over 11 years (2000 – 2011) (Olympic Games, World and European Championships, Pan-Pacific Games, US and Australian national championships) have paid attention to the pacing strategy of the 200m and 400m medley athletes. The authors highlight some specific tactic strategizes and their principles in gender, strokes and the length of distance. (*Saavedra J.M., 2012*).

Conclusion

Thus, a review of the work of scientific schools involved in the tactical training of athletes in swimming showed a significant difference in approaches. First, we can note a little attention to the influence of the functional and technical components to the distance analyze. Without understanding the reasons for the athlete's tactical choice of a pace strategic model at each part of distance we can't build training process correct. A coach mast consider not only functional ability of swimmer, but an idea how to built pacing strategy model of a swimming distance. The second case is an attempt to predict a competition result using coefficients based on the study of the pace structure of swimming distance and the morpho-functional characteristics of the swimmer. In our opinion, the main purpose of training is to create individual architecture of swimming distance, which consists of views about energetic system of swimmer and his pace strategy model. This system involves training a swimmer with pacing strategy skills.

We believe that when predicting a competition results, it is necessary to consider each part of the distance according to the individual characteristics of the athlete, take into account changes in velocity in every distance part, taking into account of stroke rate and stroke length, and pay attention to the distribution of energy in all its sections. Thus, there is a practical need to create a methodology for collecting and analyzing the pace strategy of swimming with the transfer of analysis results into the training process.

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英语和吉尔吉斯语名词数类的特殊性

THE PECULIARITIES OF THE NUMBER CATEGORY OF NOUNS IN ENGLISH AND KYRGYZ LANGUAGES

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抽象的。 该作品重点介绍了英语和吉尔吉斯语中名词的数量类别。 数的范畴问题在当今非常重要。 英语和吉尔吉斯语有不同的语法、句法和语音表达形式。 因此，本研究致力于英语和吉尔吉斯语名词数研究的比较分析问题。 研究的主要目的是比较和比较两种语言材料中数范畴的共同系统及其异同。

Abstract. *The work highlights the category of number of the noun in the English and Kyrgyz languages. The problem of category of number is very essential nowadays. The English and Kyrgyz languages have different grammatical, syntactical and phonetic forms of expression. So, this research is devoted to the problems of comparative analysis of the study of the number of the noun in the English and Kyrgyz languages. The main aim of the research is to compare and investigate comparatively the common systems of the number category in the materials of these two languages, their similarities and differences.*

Introduction

The paper is based on various English and Kyrgyz grammar books, written by prominent authors, which provide an abundance of data examined through the contrastive method. The results indicate that nouns in these two languages show differences which concern several aspects of the grammatical category of number. Some of these differences concern the way these two languages treat nouns in the singular and plural number, the ways of forming the plural number, and their usage with articles and numerals.

One essential difference, however, concerns the collective and compound nouns which show an almost complete discrepancy in these two languages due to the ways they write these nouns, and the ways these nouns function in these languages. Nevertheless, in spite of the differences, there are also some similarities

that concern mainly the ways of forming the plural number, but also the group of nouns used only in the singular called “singularia tantum”, and those used only in the plural “pluralia tantum”.

The category of number is expressed by the opposition of the plural form of the noun to its singular form. The semantic difference of the oppositional members of the category of number in many linguistic works is treated traditionally: the meaning of the singular is interpretation as «one» and the meaning of the plural as «many» (more than one).

The Category of Number in English and Kyrgyz Nominal System

The grammatical category of number is one of the categories that English and Kyrgyz have in common but being structurally different, show many differences and also similarities in the way they treat nouns in the singular, and the way they form the plural. In English, nouns in the singular number are always used either with the numeral one or with an article, the indefinite article a/an which is semantically equal to the numeral one, and the definite article the: *one/a student or one/an apple; the student or the apple*

In English, nouns in the singular number may not be used without an article or without the numeral one. Forms such as student or apple, used without the above mentioned functional words, are grammatically unacceptable. Proper nouns and uncountable nouns, such as Tom, William, Jane, James, London, Washington, love, courage, peace, water, bread, sugar, milk, furniture, etc., are, of course, an exception to the rule. Proper nouns do not take the numeral one nor the indefinite article a/an, but they can be used with the definite article the. From this group, we can distinguish personal names which make use of the stressed definite article the /ði:/ which, according to Huddleston & Pullum (2002), is highly unusual. In this form, the definite article the [ði:] has three functions:

1. to verify the identity of the person we are addressing to - Are you the Mrs. Carlyle? (we recognize the person, but we are not quite sure of his/her identity, and expect a confirmation)

2. to distinguish two people with the same name from one another - I need to see the Mrs. Harrison who has organized this event.

3. to express surprise at someone’s behaviour - You are not the Rebecca I know! (I know who you are, but you are not acting accordingly) In this last function the [ði:] is especially used in American English. [1, 17]

Uncountable nouns are not used with the numeral one, nor with the indefinite article a/an, but they use the unstressed definite article the:

There is no time for regret. (an uncountable noun used without the numeral one or articles)

This is the time to act and end the misery. (an uncountable noun used with the article the). [1, 18]

Unlike English, in Kyrgyz, nouns do not take articles. Singular nouns can be used with or without the numeral one, but when used with the numeral, they emphasize the number of animates, things, concepts designated by those nouns, and not solely the fact that they are singular nouns, that is, the category of number. E.g.: кой, бала, китеп, он кой, эки бала, беш китеп. As seen in these examples, unlike English, the defineteness and the indefiniteness of singular nouns in Kyrgyz is expressed not by articles.

The categorical opposition of number is subjected to the process of oppositional reduction. Neutralization takes place when countable nouns begin to function as Singularia Tantum nouns, denoting in such cases either abstract ideas or some mass material, e.g. on my birthday we always have *goose;* or when countable nouns are used in the function of the Absolute Plural: the *board* are not unanimous on the question. A stylistically marked transposition is achieved by the use of the descriptive uncountable plural (*the fruits* of the toil are not always visible) and the «repetition plural» (*car* after *car* rushed past me). In Modern English the form of the singular of nouns is a bare stem without any flexion or with zero inflexion, as in Kyrgyz. E.g.: pen-ручка, book-китеп, pillow-жаздык, etc.

Formation of the plural number with inflectional suffixes

According to M. I. Rasulova category of plurality can be expressed in Modern English [5, 82] by following ways: • morphological; • phono-morphological; • syntactic.

As specified by Murphy's reference book. [4, 156], English plurality of nouns is usually expressed with inflexion – s(es): *desk – desks; lady – ladies*. At the same time a lot of English nouns' plural form is given with zero inflexion (*deer, sheep*) or changing the morphemes (*foot - feet; man - men*), or with the adding suffixes (*child-children*). The grammarians as Murphy, Maclin also single out the following type of plural form in irregular nouns: *loaf-loaves; shelf – shelves*.

In Kyrgyz language plural is formed by adding to the stem the suffix *–лар*. It is the *morphological way* of forming plural. This suffix is changed according to vowels and consonants of the root word and has twelve variants:

-лар, -лер, -лор, -лөр;-дар, -дер, -дор, -дөр; -тар, -тер, -тор, төр.

The first group of suffixes is used for stems ending in a vowel or in the consonant *й*: E.g.: окуучу - окуучулар, үй - үйлөр, student - students, house -houses, д←р is used for stems that end in voiced consonant: E.g.: көз ----- көздөр, eye ----- eyes. The suffix т←р is used for noun stems that end in voiceless consonants. E.g.: таш - таштар, stone - stones . [10, 19]

Thus, the English and Kyrgyz languages have variety forms of plurality, but there are specific morphological and semantic features which can be found out through comparison and contrast.

The comparative-contrastive analysis shows that in both languages (English vs. Kyrgyz) plural forms of the nouns are expressed by morphological ways. In

English the most productive way is adding the morpheme -s, but in the Kyrgyz language are suffixes.

Pluralia Tantum and Singularia Tantum

Though there are many differences in the number of noun in Kyrgyz and English languages, there are also similarities, such as, there are nouns that are used either only in singular form or in plural form in both languages.

Nouns Used Only in the Singular or Singularia Tantum

Nouns denoting things which have neither shape nor precise limits cannot be counted and therefore have no distinction between singular and plural; they are used only in the singular. Such nouns may be called uncountable or mass-nouns in English. To the group of nouns used only in the singular belong:

a) Concrete nouns:

1. Names of materials: *water, milk, wine, snow, bread, air.*

- *On* my breakfast table there is a pot of *honey.*
- We didn't take *beer* or *wine.*
- Seizing *ink* and *writing-paper,* she began to write…

2. Some collective nouns: *foliage, leafage, shrubbery, brushwood, linen*, *machinery, furniture:*

- Birds fluttered softly in the wet *shrubbery…*
- He had chosen *the furniture* himself.

b) Abstract nouns: *friendship, joy patriotism, love, kindness, weather, courage, information, progress,* etc.:

- There was *a* great deal of *confusion* and *laughter* and *noise.*
- It was beautiful *weather***.**

Nouns used only in the singular (uncountable) have no article where a noun which expresses both numbers (countable) would be associated with the indefinite article; they may be used with the pronouns *what, some, much* or *little:*

Some collective nouns used only in the plural also belong to the group of uncountable such as: *goods, sweepings, tidings,* etc.[2, 37]

There are nouns that are always plural in English:

Jeans, knickers, pants, pajamas, shorts, tights, trousers, stockings and underpants, pincers, pliers, scissors, shears, tongs, clogs, sandals, slippers, shoes, and sneakers, glasses (spectacles), binoculars, goggles, arms, belongings, chopsticks, clothes, congratulations, contents, customs, earnings, goods, outskirts, remains, steps, surroundings, thanks, troops, tropics, wages, wits.

A pair of can be used with the above plural nouns to make them singular and take a singular verb.

- This pair of purple *trousers does* not match your yellow jacket..
- This set of *kitchen knives belongs* to me.
- A new pair of stainless steel *scissors is* what I need

Other nouns that are always plural in English. Clothes: My *clothes* need to be washed. Earnings: *Earnings* in the agricultural sector *have* increased by 5% in the fourth quarter. Cattle: *Cattle are grazing* all over the field. Police: *Police are charging* him with the murder of the princess. People: *People* in general *are not very approachable.* (Peoples when used in the plural (i.e. with '–s') refers to peoples from more than one race or nation, e.g. the peoples of Asia). Football team: *Liverpool are* a very successful football team. (But Liverpool is a great city.) Nouns which are plural in form but take a singular verb. The following plural nouns are used with a singular verb as they are treated as singular: *Acoustics, athletics, economics, gymnastics, linguistics, mathematics, mechanics, news, numismatics, measles, mumps, physics, politics, pyrotechnics and statistics.*

Examples: Economics: *Economics was* my favourite subject at school. *Gymnastics* in her college *involves* exercises on bars, beam, floor, and vaulting horse. News – The good *news is* that we have all been invited. Diseases such as mumps, measles, etc: An infectious illness, *mumps was* common among children. Measurements and amounts that are considered as a single unit: Examples: One hundred years *is a century. Ten kilometers long. Twenty dollars* is not enough to buy a good shirt. *Seven days* in prison is all he got for shoplifting.

A list of Kyrgyz language nouns which are used only in singular form. They are:

1. *Natural phenomenon:* Жаан-rain, чагылган-thunder, жарык-light(daytime), караңгы-dark (night), асман-sky, Ай-Moon, Күн-Sun, суук-cold, etc.
2. *Seasons, names of the months and weekdays:* Жаз-spring, жай-summer, күз-autumn, кыш-winter, January, …, December, дүйшөмбү-Monday, etc.
3. *Abstract notions:* Чыгармачылык-art, балалык-childhood, атак-famousness, акыл-cleverness, айып-guilt, etc.
4. *Proper nouns:* Ош-Osh, Бээжин-Beijing, Кара деңиз-The Black Sea, etc.
5. *The names of metals, chemical substances, foods, etc:* Алтын-gold, жез-copper, сүт-milk, etc.
6. *The body organs that are only one in the body:* Төш-breast, ооз-mouth, мурун-nose, жүрөк-heart, etc.[10, 39]

In this way two languages have similarities even if they belong to different language families. The one thing to be underlined is, that the Kyrgyz language plurality suffix *–лар* can be added to the singular, proper nouns, by not giving the meaning of plurality.[9, 53] E.g.: Биз *дүйшөмбүлөргө* келип калабыз-We will probably come by Monday.

Nouns Used Only in the Plural

A number of nouns are used only in the form of the plural. With these nouns the plural does not indicate several objects but denotes a composite whole.

1. To the group of nouns which are used only in the plural form belong:

a) The names of things which consist of two similar halves such as *scissors, trousers, spectacles, scales* (весы), *eye-glasses, tongs* (щипцы): These *scissors* are sharp. Your *spectacles* are on the table. Your *opera-glasses* are very good.

b) Nouns which have collective meaning (concrete or abstract):

1. Concrete: *stairs, goods, eaves, slums, outskirts, tropics, memoirs, supplies, clothes, sweepings, slops*, *preserves*, *parings* (кожура), *sweets, lodgings,* etc.:

2. Abstract: *holidays, tidings, goings-on* (поступки), *beginnings* (also *beginning), earnings, wages* (often in the singular, especially in the following combinations: *a living wage, a fixed wage, a minimum wage), contents,* etc.

3. In some nouns the final – s loses the meaning of the plural inflexion and the noun is treated as a singular. This is the case with the names of sciences and occupations in – *ics: mathematics, phonetics, optics,* which are usually considered as singular: These nouns are treated as plurals when practical application is meant: E.g.: His *phonetics are* excellent. *The acoustics* of this hall *are* good. [7, 38]

In the Kyrgyz language plural nouns have the same group of words. But in Kyrgyz they are made without plurality suffix *–лар*, while in English they are made with the help of the suffix *-s*: E.g.: Качкын аба бармактайынан *мал* менен өскөн адам эле. Mr. Kachkyn had been looking after the *animals* from his childhood. Here we see the differences between the number of nouns and how they are used in the translation from one language into the other:

кайчы-scissors	эки кайчы-two pairs of scissors
көз айнек-eye glasses	беш көз айнек-five pairs of eye-glasses

E.g.: I have two *hands*. – Менин *эки колум* бар. not: Менин эки колдорум бар. Because the word “two” is already shows that the noun is in plural. Here in Kyrgyz used only lexical element.

A small number of nouns have *irregular plurals in English*. They are: *Man-men, woman-women,goose-geese, foot-feet, tooth-teeth, mouse-mice, louse-lice, child-children, ox-oxen.*[8, 43]

As for Kyrgyz there is no such structure. The vowels are changed in these nouns to become plural. Just for the example, if we change vowels of noun in Kyrgyz language, we will get absolutely another word: E.g.: *киши- каша, каш-куш-кыш, чычкан-чачкан, баш-быш, etc.*

Nouns Used in the Plural in a Special Sense

In some cases the plural form of the noun does not express were pluralities (as in *tables = table + table…)* but acquires a special meaning. Very often the plural form, besides this specific meaning, may also retain the exact meaning of the sin-

gular thus resulting in two homonymous words: *colour* - *tint, colours* - 1) plural of tint, 2) flag: E.g.: «I do not mean regimental *colours,* but the *watercolours.» custom* - *habit, customs* -1) plural of habit, 2) duties:

E.g.: Many old *customs* are dying out. *Customs* (пошлины) are duties imposed by law on goods imported and exported. *pain = suffering, pains = I)* plural of suffering, 2) effort: E.g.: She enlivened our journey by describing to us… the various *pains* she had in her back.

quarter = fourth part, *quarters* = 1) plural of fourth part, 2) lodgings:

E.g.: I have read three *quarters* of the book. We found him ire his old *quarters. work* = toil, labour; *works* in various senses: the works of a watch (механизм часов), works of art, etc.

Conclusion

This paper has elaborated the key concepts in regard to the grammatical category of number in English and Kyrgyz, placing emphasis on the differences and similarities between these two languages, and providing examples that constitute sufficient evidence that these languages, in spite of their different structural complexity, share several characteristics, namely, both languages have nouns that have the same stem in the singular and plural number, nouns that form the plural by suffixes and both languages have nouns that are used only in the singular or only in the plural number. These simililarities, however, come hand in hand with a range of differences such as the ways English and Kyrgyz treat their nouns in the singular and plural number, their use of articles which is exclusively a feature of English, certain plural forms, their almost complete discrepancy in regard to the group of collective nouns that have almost nothing in common in these languages, except the definition, and their compound nouns that are quite confusing, particularly in Kyrgyz which imposes the rule of writing compound nouns as one word, with few exceptions, therefore, compound nouns written as two words in English are not considered compound nouns in Kyrgyz.

The similarities are: Nouns of English and Kyrgyz have two numbers: *singular and plural,* Both languages have *Pluralia Tantum* and *Singularia Tantum,* Singularia Tantum: both of languages have the same group of words that can be used only in singular,The singular form of the nouns is a bare stem with a zero-inflexion in both languages, Formation: English- with the help of suffix *–s,* Kyrgyz- with the help of suffix *–лар. The differences are:* In English exist number of nouns that have *irregular plurals*; as for Kyrgyz there is no such structure,Kyrgyz language plurality suffix –лар can be added to the singular, proper nouns, by not giving the meaning of plurality, Pluralia Tantum in English forms with the help of plurality suffix, in Kyrgyz without.

Results of investigation show that morphological, lexical and syntactic properties of nouns' plurality in each language have its own peculiarities from position

of functions carrying out. So, the comparative-contrastive studies are conducted for lingua-didactic aims.

To conclude, the material will be useful for realizing the differences and similarities between two different languages in the aspect of expressing plurality and will be taken into consideration in ELT for Kyrgyz students.

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俄罗斯次标准的形态特征
MORPHOLOGICAL FEATURES OF THE RUSSIAN SUBSTANDARD

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抽象的。 文章致力于与文学语言的形态特征相比较，对俄语不合格的形态特征进行识别和描述。 本研究的对象是艺术作品中人物的言语（L.S. Petrushevskaya 的童话故事）。 作为研究对象，在艺术作品的人物言语中发现了一些不合格的语法特征。 在不合格的语言中，有与文学语言相同的形态指标，但它们的使用方式不同。 类比教育是不合标准的教育所特有的。 例如，它们可以在名词和代词的诱导、动词形式的使用中找到。 在揭示了一些不合格的形态线之后，可以得出这样的结论：俄罗斯不合格在形态领域具有特殊性。 不合格的作品违背了文学规范。

关键词：不合格、规范、违反规范、形态选择、类比对齐。

Abstract. *Article is devoted to identification and the description of the morphological features of Russian substandard in comparison with morphological features of literary language. Object of this research is speech of characters of works of art (the fairy tale of L.S. Petrushevskaya). As an object of research some grammatical features of substandard found in speech of characters of works of art served. In substandard there are same morphological indicators, as in the literary language, they however are used differently. Educations by analogy are peculiar to substandard. They can be found, for example, in inducement of nouns and pronouns, in the use of forms of a verb. Having revealed some morphological lines of substandard, it is possible to come to a conclusion that Russian substandard has the specifics in the field of morphology. Substandard resists to literary norm.*

Keywords: *substandard, norm, norm violation, morphological options, analogical alignment.*

The morphological structure of the Russian language is more stable than the lexical composition and less susceptible to the influence of social factors.

Morphological norms are characterized by relative stability, a reduction in the number of varying forms. This applies to generic doublets (*метод - метод*), and

to variants of case forms (*-а/-у*), and to some verbal formations. The actions of the internal law of analogy (as well as normalizing practice) led to the unification of individual morphological variants (the preserved variants were separated stylistically or otherwise) [2, p.153].

Colloquial morphological variants are beyond the literary norm, despite the fact that they are understandable and quite common, especially in oral varieties of speech, have a pronounced stylistic coloring (for example: *у ней*; я к тебе *подъеду*).

Violations of the norms of grammatical design of a word in the vernacular are numerous and diverse. Let's take a closer look at some morphological features.

1. The use of noun forms.

- Masculine nouns in the prepositional singular in the literary language tend to reduce the number of words with the ending *–у (-ю)*. Such variants are presented mainly in colloquial speech and have a colloquial connotation. For example, the form *в дому* is colloquial:

Но, с другой стороны, и так <u>в дому</u> бедлам, а тут карликовые муравьи блеют…

In accordance with the norms of the literary language, in this sentence it would be necessary to use the noun *дом* in the prepositional case with the inflection -е (*в доме*), or the adverb of place (*дома*).

- In the vernacular, there is often a mixture of types of declensions of nouns in the forms of individual cases, for example, an analogical alignment of the bases with respect to the bases with the so-called build-up. This concerns the declension of words like *время, имя*, which in the vernacular usually have word forms without extension *-ен-* [4, p.76]:

… мимоходий карп дядя Сережа, который приплыл стилем «фрихасбэнд» и спросил у комара Томки, <u>сколько время</u>: просто так.

- Some nouns in the vernacular have non-normative variants of case forms (for example, the use of the genitive case instead of the dative, and vice versa):

- *<u>От своей сестре не уйдешь, к сестры</u> же и возвращаешься, <u>к Лиды</u>: родня.*

- Words that have the singular form, but are mainly used in the plural, are characterized by fluctuations in the grammatical gender [5, p.104]. Masculine nouns with an accent on the base are used as feminine nouns:

Тут комар Томка еще раз сплюнула и растерла меховой <u>тапкой.</u>

In this sentence, the noun *тапок* has a feminine form and in the creative case receives the inflection *-ой*, instead of *-ом*, which contradicts the norm.

- Universalization of frequently used phrases that carry a single nominative function, acting in the vernacular as a single jointly declinable complex:

- Я имею в виду, <u>ваше ФИО</u>?

Она говорит:

- *Нет, не моё*.

In the literary language, the abbreviation of the full name has the plural form: *ваши ФИО*.

- Colloquial variants of the number of nouns:

- erroneous use of plural forms:

Не говоря уже о газетах и интернетах!

А я ничего не ждала, никаких прибылей…

In the above proposals, the following forms should be used: *интернете, прибыли*.

- The use of the "singular generalizing type" [2, p.75], i.e. the use of the nominative singular noun form in speech as a generic concept:

Еж Гарри сел к столу, игла дыбом.

The examples above show the singular forms of nouns in the plural sense.

- Morphological variants of nouns often arise during the grammatical development of a borrowed word, such words in the vernacular may change:

…По́льта поротые без воротника, бушлаты задубелые. In the literary language, changing the cases of non-declinable nouns is unacceptable [1, p.103].

Declension of non-declinable proper names:

Но надо приходить с Барбями. Без Барбей не пускают. Там в газете о Барбях сказано…

2. The use of pronouns.

The morphology of pronouns in the vernacular, as well as the morphology of nouns, is characterized by the phenomena of analogical alignment. The following changes are noted in the declension of pronouns:

- The pronoun of the 3rd person of the feminine gender has the form of the genitive or accusative case (*ей* or *ней*):

… Муж у ей помирает...

… У ней сумку прохожий отобрал…

In accordance with literary norms, the form *неё* of the pronoun *она* should be used in the above sentences.

- The phenomena of analogical alignment (in the vernacular, the declensible forms of possessive pronouns function - *ейный, ихний*, in the literary language, the forms of *её, их* are used):

Но помчаться не получилось, на пятой поперечной ихнего шоссе муравей деда Миша потерял управление и выехал на встречную полосу, где следовал жук-солдат Андреич в сцеплении с женой Веркой за бампер.

3. The use of verb forms.

In the field of verbal morphology, the vernacular has many differences from the literary language, concerning both the formation of individual word forms and the functioning of certain members of the verb paradigm [4, p.82].

- Variants that go beyond the literary norm, as neutral stylistic units, are unacceptable neither in written nor in oral styles of literary speech:

Жвала выросли у них, как пассатижи, если кусок взят, не отымешь: буквально новая порода мурбультерьеры!

In the above sentence, the colloquial form of the verb *отнимешь* is used, you will take away, corresponding to the form you will take away.

- *Посуду не выкидают, посуду сдают!*

In this example, an imperfect form is used with the suffix *-а: не выкидают*, in accordance with literary forms with the suffix *-ыва* (*не выкидывают*).

In accordance with the literary suppletive forms of the form *положить - класть*, the verb *ложить* is widely used in the vernacular (as a pair to *положить*), for example:

Ложьте Барбей взад!

In addition to the colloquial verb form, *ложьте* instead of *кладите* in this sentence, the non-declinable proper name *Барби* is also used in the form of the genitive plural and the colloquial form of the adverb *назад - взад*.

- Potential variants allowed by the system, but not accepted by the norm, for example, the forms of the first person of the future tense from the verbs *победить, убедить, угораздить, ерундить, чудить, умилосердить, шкодить* [3, p. 78]:

Я скоро до вас доберуся! Я вас победю!

- Using the infinitive *звать* instead of the present tense form *позвать* in the question:

- *Не знаю, как тебя звать, но это неважно, - сказал волшебник.*

- Colloquially, the use of passive voice participle forms *-тый* is typical:

Еще вчера одну женщину положили, тоже по голове стукнутая, у ней сумку прохожий отобрал…

- The functioning of adverbs with suffixes in the vernacular *-вши*:

Паук Афанасий до слез дошел, так хохотал, но беззвучно, корчился, отворачивался, ногами сучил, губы плотно сжавши, чтобы не обидеть товарища.

Adverbs with the suffix *-вши* “are cumbersome, discordant, and the suffix is known to cause parasitic associations” [2, p. 88]. The use of the suffix *-в: сжав* is normative.

In this article, a description of some morphological features of the vernacular that distinguish it from the literary language has been proposed. In the vernacular, there are the same morphological indicators as in the literary language, but they are used differently. For example, inflection –е in the genitive singular (*у сестре*)) and inflection –s in the dative singular (*к сестры, к Лиды*) colloquially correspond to inflections: –е in the dative singular (*к сестре*) and –ы in the genitive singular (*у сестры, у Лиды*).

The vernacular is characterized by education by analogy. They can be found, for example, in the declension of nouns and pronouns, in the use of verb forms. Having identified some morphological features of the vernacular, it can be concluded that the Russian vernacular has its own specifics in the field of morphology. Being a substandard subsystem of the Russian language, the vernacular opposes the literary norm.

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重读经典
REREADING THE CLASSICS

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抽象的。 以 A. I. 赫尔岑 (A. I. Herzen) 的著名小说《谁该受到责备?》为例。 考虑了重读经典小说作品的重要性。 在讨论小说中提出的科学、哲学、社会心理、社会政治和伦理问题时与作者的心灵对话表明，古典文学在我们这个技术与技术、数字化与互联网化、芯片化与人工智能的时代尤其重要。 淹没了人的智力和精神品质，严重阻碍了人类人性的发展。

关键词：古典文学、A.I.赫尔岑、小说《谁该怪?》、读者与作者的对话。

Abstract*. Using the example of the famous novel by A. I. Herzen "Who is to Blame?" The importance of rereading classical works of fiction is considered. A mental dialogue with the author when discussing scientific, philosophical, socio-psychological, socio-political and ethical problems raised in this novel indicates that classical literature is especially relevant in our time, when technology and technology, digitalization and internetization, chipization and artificial intelligence drowns out the intellectual and spiritual qualities in people, significantly hindering the development of humanity in humans.*

Keywords*: classical literature, A. I. Herzen, novel "Who is to Blame?", dialogue between reader and author.*

> *"Without reading there is no real education, there is and cannot be any taste, no style, no multifaceted breadth of understanding of life."*
> ***A. I. Herzen***

The creative heritage of A. I. Herzen (1812–1870) is very extensive and includes both various types and genres of literature (prose, journalism, literary criticism, memoirs, epistolary genre, etc.), and the results of his detailed scientific,

philosophical and vibrant social and political activities. Moreover, in almost each of the listed areas, according to his contemporaries and followers, he managed to reach the highest level.

Despite the variety of creative interests, Herzen was characterized by their deep unity. This unity was most clearly manifested in his classical literary works, giving them unconditional originality and uniqueness, special scientific, philosophical, socio-psychological and artistic content and value.

In the year of the 210th anniversary of the birth of A. I decided to re-read I. Herzen's famous novel "Who is to Blame?" My first acquaintance with this work took place in my distant student years, i.e. about half a century ago. Over the past time, much of what I read has certainly been forgotten. However, the plot of the novel and its main characters are generally preserved in memory: Vladimir (Voldemar) Beltov, the young spouses Lyubov and Dmitry Krutsifersky, Doctor Krupov, etc.

Rereading a work of fiction, according to literary scholars, is a very complex process. D.I. Pisarev, for example, even especially emphasized that *"to re-read a work of art for the second time just because it is artistic or imbued with deep thought is a feat ... that very few dare to undertake"* [1].

In general, reading is a kind of mental dialogue between the reader and the author. However, when reading a work of fiction for the first time, such a dialogue rarely occurs, since the reader's interest is focused mainly on the plot, the dynamics of the events described by the author, getting to know the characters, etc. When re-reading a novel or story, the reader's attention is focused on deeper things: analysis of what was read, subtext, comprehension of individual statements of the author, assessment of his artistic and scientific-philosophical worldviews. Consequently, it is in this case that a detailed dialogue "reader – author" can result. Some researchers call such dialogism co-creation. In order for the reader to be more prepared for such a dialogue, it is recommended that before re-reading a work of art, be sure to read the reviews of one or even several critics about it.

A very deep analysis of the novel "Who is to Blame?" was made at one time by the outstanding literary critic V. G. Belinsky. In his opinion, this is one of the best works of art published in Russia in the forties of the 19th century. He admired the author's observation and sharp mind, his ability to accurately and vividly describe events and pictures of life. However, Belinsky especially emphasized that to see only an extraordinary writer in the author of this novel means not to fully understand his talent. He noted that Herzen's main strength is not in his artistry, but in his thoughts, which he deeply felt, realized and originally expressed in the novel. What kind of thought is this? Belinsky answers this question as follows: *"This suffering, illness at the sight of unrecognized human dignity, insulted with intent and even more without intent, is what the Germans call humanity (Humanitat) ...*

Humanity is love of humanity, but developed by consciousness and education. A person who raises a poor orphan not out of calculation, not out of boasting, but out of a desire to do good - raising him like his own son, but at the same time making him feel that he is his benefactor, that he is being spent on him, etc., and etc., such a person, of course, deserves the name of good, moral..., but by no means humane. He has a lot of feelings and love, but they are not developed in him by consciousness...” [2].

Belinsky clearly substantiates that not only in this novel, but also in any other work of art by Herzen, this main active feeling is present - humanity, and the author himself is its talented preacher and defender.

In the process of re-reading the novel “Who is to Blame?” [3] I wrote down individual statements of the author of a scientific-philosophical, ideological, socio-psychological and ethical nature. Below I will dwell on some of them and my comments on them, thereby carrying out a mental dialogue with the author.

1. ***“Serve the cause, but be careful that the opposite does not happen: that the cause does not serve you. Don’t confuse means with ends, Voldemar. One love for one’s neighbor, one love for the good should be the goal. If love dries up in your soul, you will do nothing, you will deceive yourself; only love creates something durable and living, and pride is fruitless, because it does not need anything outside of itself...” [3, p. 162].***

This is from a letter from Genevan Joseph to his pupil Vladimir Beltov. Herzen’s humanistic attitude and his promotion of philanthropy are clearly visible here. Very correctly said about pride. On the one hand, this is a wonderful feeling because it expresses a person’s own dignity and self-respect. But often this feeling, fueled by painful conceit, grows very quickly, outstripping the development of all other feelings. As a result, pride turns into arrogance, and such spiritual and moral empty flowers as arrogance, hypocrisy, lordship, and arrogance appear.

2. ***“Who doesn’t know the old adage that children who promise too much rarely deliver. Why is this? Is it really possible that a person’s strength develops in such a definite quantity that if it is consumed in youth, there will be nothing left by the time he reaches adulthood? This is a tricky question. I don’t know how to solve it and don’t want to solve it, but I think that its solution should be sought rather in the atmosphere, in the environment, in influences and contacts, rather than in some absurd mental structure of a person” [3, p. 167].***

Indeed, this case is not rare, and is now even more common than before. It is most likely connected with the not very correct reaction of parents to the early manifestation of special qualities in their children. Parents, having discovered some unique abilities in their child, usually willingly share this joy with their relatives and friends, who express their sincere admiration for the child. Sooner or

later, these admiring responses reach the child. He begins to develop feelings of his own exclusivity, arrogance and pride, which dampen the further development of a person's abilities. As Goethe once said: a genius who realizes that he is a genius is no longer a genius.

3. ***"But we do not know how to drag our family life over the threshold of education, and what is even more remarkable, perhaps, is that, cooling down to family life, we do not stick to any other; It's not our personality that's developing, it's not our common interests that are developing, it's just the family that's stalling" [3, p. 187].***

The fact that even today we do not know how to organize our family life is, unfortunately, a fact. We don't teach family life skills in schools, colleges, or universities. But the family is one of the most significant social units of society! However, we teach everyone: painter, plasterer, mechanic, carpenter, doctor, engineer, technician, etc. We don't teach only the family man. He remains with us a dense ignoramus. The lack of family education leads to the fact that our families give away a lot of social marriage to the state. If a defect occurs in factory production, the defective part is sent either to a landfill or for rework. You can't send scraps from family production to a landfill. As for reworking, only the most inveterate scoundrels and criminals who come from specific dysfunctional families are subjected to it in correctional colonies. But it is difficult to change an adult by punishment. This can only embitter him. Thus, family education is the most important social problem today.

4. ***"The inability to live in the present, appreciate the future, and surrender to it is one of the moral epidemics that are most developed in our time" [3, p. 192].***

However, in relation to modernity, the moral definition of the social situation in the world can be formulated as follows: the desire to live in the present, not think about the future and not value the past. Such a moral situation is many times more catastrophic than the one that alarmed Herzen in his time.

5. ***"Woldemar," the old man objected, "be afraid to indulge in too sober a glance, lest it cool your heart and extinguish the love in it!" There was a lot I didn't foresee in your life; It was hard for you, but you shouldn't immediately put down your weapon; the dignity of human life in struggle..., the reward must be suffered" [3, p. 224].***

Sober calculation, which means naked pragmatism and the search for benefits for oneself, really should be feared. Such an approach dulls the spiritual and moral development of a person, contributes to the prosperity of philistinism - this, according to M. Gorky, is the curse of the world, devouring a person from the inside, like a worm devastates a fruit. Herzen was also always afraid of philistinism. He called it an expression of the animal side of humanity, for which the main thing is

goods, money and property. In those distant times, as, unfortunately, today, it was especially characteristic of Western countries. For example, Herzen directly called France the country of philistinism, which has lost everything youthful, poetic and everything honest.

6. ***"It has long been noticed by poets that nature is disgustingly indifferent to what people do on its back, does not cry over poetry and does not laugh at prose, but does its job according to the utmost understanding" [3, p. 227].***

In principle, nature cannot be indifferent to human activity. She, of course, does not laugh at the prose, but she almost cries at the sight of human cruelty, mismanagement and short-sightedness. And is it right to separate man from nature? After all, she created him so that he would become her reasonable protector and wise master. After all, it is impossible to live without an owner in the house that is our planet. Without it, the house can quickly collapse. Only the owner can patch up, repair and replace in time what has become unusable due to time or an accident. This means that nature completely trusted her matured child, relying on his mind, heart and soul. But what about man? As an adult, he forgot about his duty and his humanistic purpose in life. His actions seriously wound nature, causing her physical and mental pain. Immorality must always be punished. It is impossible otherwise, otherwise beauty and harmony in the world will disappear. Nature will punish a person, but for the first time in such a way as to give him another opportunity to come to his senses and become a real master in her house.

7. ***"Man always sees in man an enemy with whom he must fight, dissemble and hasten to determine the terms of a truce... We grew up with this, and it is almost impossible to get rid of it; We all have a petty-bourgeois pride that makes us look around, look around; Man does not compete with nature, is not afraid of it, and that is why it is so easy, so free for us to be alone..." [3, p. 229].***

Indeed, most of all we take out our anger on our own kind. We are not angry with animals or plants even when they harm us, understanding that they do this without malicious intent. When a person causes us trouble or harm, he often does so consciously, and therefore causes a strong hostile response. Even if this or that act was done by a person without malicious intent, we often still attribute it to a thoughtful act directed against us. Isn't this where alienation between people, national disunity, civil strife and constant wars come from? There is information that over the last 5 thousand years of its existence, humanity lived peacefully for only 290 years, i.e. 6%. The rest of the time was taken up by 14,500 wars, which claimed almost 4 billion human lives. Such a suicidal and anti-humanistic policy, given the steady improvement of military equipment and methods of killing, will sooner or later lead either to a global catastrophe or to the gradual degeneration and disappearance of man as a species.

Thus, A. I. Herzen in his novel touched upon a huge layer of scientific, philosophical, socio-psychological, moral, ethical and socio-political problems that have worried people at all times and are extremely relevant today. This is the main feature characteristic of classical literary works in general and emphasizing that they remain the most meaningful and sought-after tool for understanding man, society and our entire reality.

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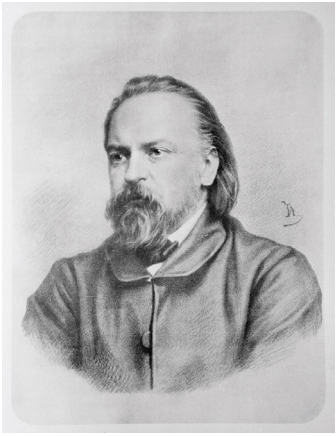

Figure 1. *Outstanding Russian philosopher, writer, literary critic, publicist and revolutionary Alexander Ivanovich Herzen (1812–1870)*

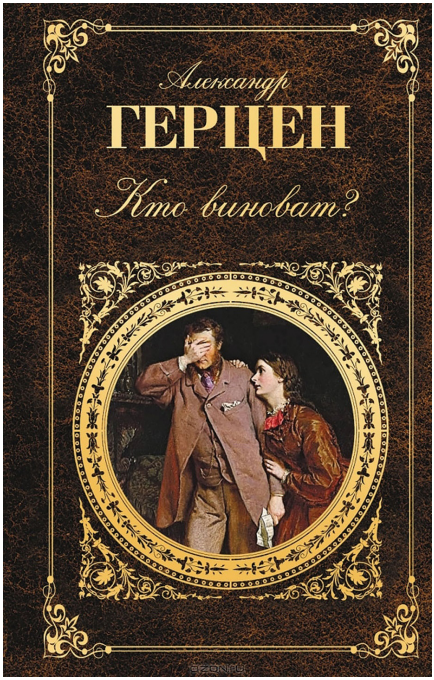

Figure 2. *Cover of one of the separate editions of the novel by A. I. Herzen*

Figure 3. *Scene from the movie "Who's to Blame?" (1962)*

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论古罗马社会的起源
ON THE BEGINNING OF ANCIENT ROMAN COMMUNITY

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抽象的。 作者根据著名罗马文物研究者的著作，分析了意大利半岛境内古罗马社区的出现。 本文描述了将人们聚集在一起形成新罗马社区的历史原因、创建这种社区的目标及其典型特征。 作者展示了最古老的拉丁术语，揭示了古罗马社会创造和存在的实际焦点。

关键词：亲属、亲属社区、被遗弃者、土匪、战争、伊特鲁里亚人、拉丁人、萨宾人、库里亚、部落、城市殖民地、罗马、木星、火星、罗马社区、人民、社区领袖、雷克斯、酋长、国王、富豪徽章 尊严、Quirites、军队、士兵、公民、军事民主。

Abstract. *Based on the works of well-known researchers of Roman antiquities, the author analyses the emergence of ancient Roman community within the territory of the Italian Peninsula. The paper describes historical reasons for bringing people together to form a new Roman community, goals of creating such a community, and its typical features. The author shows the oldest Latin terminology that reveals the actual focus of creation and existence of the ancient Roman community.*

Keywords: *kin, kinship community, outcasts, bandits, war, Etruscans, Latins, Sabines, curia, tribe, city-colony, Rome, Jupiter, Mars, Roman community, people, community leader, rex, chief, king, insignia of regal dignity, Quirites, army, soldier, citizen, military democracy.*

The paper is dedicated to the issue of emergence of the ancient Roman community, and in this context describes the reasons for bringing people together to form such a community, the goals for creating such, and its typical features.

Before we start our study, let us note that in order to avoid the accusations of fabrications and contrived events, the author excluded his own historical analysis and arguments on the given topic to the maximum extent possible. Almost all

events and information of mentioned in this paper have been taken from the monographs of internationally renowned researchers of the history of Ancient Rome.

First, we need to understand the historical reasons, which caused the need of bringing people together to form a new social unit called "ancient Roman community". For these purposes, let us consider the historical situation, which led to the emergence of the ancient Roman community.

The following groups of people existed within the territory of the Italian peninsula during the period preceding the formation of the ancient Roman community: male kinship communities, male unions (curiae), and gangs of robbers. The detailed description of emergence of such male communities on the Italian Peninsula will be given in our next paper on the historical foundations and fictitious constructs, which allowed bringing people together to form primary social groups of pre-Roman and early Roman period.

Given the ongoing increase of the population, the existing environmental niche no longer allowed to feed all people living on the Italian Peninsula. As I. V. Netushil notes: "The territory of Rome, as well as of other parts of Latium, has been densely populated since ancient times"[1]. L. Morgan writes, "The Italian tribes had then become numerous and populous"[2], whereas the coming of new immigrants led to a substantial restriction of the food base of the inhabitants of this territory. Food and other vital resources are gradually becoming scarce. This fact resulted in the need to constantly fight defensive wars in order to protect their own resources and territories, and to conduct armed operations and attack the neighbouring communities, if there was an urgent need to survive. In addition, when early humans realized that an armed attack on the neighbouring community brings more wealth than daily hard labour of an agricultural worker or a stockbreeder, they began to consider wars as a main source of gaining means of survival. As S. A. Muromtsev said about that: "Stockbreeding and agriculture formed the basis of the economic life of tribes settled in Italy. The war soon became one of the regular means of supporting their sustenance"[3].

Since the war was an easier and more reliable way to gain material wealth, it has very soon become a major and daily activity of the majority of male kinship communities. Properly speaking, in those far-off times war was nothing else but an ordinary robbery, banditry, and related killings. Both existing and newly formed male communities were involved in these so-called "military actions". The most primitive of those communities represented gangs of robbers, which

[1] *Netushil I. V.* Outline of the Roman State Antiquities. In 2 vols. Kharkiv, 1893, P. 475.

[2] *Morgan L.* Ancient Society Or, Researches in the Lines of Human Progress from Savagery, through Barbarism to Civilization / Translated from English and ed. by M. O. Kosven / 2nd ed. Leningrad, 1935. P. 160.

[3] *Muromtsev S. A.* Civil Law of Ancient Rome. Moscow, 1883. P. 29.

consisted of adventurers[4], vagrants[5], runaway slaves[6], and outcasts[7]. Male unions (*curiae*) represented another large group of such communities. They, in turn, consisted of male kinship communities, which also made regular plundering raids on their neighbours, ruining their cities and settlements. All kinship communities of the Italian Peninsula, including Latin and Etruscan ones, were involved in robberies and banditries. For instance, with respect to the Latin communities V. V. Efimov writes, "They had only just embarked on agriculture, continuing to engage in stockbreeding and plundering raids on Caere, a neighbouring trading city[8] and other cities"[9]. The same phenomenon is mentioned by H. Maine: "in old times all territory of ancient Italy was composed in great measure of robber tribes"[10]. By nature, both of these groups of male communities were ordinary robbers, who constantly terrorized the neighbouring local settlements by carrying out raids thereon for the purpose of robbery, banditry, and abuse of women.

It is in these communities of free and armed men where the first manifestation of a new basis took place, which was able to bring the people, who were different by both blood and cult, together. For the first time the approach to the creation of a new union of people was changed, and such union was formed not due to kinship but due to the feasibility of military cooperation, and hence, the easier way to obtain wealth by brute force.

Now, since we have understood the historical situation that preceded the formation of an ancient Roman community, let us proceed directly to the problem of the emergence of this community. For centuries before the foundation of Rome, the Etruscans had already occupied all territory of the future Roman community[11]. This suggests that the Etruscans pursued their own aggressive policy in relation to the adjacent territory for carrying out robbery and banditry, as it has always been the best protection of their cities and property from the attacks of neighbouring male tribal communities and curiae. The famous researchers of the history of ancient Rome report that since the Etruscans conquered Latin and other nearby communities[12], and captured their cities[13] because they had a higher level of mili-

[4] *Jhering R.* Geist des römischen Rechts auf den verschiedenen Stufen seiner Entwicklung / transl. from the 3rd corr. German edition. Saint Petersburg, 1875. P. 82; *Morgan L.* Ibid. P. 186.

[5] *Kofanov L. L.* Formation of the System of Roman Law / Article in the book "Colleges of Pontiffs in Ancient Rome. On the History of Formation of Roman Sacred and Public Law". Moscow, 2001. P. 300; *Eliade M.* A History of Faith and Religious Ideas. Moscow, 1975. Par. 162.

[6] *Morgan L.* Ibid. P. 178.

[7] *Kulakovsky Yu. A.* On the Beginning of Rome. Kiev, 1888. P. 90-95.

[8] The largest city in Etruria, located in the immediate vicinity of the future territory of Rome.

[9] *Efimov V. V.* Lectures on the History of Roman Law. Saint Petersburg, 1898. P. 153.

[10] *Maine H.* Ancient Law, its connection with the early history of society and its relation to modern ideas / trans. from English by N. A. Belozerskaya / 3rd ed., London, 1873. P. 37.

[11] *Netushil I. V.* Ibid. P. 531.

[12] *Morgan L.* Ibid. P. 174.

[13] *Kulakovsky Yu. A.* Ibid. P. 80.

tary, administrative and cultural development[14]. Yu. A. Kulakovsky notes, "Rome came under Etruscan domination at the beginning of its history and for some time was in their possession"[15].

The Etruscans not only subdued the adjacent tribal communities and curiae. To continue their expansion, the Etruscans decided to create a single robber union for the purpose of robbery, banditry, and conquering all their nearby and distant neighbours. As L. Morgan notes, the objectives of creating a new Roman union "were essentially military, to gain a supremacy in Italy, and it is not surprising that the organization took the form of a military democracy"[16]. It is the time when the history of emergence of the so-called "ancient Roman community" begins (L. Morgan calls it a period of the Upper Status of Barbarism[17]). As Livy (Latin in full *Titus Livius*), a Roman historian, points out, "the new Roman union of strong armed men was formed only for the purposes of robbery being maintained by power and military discipline"[18]. Hegel, while analysing the primary union of the ancient Romans, directly calls it a "society of robbers"[19]. Analysing the founders of Rome, R. Jhering calls them "bandits and adventurers", and further, when describing their customs, does not hesitate to call them "murderers"[20],

The Etruscans wanted to implement their expansionist plans and at the same time to solve the problem with their redundant population (outcasts). Therefore, they began the construction of their city-colony named Rome. This is confirmed by numerous historical data submitted by the researchers of Roman antiquities. As for the foundation of Rome, it is necessary to pay attention to the urban planning rules (if we use the terms of modern language), according to which the foundation was made. So, the city of Rome was founded "in accordance with all the rules of the Etruscan rituals (*ritus etruscus*)" as that of a new colony[21] according to "the foundation ceremony of the Etruscan cities"[22]. Next, what can the shape of the first fortress in Rome tell us? The answer is: the first fortress of Rome was built in the shape typical for the construction of all fortresses-colonies,[23] and, as Varro mentions, was of a square shape[24] (it was called in Latin *Roma quadrata*, "Square

[14] See e.g., *Pokrovsky I. A.* History of Roman law. Saint Petersburg, 1913. P. 17;*Wägner, W.* Rome: History and Culture of the Roman People for the Lovers of Classical Antiquity and for Self-education / ed. by V. I. Modestov / 3rd Russian ed., ed. and amended. Saint Petersburg, 1902, PP. 17, 20-24; Eliade M. Ibid. Par. 167.

[15] *Kulakovsky Yu. A.* Ibid. P. 119.

[16] *Morgan L.* Ibid. P. 177.

[17] *Morgan L.* Ibid. PP. 13, 22-23, 71.

[18] Op. cit. *Jhering R.* Ibid. P. 85.

[19] Op. cit. *Jhering R.* Ibid. P. 86.

[20] *Jhering R.* Ibid. PP. 82, 86.

[21] *Kulakovsky Yu. A.* Ibid. P. 25.

[22] *Wägner W.* Ibid. P. 31.

[23] *Netushil I. V.* Ibid. P. 476.

[24] Op. cit. *Kulakovsky Yu. A.* Ibid. P. 62.

Rome"[25]). In addition, let us note that the ancient Greeks called the Etruscans *Tyrrhenians*[26], the name, which, according to Dionysius of Halicarnassus, "was given them from the forts, which they were the first of the inhabitants of this country to build"[27]. How was the *Roman Cloaca Maxima* built? This enormous sewer was built "using the Etruscan method of building the arch"[28]. Next, what were the rules to define the width of pomerium around the city wall? The answer is: as both Livy and – after more than two thousand years –W. Wägner point out, the width of the pomerium around Rome was defined according to the Etruscan traditions[29]. What was the number of gates founded during the construction of Rome? The answer is: "According to the Etruscan traditions, not less than three gates were supposed to be arranged during the city foundation, and this number of gates was also found on the Palatine Hill"[30]. What general conclusion can be drawn from this information? The only conclusion to be made is that the city of Rome was built as an Etruscan city-colony, and the construction of the city of Rome, of its first fortress, and of the main structures was carried out according to the Etruscan standards and rules.

Now let us clarify the reasons why the Etruscans constructed their city-colony. The oldest method of arranging a place of residence for the redundant young people, who were expelled from the community, is to build cities-colonies for them. As Dionysius of Halicarnassus points out, "Famine, fodder shortage, and winning a victory over neighbour could have resulted in eviction and expansion of borders of the given tribe" by means of "spreading of colonies"[31]. It turns out that Rome was built as a city-colony for the outcasts of one of the cities-communities of Etruria to live in. What kind of city-community was it, which arranged the construction of a new city-colony for the expelled redundant people, and gave architects and materials for that? To learn this, first it is necessary to define the city of Etruria, with which Rome had good relations at the beginning of its history and afterwards, and the city, from which Rome received military and financial assistance The first thing to discover is from which side the city of Rome did not have any defensive structures? The answer is: "it is in the place where the road from Caere ended"[32], where there were no defensive structures. The second thing to specify is where were gods, flamens, and vestal virgins of Rome hiding in the event of an

[25] *Mommsen T.* The History of Rome / 7th ed. / trans. by V. N. Nevedomsky. Moscow, 1887. P. 48; *Wägner W.* Ibid. P. 32.

[26] *Wägner W.* Ibid. P. 17.

[27] Op. cit. *Netushil I. V.* Ibid. P. 531.

[28] *Netushil I. V.* Ibid. P. 19.

[29] Op. cit. *Kulakovsky Yu. A.* Ibid. P. 60.*Wägner W.* Ibid. P. 21-22.

[30] *Netushil I. V.* Ibid. P. 477.*Wägner W.* Ibid. P. 22.

[31] Op. cit. *Kulakovsky Yu. A.* Ibid. P. 92-93.

[32] *Netushil I. V.* Ibid. P. 18.

enemy attack on Rome? As I. V. Netushil says, even at the beginning of the republican period gods, flamens, vestal virgins, and other residents of Rome still could find refuge in the Etruscan town of Caere during the Sack of Rome by the Gauls[33]. All this suggests that it was the city of Caere, with which Rome had no hostile relations from the very beginning. F. Coulanges writes, "The city of Caere in Etruria was the first city, with which Rome made an alliance of friendship"[34]. Moreover, I. V. Netushil tells us that before their accession to the throne, the Tarquin kings of Rome were supreme rulers in the city-community of Caere[35]. Therefore, the city of Caere ensured the construction of a new city-colony under its protectorate, and the Etruscans from Caere later became kings of Rome.

Later, Romulus invited to Rome gangs of robbers and outcasts, which were hanging around nearby. He did this in order to increase the number of residents of the new city and to form its primary army. As Livy mentions, "accumulating a mass of humble and insignificant people was an old custom of the city's founders"[36]. Having studied the history of the formation of the Roman community, Yu. A. Kulakovsky notes, "When Romulus opens a shelter on the Capitolium, people without kin, outcasts, and runaways from everywhere come to his call, and it is these people, who will make his army"[37]. V. M. Khvostov points out that Rome was a refuge of "wolves" (criminals)[38] (the Indo-European tribes always worshipped a wolf, a strong and wild robber[39], as a patron of outcasts[40]; that is why the wolf remained a patron of the Romans). That is why we find no Roman history of their own gentiles and communities: it simply does not exist[41]. As L. Morgan clearly indicates, "The accounts of these tribes (*Latin tribes – author's note*) from the time of the supremacy of the chiefs of Alba down to the time of Servius Tullius, were made up to a great extent of fables and traditions"[42]. W. Wägner notes, "This faked-up ancient history of Rome contains little reliable information"[43]. As Yu. V. Kulakovsky explicitly states, "The Roman nation had not existed before the city of Rome was founded"[44].

[33] *Coulanges F.* The Ancient City: A Study on the Religion, Laws, and Institutions of Greece and Rome / trans. from French by N.N. Spiridonov. Moscow, 1895. P. 181; *Netushil I. V.* Ibid. P. 19.

[34] *Coulanges F.* Ibid. P. 181.

[35] *Netushil I. V.* Ibid. P. 18.

[36] Op.cit. *Morgan L.* Ibid. P. 178.

[37] *Kulakovsky Yu. A.* Ibid. P. 26, 65.

[38] *Khvostov V. M.* History of Roman Law / 7th ed. Moscow, 1919. 1919. P. 19

[39] *Wägner W.* Ibid. P. 76.

[40] *Ivanov V. V.* Reconstruction of Indo-European Words and Texts Reflecting the Wolf's Cult / Proceedings of the wolf / Proceedings of the USSR Academy of Sciences. Series of literature and language. Moscow, 1975. Vol. 34. Iss. 5. P. 405.

[41] On the mythological nature of the history of ancient Rome, see *Kulakovsky Yu. A.* Ibid. P. 1-24.

[42] *Morgan L.* Ibid. P. 160.

[43] *Wägner W.* Ibid. P. 32.

[44] *Kulakovsky Yu. A.* Ibid. P. 68.

Next. All researchers of the ancient Rome know that the vast majority of Roman kings as well as the founder of the Roman Republic were neither Latins nor other Italians, who, according to the legend, formed the Roman community, but Etruscans[45]. So why did the Etruscans become the leaders of the Roman community? Indeed, a number of researchers studying the emergence of Rome try to convince us in the authority of Latins as compared to other communities living on the Italian Peninsula[46]. The answer to this question lies in the ancient traditions of the proclamation kings (chiefs). If we take the traditions of ancient European tribes dedicated to the origin of the power of king (chief), we shall see that in time of peace the king (chief) was elected[47], whereas in the times of war the supreme power of the king (chief) was always given to the victorious military commander[48]. L. Morgan writes that the position of king (chief) "came out of the military necessities of the united tribes"[49]. The same approach was used in kinship communities living within the territory of the Italian Peninsula. Given the fact that in those hard times, the war with neighbouring communities for the spoils of war was almost permanent[50], it is not surprising that cases, when the most fortunate military commander was appointed a *rex* (king) were most common. As stated by L. Morgan, the government of the Italic tribes in the time of Romulus consisted of "the council of chiefs, the assembly of the people, and the military commander"[51] and "the rex was a general"[52]. S. A. Muromtsev writes, "Personal courage has become valued more than social background and seniority"[53]. I. V. Netushil states, "The

[45] See e.g., *Pukhan I., Polenak-Akimovskaya M.* Roman Law: Basic Studies. / ed. by V. A. Tomsinov / trans. from Macedonian by V. A. Tomsinov and Yu. V. Filippov, Moscow, 1999. P. 11; *Dozhdev D. V.* Roman Private Law. Textbook for Law Universities and Faculties / gen. ed. by V. S. Nersesyants. Moscow, 1999. P. 17; *Zelinsky F. F.* History of Ancient Religions: Ancient Greek religion, Hellenistic religion. Rome and its religion. The Roman Empire and Christianity. Rostov-on-Don, 2010. PP. 348, 360; *Kulakovsky Yu. A.* Ibid. P. 120.*Kofanov L. L.* The College of Augurs / Article in the book "Colleges of Pontiffs in Ancient Rome. On the History of Formation of Roman Sacred and Public Law". Moscow, 2001. P. 64; *Shtaerman E. M.* Social Foundations of Ancient Roman Religion. Moscow, 1987. P. 21; *Eliade M.* Ibid. Par. 162; *Krasheninnikov P. V.* Ancient Law: A Short History, Moscow, 2018. P.50.

[46] See e.g., *Mommsen T.* Ibid. P. 6.

[47] Bartošek M. Roman Law: Notions, Terms, Definitions. Moscow, 1989. P. 87: *Netushil I. V.* Ibid. P. 59; *Pukhan I., Polenak-Akimovskaya M.* Ibid. P. 9; *Coulanges F.* Ibid. P. 218-219; *Kosarev A. I.* Roman Private Law: Textbook / 2nd ed. Moscow, 2007. P. 53.

[48] Real Dictionary of Classical Antiquities according to Friedrich Lübker / ed. by F. Gelbke, F. Zelinsky and L. Georgievsky. Iss. II. Saint Petersburg, 1884. P. 659; *Maine H.* Ancient Law: Its Connection to the History of Early Society / trans. from English by A. G. Ammon and V. F. Deryuzhinsky, ed. by M. M. Kovalevsky. London, 1874. P. 112.

[49] *Morgan L.* Ibid. P. 147.

[50] *Muromtsev S. A.* Ibid. P. 29-31.

[51] *Morgan L.* Ibid. P. 178.

[52] *Morgan L.* Ibid. P. 178.

[53] *Muromtsev S. A.* Ibid. P. 30.

title of the king was familiar to the Indo-Europeans but its meaning depended on the extent of the personal bravado of its bearer. The admiration for the bravado and personal power is evident everywhere"[54]. There was no other way to become a *rex* (king) in times of war. For instance, Yu. A. Kulakovsky draws our attention to the fact that Tarquin (Latin "*Tarquinius*"), an Etruscan military commander "became the king of Rome"[55] after he became known for the military victories as a head of the army. It should be noted that there are no contradictions in the opinions of a number of researchers of the history of Rome regarding the fact that the Roman king was elected[56], and not proclaimed as a victorious military commander. The ancient ceremony of the election of the king had always been observed; however, the election procedure was always held with respect to the victorious military commander, and not someone else.

The existence of Etruscan kings, who were regularly appointed leaders of the ancient Roman community, is the evidence of the fact that it is these kings, who were victorious military commanders, who received an absolute power over the newly-emerged community[57]. Some researchers of Roman antiquities directly consider the king's period of the Ancient Rome to be an Etruscan period[58], a period of Etruscan domination[59], or the reign of "Etruscan dynasty"[60]. H. Maine notes that in those old times there were no terms for the combination of different groups of people "except those of absolute superiority on one side and absolute subjection on the other"[61]. Bartold Niebuhr made an interesting conclusion on that basis saying that "originally patricians were Etruscans, and plebeians consisted of Latins"[62]. W. Wägner takes a similar approach on the origin of the patricians and plebeians. He states that the opposition between patricians and plebeians is because "once Rome was conquered by an alien tribe"[63]. Another proof that the Etruscans conquered Rome lies in the mismatch in the name of the city (Rome) and the self-appellation of its residents (the Quirites). V. Erenberg notes that given the polis of Sparta, the proper name of the polis (*Lacedaemon*) does not coincide with the name of its citizens (*the Spartiates*), which is "contrary to the characteris-

[54] *Netushil I. V.* Ibid. P. 13.

[55] *Kulakovsky Yu. A.* Ibid. P. 121.

[56] *Netushil I. V.* Ibid. P. 64-65; *Wägner W.* Ibid. P. 28-29.

[57] If, as I. V. Netushil suggests (see Ibid. P. 45), the Latins were the first invaders, it would be them, who would have become the first kings of Ancient Rome.

[58] *Netushil I. V.* Ibid. P. 31.

[59] *Pokrovsky I. A.* Ibid. P. 17; *Kulakovsky Yu. A.* Ibid. P. 101.Eliade M. Ibid. Par. 166.

[60] *Kofanov L. L.* The College of Augurs / Article in the book "Colleges of Pontiffs in Ancient Rome. On the History of Formation of Roman Sacred and Public Law". Moscow, 2001. P. 64.

[61] *Maine H.* Ibid. P. 103.

[62] Op. cit. *Muromtsev S.A.* Ibid. P. 18.

[63] *Wägner W.* Ibid. P. 68.

tic feature of the polis –the identity of the state and the society"[64]. It turns out that a more ancient settlement called Rome had been previously located on the place, of a new Etruscan city-colony. The Etruscan invaders built their city-colony on the place of this settlement, having retained its former name of Rome but giving a new name to its residents, the Quirites. As for the military capacity of the Latins for invasion and subjugation of neighbouring tribes, T. Mommsen, the most prominent and respected scholar of Roman history, explicitly points out that the Latins invaded nobody on the Italian Peninsula: "in Italy we do not meet with any race of earlier settlers less capable of culture, that had become subject to the Latin immigrants"[65] (L. Morgan believes that the Latin tribes came to the Italian Peninsula during the Middle Status of Barbarism[66], and Yu. A. Kulakovsky thinks that they came to the Italian Peninsula approximately in the 10th century BC[67]).

The fact that Romulus, the first king, was Etruscan is proved by other well-known but for some reason little mentioned data. For example, it can be proved by a calendar introduced by Romulus in his new Roman community. The fact is that the calendar introduced by Romulus was an Etruscan one[68]. A Roman week consisting of nine days was taken from the Etruscan tradition and was in the Etruscan manner called "*nundinae*"[69]. If Romulus were Latin, Sabine, or other Italian, or even Greek (some attempts were made later to trace his family tree to Aeneas[70]), he would have never adopted the alien Etruscan calendar. The art of writing "came to Rome through Etruria"[71]. The reference numerals used in the ancient Roman community, came to Rome from the Etruscans[72]. Even the so-called "Roman toga", the everyday clothing of the Romans, and the external distinctive insignia of Roman officials were borrowed from the Etruscans[73]. According to Symmachus, a Roman author, "we have borrowed the distinctive insignia from the Etruscans"[74]. Next, who guarded Romulus the king? The answer is: "Romulus was guarded by 12 lictors (*bodyguards – author's note*) given to him by each of

[64] Op. cit. *Andreev V.* Male Unions in Dorian Polises (Sparta and Crete). Saint Petersburg, 2004. P. 17.

[65] *Mommsen T.* Ibid. P. 68.

[66] *Morgan L.* Ibid. P. 159.

[67] *Kulakovsky Yu. A.* Ibid. P. 118.

[68] Real Dictionary of Classical Antiquities according to Friedrich Lübker / ed. by F. Gelbke, F. Zelinsky and L. Georgievsky. Iss. II. Saint Petersburg, 1884. P. 1484.

[69] *Netushil I. V.* Ibid. P. 537.

[70] *Zelinsky F. F.* Ibid. PP. 361, 366; *Netushil I. V.* Ibid. P. 516; *Kulakovsky Yu. A.* Ibid. PP. 5, 45; *Wägner W.* Ibid. P. 33-35.

[71] *Netushil I. V.* Ibid. PP. 21, 59.

[72] *Netushil I. V.* Ibid. P. 540.

[73] *Netushil I. V.* Ibid. P. 19.

[74] Op. cit. *Kofanov L. L.* The College of Augurs / Article in the book "Colleges of Pontiffs in Ancient Rome. On the History of Formation of Roman Sacred and Public Law". Moscow, 2001. P. 300.

the 12 cities of Etruria"[75]. This suggests that the Etruscan cities ensured safety of their royal representative in their city-colony. All these data leave no doubt that Romulus belonged to the Etruscan community.

If we talk about Jupiter, Mars, and Quirinus, the major deities of the ancient Roman community[76], the most powerful of them was Jupiter[77], whom the Romans still remembered from the era of the Indo-European (Aryan) unity as the ancient god of the sky, light and lightnings[78]. If we accept G. Allen's opinion that only the most powerful god ancestor of the chief (king) of the community could be recognized the patron god of the new Roman community[79], then we should also accept that the god ancestor of Romulus was Jupiter. Pliny confirms the Etruscan origin of Jupiter: he writes about the Temple of Jupiter Optimus Maximus in the main acropolis of the ancient Roman community on the Capitolium. The cult statue of Jupiter was said to have been purposefully brought from Etruria and installed in this temple[80]. The Etruscan cult statue of the main deity of the ancient Roman community shows that it had been intentionally brought to the city-colony to confirm its subjugation to the gods of Etruria. As for the construction of the temple on the Capitolium dedicated to Jupiter, Mars, and Quirinus, three major deities of the ancient Roman community, it was carried out by Etruscan architects and craftsmen[81].

As for the story how the insignia of regal dignity (a golden crown, a throne of ivory, a purple cloak, a purple tunic with golden embroideries, and, most importantly, a sceptre with the image of an eagle on the upper end, the most famous symbol of Roman power and authority) appeared in the Ancient Rome, they, as the researchers of the Roman history suggest, were transferred to Rome from the Etruscans[82]. Dionysius of Halicarnassus states that the insignia of regal dignity were given to Lucius Tarquinius Priscus, a Roman Etruscan king, by all 12 cities of Etruria as a sign of recognition of a Roman king's supremacy[83]. This fact does

[75] *Netushil I. V.* Ibid. PP. 31, 537.

[76] *Nemirovsky A. I.* Ideology and Culture of Early Rome. Voronezh, 1964. 97-98; *Eliade M.* Ibid. Par. 166.

[77] *Mayorova N. G.* The College of Fetiales / Article in the book "Colleges of Pontiffs in Ancient Rome. On the History of Formation of Roman Sacred and Public Law". Moscow, 2001. P. 178.

[78] *Dumézil G.* La Religion romaine archaïque, avec un appendice sur la religion des Étrusques / trans. from French by publ. T.I. Smolyanskaya / ed. by F. A. Pirvitsa and T. G. Sidash. Saint Petersburg, 2018. P. 251; *Zelinsky F. F.* Ibid. P. 342-346; *Wägner W.* Ibid. P. 32. PP. 75, 77.

[79] *Allen G.* Evolution of the Idea of God: An Inquiry into the Origin of Religions / trans. from German by E. A. Volk / 2nd ed., Saint Petersburg, 1906. PP. 34, 39.

[80] Op. cit. *Netushil I. V.* Ibid. P. 486; *Wägner W.* Ibid. P. 72.

[81] *Kulakovsky Yu. A.* Ibid. P. 124.*Wägner W.* Ibid. P. 61. *Netushil I. V.* Ibid. P. 19.

[82] *Wägner W.* Ibid. PP. 24. 50; *Kofanov L. L.* The College of Augurs / Article in the book "Colleges of Pontiffs in Ancient Rome. On the History of Formation of Roman Sacred and Public Law". Moscow, 2001. P. 91.

[83] Op. cit. *Kulakovsky Yu. A.* Ibid. P. 122.

nothing but confirms the Etruscan nature of the ancient Roman community and the fact that as the power and authority of Rome increased, the cities recognized the increased power and authority of their city-colony and handed over the insignia of regal dignity to the Etruscan king in order to confirm the Etruscan origin of Rome. According to I. V. Netushil, due to relocation of Tarquin, the king of the Etruscan city of Caere, to Rome and his accession to the throne "the city became a political centre not only for the Latin region but also for the part of Etruria"[84]. Later: "All the indications are that the power of the Tarquins was not based on the rights of the conquerors or the invaders. It was rather the power of foreign sovereigns, who came to live in the capital of the Roman vassal state"[85]. That is why the insignia of Etruscan regal dignity were given to Tarquin. The word "ceremony" ("*caeremonia*" in Latin) is derived from the name of the Etruscan town of Caere[86], from which there came a solemn procedure made in honour of the supreme ruler of Rome, together with the regal attributes[87]. L. L. Kofanov writes about this fact: "The Romans borrowed from the Etruscans a lot of Etruscan regulations regarding the nature of king's power, together with the regal attributes"[88]. If we talk about the bodies of power in the king's Rome, let us refer to V. M. Khvostov, who points out that "all the political institutions of Rome were borrowed by the Romans from the Etruscans"[89]. However, to be more precise, they are not borrowed but brought by the Etruscans together with their king and their traditions to control their cities-colonies[90]. Were there any wars between Rome and Etruria in the regal period of ancient Rome? As Dionysius of Halicarnassus points out, Servius Tullius's reference to wars with the Etruscans is a pure fiction and "is a kind of later artificial inset into the authentic narration"[91], since Servius Tullius always acted "at the direction of Etruria"[92].

Now for the most important question: how was the Roman community formed? We also find the answer in the works by Dionysius of Halicarnassus, who gives an

[84] *Netushil I. V.* Ibid. P. 18.

[85] *Netushil I. V.* Ibid. P. 60.

[86] *Netushil I. V.* Ibid. P. 19.

[87] If the word "ceremony" is derived from the Etruscan city of Caere, then it is logical to assume that the word "king" has the same etymology and denotes a supreme ruler, who came from Caere to rule the dependent city-colony of Rome.

[88] *Kofanov L. L.* Formation of the System of Roman Law / Article in the book "Colleges of Pontiffs in Ancient Rome. On the History of Formation of Roman Sacred and Public Law". Moscow, 2001. P. 302.

[89] *Khvostov V. M.* Ibid. P. 17.

[90] Even if we admit that the first kings of Rome were mythical heroes of antiquity (e.g., as stated by Netushil I. V. Ibid. P. 59.), the historical data about the Etruscan nature of the city of Rome, its first fortress, calendar, regal robes, everyday clothing of the Romans etc. clearly demonstrate the Etruscan origin of Rome.

[91] Op. cit. *Kulakovsky Yu. A.* Ibid. P. 123.

[92] *Netushil I. V.* Ibid. PP. 18, 46.

accurate description of how Romulus, Etruscan by origin, formed the Roman community. "The system (*of the Roman community – author's note*) was as follows: he (*Romulus – author's note*) divided the entire mass of people into three parts and then appointed the most outstanding person to be a leader of each of these parts"[93]. What comes from these Dionysius' words? First, Romulus was a supreme ruler, who could give binding orders. According to our version, it was Romulus, the Etruscan victorious commander, who conquered the neighbouring kinship communities and curiae. Second, Romulus divided the whole mass of his subordinate population into three parts. Pursuant to the aforesaid, it turns out that Romulus divided the whole mass of people residing in the conquered communities and curiae into three parts, and appointed a leader to each of them. Researchers that are more contemporary also mention these facts. For example, as I. A. Pokrovsky notes, "Romulus divided the initial population of Rome into three tribes"[94]. So, each of the three parts of population received a general designation "tribe". This only confirms the described version, since the world "*tribus*" in translation from ancient Latin means nothing else than "a third part"[95], or "a third"[96]. A natural union of people, which is combined with another natural union, cannot be named so. On the contrary, the given word is the evidence of the existence of something, which later was artificially divided into three parts[97]. L. Morgan writes, "A people under gentile institutions do not divide themselves into symmetrical divisions and subdivisions"[98]. In our case, the residents of subordinate kinship communities and curiae were forcibly divided by Romulus the Etruscan into three parts (tribes). The unnatural sonorant names – "*Ramnes-Ramni*" meaning "the revered"; "*Tities-Titii*" meaning "the respected"; "*Lucerers*" meaning "the sacred" – was another proof of artificial nature of these parts[99]. It is worth mentioning that the kinship communities, like all other natural gentile alliances, always had names derived from the name of their heroic deity[100]. This is how a new social group – a military-political union of male warriors – was formed.

This method of formation of the Roman community was neither a new thing nor an "invention" of Romulus the Etruscan. This was the way the vast majority of newly emerging communities was formed in those times. According to

[93] *Dionysius of Halicarnassus*, Op.cit. *Morgan L.* Ibid. P. 176.

[94] *Pokrovsky I. A.* Ibid. P. 18.

[95] *Dionysius of Halicarnassus*, Op.cit. *Morgan L.* Ibid. P. 176.*Netushil I. V.* Ibid. P. 27. *Morgan L.* Ibid. P. 161.

[96] *Bartošek M.* Ibid. P. 315; *Mommsen T.* Ibid. P. 42.

[97] *Wägner W.* Ibid. P. 67; *Mommsen T.* Ibid. P. 66.

[98] *Morgan L.* Ibid. P. 138-139.

[99] For translation, see *Netushil I. V.* Ibid. P. 27.

[100] See e.g., *Maine H.* Lectures on the Early History of Institutions / trans. from English by A. P. Nakhimov, London, 1874; *Mommsen T.* Ibid. P. 35; *Kulakovsky Yu. A.* Ibid. PP. 31, 107.

F. Coulanges: “When some leader went out of the city, which had already been established, and had the purpose to establish another city, he usually took a small number of his fellow citizens with him, and joined many other people, who came to him from different places and might have belonged to different nations, thereto. However, this leader established a new state following the model of the state he had just left. Therefore, he divided his people into tribes and phratries. Each of these small social groups had their own altar, their own festivals and sacrifices; each of them invented some ancient hero to worship as their cult, and eventually this group came to believe into their descent from such a hero”[101].

Afterwards, a legend was created in order to conceal the obvious anti-social and inhumane nature of a new ancient Roman community. According to this legend, three neighbouring tribes-communities[102] (without robbers) were combined into a new Roman civil community[103]. Later, as the legend states[104], the Latins stole the Sabine women for themselves and made them their wives[105], since during continuous wars it was only possible to take wives from the neighbouring kinship communities by means of stealing them[106].

Analysing the ancient history of kinship communities of the Italian Peninsula in the times of the foundation of Rome, as we know it, we find these communities in the state of permanent wars[107]. While specifying names for the periods of the formation of the Roman State, the historians point therein directly to the essence of its initial period. Thus, the regal period of Ancient Rome had a second name – the period of military democracy[108]. I. Pukhan writes, “Since the period of military democracy . . . war and the military organization were “principal occupation” of the Romans and the predominant function of the Roman society”[109]. L. Morgan points out, “Under the constitution of Romulus, and the subsequent legislation of Servius Tullius, the government was essentially a military democracy, because the military spirit predominated in the government[110]. Throughout its history, Rome

[101] *Coulanges F.* Ibid. P. 108.

[102] *Bogolepov N.P.* Textbook on the History of Roman Law / 3rd ed., Moscow, 1907. P. 22; *Muromtsev S. A.* Ibid. P. 18.

[103] Real Dictionary of Classical Antiquities according to Friedrich Lübker / ed. by F. Gelbke, F. Zelinsky and L. Georgievsky. Iss. II. Saint Petersburg, 1884. P. 1410; *Mommsen T.* Ibid. P. 41; *Coulanges F.* Ibid. P. 103; *Morgan L.* Ibid. PP. 61, 173; *Kulakovsky Yu. A.* Ibid. P. 17.

[104] About the implausibility of this legend, see *Coulanges F.* Ibid. P. 313-314;

[105] *Kulakovsky Yu. A.* Ibid. PP. 26, 65, 96; *Eliade M.* Ibid. Par. 162; *Wägner W.* Ibid. P. 38-39.

[106] *McLennan J.F.* Op.cit. *Morgan L.* Ibid. P. VI; *Kovalevsky M. M.* Essay on the Origin and Development of Family and Property / 4th ed. / trans. from French by M. Iolshin. Moscow, 1890. P. 38-39.

[107] *Bogolepov N.P.* Ibid. P. 21; *Coulanges F.* Ibid. P. 247.

[108] *Morgan L.* Ibid. PP. 146, 177, 183.

[109] *Pukhan I., Polenak-Akimovskaya M.* Ibid. PP. 10, 14.

[110] *Morgan L.* Ibid. P. 161.

conducted an incredible number of wars[111]. Wars have become a common, everyday activity of the Romans[112]. The war with the neighbouring communities for the spoils of war was almost permanent[113]. As Gaius, a celebrated Roman jurist, wrote, "To acquire spoils of war is a main purpose of war"[114]. Here let us note that it is spoils of war (in Latin "*peculium castrense*" meaning literally "*camping gear*") that became the first type of property, which could be taken by an individual member of the kinship community (the old rule said that all property acquired by members of the kinship community was owned by the entire community)[115]. In our case, it is in those times of robbers, when a custom appeared, according to which the property, obtained during robberies and banditries, is considered the personal property of a robber, and not of their kin.

In those times of international relations the state of war was taken for granted, whereas the state of peace, on the contrary, always results from the agreements achieved[116]. It is for the purposes of a temporary "breathing spell" between the constant warfare that the main all-Latin holiday was established in ancient times. It was named "*indutiae*", which literally means "*truce*" in Latin, and any warfare was prohibited in the period of this holiday[117].

It was war that became the basis for a fundamental change in the entire system of controlling the population of the neighbouring kinship communities and curiae. At the same time, there was a transition from a paramilitary arrangement of this control system to a purely military one. As L. Morgan states, the objects of creation of the Roman community "were essentially military, to gain a supremacy in Italy"[118] and later, "the primary organization of the people into an army with the military spirit" took place[119]. F. F. Zelinsky writes, "Rome prepared and performed its main task of conquering the world by force of arms"[120].

Since the ancient Roman community was established as a military-political social group, there was a change of the general direction of the activities of all adult men: the transition from uncontrolled robberies to professional and lifelong military service took place. T, Mommsen points out, "The most important function of the burgess was his service in the army"[121]. I. V. Netushil tells about the same:

[111] *Mayorova N. G.* The College of Fetiales / Article in the book "Colleges of Pontiffs in Ancient Rome. On the History of Formation of Roman Sacred and Public Law". Moscow, 2001. P. 151.

[112] *Mayak I. L.* Rome of the First Kings: Genesis of the Roman Polis. Moscow, 1983. P. 197.

[113] *Muromtsev S. A.* Ibid. P. 29-31.

[114] Op. cit. *Muromtsev S.A.* Ibid. P. 30.

[115] *Kovalevsky M.M.* Ibid. P. 101.

[116] *Jhering R.* Ibid. P. 194.

[117] *Mommsen T.* Ibid. P. 39.

[118] *Morgan L.* Ibid. P. 161.

[119] *Morgan L.* Ibid. P. 194.

[120] *Zelinsky F. F.* Ibid. P. 381.

[121] *Mommsen T.* Ibid. P. 69.

"And indeed, it is the organization of military affairs that all the data about the state system of the Ancient Rome, are closely related to"[122]. L. Morgan confirms that all the bodies of power of the Ancient Rome were initially adapted for military purposes"[123]. S. A. Muromtsev in his study notes, "The military authority was a source of other public authorities"[124]. L. L. Kofanov writes about this fact, "Public gatherings are gatherings of the army. They are convened by a commander (sometimes public gatherings are called "*comitia calata*" (derived from Latin "*calare*" – "*to convene*"). Only the citizens who are part of the army can take part in those gatherings. Pubes, an adult, is a person who can handle arms"[125]. S. A. Muromtsev notes, "The citizen's political rights and duties were determined by their position as a warrior"[126].

The supreme authority of the Ancient Rome provided a professional employment for the adult male population engaging them in permanent military service from 18 to 60 years of age, and a paramilitary way of life for all the other people of the civil community. T. Mommsen points out, "It is evident at a glance that this whole institution (*of the authorities – author's note*) was from the outset of a military nature"[127]. L. Morgan confirms that "In its main features the new organization (*the Roman community – author's note*) was a masterpiece of wisdom for military purposes. It soon carried them entirely beyond the remaining Italian tribes, and ultimately into supremacy over the entire peninsula"[128].

The ancient Latin words and phrases denoting names, addresses, and positions, which were used by the Romans, are a proof of the fact that the new Roman community was totally military-oriented, The address of any official to the citizens of Rome would begin with the word "*Quirites*" meaning "w*arriors bearing spears*" (the Latin word "*quirites*" means "*spear carrier*"). Only warriors were full-fledged members of the Roman community and participated in its general gatherings. The word "*citizenship*" itself originally meant "*army*". The word "*populus*" (citizenship) is derived from the word "*populari*" meaning "*to lay waste*" in ancient Latin[129]. Thus, if we translate the phrase "*Populus Romanus Quiritium*" literally, it means young Roman spear bearers laying waste to houses and storages of strangers. The words "*population*" and "*army*" are synonyms[130]. An offended member of the community appealed to all citizens of Rome with the same word "*Quirites*" to protect their rights. The solemn announcement of the

[122] *Netushil I. V.* Ibid. P. 45.
[123] *Morgan L.* Ibid. P. 180.
[124] *Muromtsev S. A.* Ibid. P. 31.
[125] *Efimov V. V.* Ibid. P. 154.
[126] *Muromtsev S. A.* Ibid. P. 30.
[127] *Mommsen T.* Ibid. P. 93.
[128] *Morgan L.* Ibid. P. 161.
[129] *Mommsen T.* Ibid. P. 69.
[130] *Efimov V. V.* Ibid. P. 154-155.

funeral of a citizen of Rome ran in the words "*this warrior has departed in death*" ("*ollus quiris leto datus*" in Latin). When the Roman king sat in judgement, he always said that he gave sentence "according to the law of the warrior-freemen"[131]. All "ancient republican magistracies (that is: consulate, tyranny, tribunate of the plebs, military tribunate consulari potestate) were derived from the "senior" ranks (*magistri*) of military service"[132].

Thus, having analysed the emergence of the ancient Roman community, and knowing the subsequent history of the Roman Republic, we have to admit that the Roman nation and the Roman community became the most powerful in the world in that period due to several factors. These are: primary survival difficulties, constant struggle for resources, initial organization of the military affairs, and after that the creation of the robber unions of male warriors not burdened with moral and religious restrictions and aimed only at the invasion of foreign territories and resources. The same method of creating the state union of male warriors helped to create the USA, where the community of armed men, not burdened with moral and religious restrictions with regard to local population, used brute force and deception to capture resources and territories of indigenous peoples of the North America, thus creating a powerful military-political union of men. In today's world, we can find such male unions, for example, in the Middle Eastern and Caucasian nations. Such nations, although having official governmental agencies and bodies, are actually controlled by a powerful clan of male warriors, who had seized power in the country, or within a particular territory.

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[131] *Mommsen T.* Ibid. P. 69-70.

[132] *Netushil I. V.* Ibid. P. 45.

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Zapin Siak 舞蹈的意识形态和内容基础
IDEOLOGICAL AND CONTENT-BASED FOUNDATIONS OF THE DANCE ZAPIN SIAK

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抽象的。　　在本文中，作者探讨了代表廖内省传统文化的古代舞蹈“Zapin Siak”的实质和思想基础。　本文分析了舞蹈的结构，探讨了舞蹈的哲学、其社会和教育功能，这对于维护当地居民的精神理想具有重要意义。

关键词：印度尼西亚、舞蹈文化、意识形态、zapin siak、舞蹈“Zapin Siak”的哲学。

Abstract. *In this article, the author explores the substantive and ideological basis of the ancient dance “Zapin Siak,” representing the traditional culture of the provincial district of Riau. The article analyzes the structure of the dance and examines the philosophy of the dance, its social and educational functions, which are of significant importance in preserving the spiritual ideals of the local population.*

Keywords: *Indonesia, dance culture, ideologi, zapin siak, philosophy of the dance “Zapin Siak.”*

Introduction: Siak Sri Indrapura is one of the Indonesian districts in the Riau province, where in 1889, the magnificent palace named Istana Asserayah Hasimiah was built in the city of Siak (also known as the Siak Palace). Over time, some historical monuments have been preserved, including the unique heritage of the Siak Kingdom, namely, the Siak Palace, the mausoleums of Sultan Syarif Kasim, Koto Tinggi, Raja Kecik, and others. The Siak Kingdom is a national and historical heritage carefully preserved and supported by the residents of Siak, encompassing various forms of art, with the dance “Zapin Siak” (hereafter “Zapin”) holding a special place.

In our view, the examination and justification of the philosophy of the “Zapin” dance are necessary for the preservation of multicultural folklore.

Research methods include:

– Empirical method (data collection, synthesis, and analysis of sources within the researched problem);
– Artistic analysis of the philosophy of the "Zapin Siak" dance;
– Theoretical method (analysis of scientific works on dance culture in Indonesia and the dance "Zapin Siak").

Literature review: The study incorporates and utilizes works from the following authors:

1. Izadri, in his dissertation on "The Significance of Zapin Siak Dance Movements in the Village of Rempak, Siak District, Siak Sri Indrapura District, Riau Province," examined the ideological and substantive basis of the "Zapin" dance movements [Izadri, 2020].
2. Muhyidi Kurnia, in his book "Existence and Revival of Art," presented a philosophical analysis of Islamic civilization and the contribution of Muslims to the development of religion.

Research results: The aim of the research is to justify the philosophy of the "Zapin Siak" dance.

Main Part: Zapin is an art form recognized by the local population, existing and evolving in the archipelago as it is a legacy of the past that has influenced social life. As mentioned earlier, the authenticity of Zapin is inseparably linked to the process of Islamization of the archipelago. One of the countries that Arabs entered through marriage was Siak when the fourth Sultan of Siak, Sultan Alamudin Shah, married into an Arab family [Ditwb, 2019]. The dance "Zapin" is one of the traditional Malay dances derived from the Arabic word "Zaffan" - "dancer" and "alzafin" - leg movements. It is noteworthy that the emergence of "Zapin" in Indonesia is associated with the process of Islamization carried out by Arab traders. Indonesia, as a spice producer, attracted traders who influenced the spread of Islam in the country, including the territory of the Siak Kingdom (Cultural Heritage and Diplomacy Office, 2019).

Despite initially serving as entertainment in palace environments, Zapin gradually began to be performed in wider circles, used as a means to convey customs and teachings of the religion (Islam). Therefore, "Zapin" served not just as entertainment but carried educational intentions and was used as an active means of Islamic propaganda, through movements, accessories, poetic forms, and songs accompanying the dance.

Thus, each movement of the "Zapin" dance has its own meaning and philosophical-religious significance connected to the social life of the region and Islamic canons. It's not surprising that each poetic form, song, and rhythmic pattern of the "Zapin" dance is infused with religious content and carries the cultural and spiritual values of the region. The dance demonstrates fast foot movements in ac-

cordance with the drum rhythm (marwas), accompanied by verses full of instructions. An interesting fact is that until 1960, “Zapin” was performed only by male dancers. However, later on, and even now, Malay female dancers perform “Zapin” while maintaining modest attire and covering the aur [Nizar, 2023].

The “Zapin” dance is initially performed by two male dancers in parallel and synchronously. This is because, in society, it was forbidden for women to interact with non-mahram men. The synchronous dance pose symbolizes equality of status: sit equally low, stand equally high. Zapin dancers begin the dance by greeting each other face to face, with musicians, or with respected people at the gathering. Zapin dancers adhere to specific rules. Firstly, the dance starts with a greeting or introductory bow. Secondly, it is followed by the open “Zapin” dance, beginning with the “Alif” open dance. Thirdly, the conclusion of the performance should be closed with a tahtai or tahtum.

Characteristic features of the “Zapin Siak” dance include steps 1-8, known as ordinary or basic steps. The dance begins with these steps, followed by:

1. Ragam Alif (to start the dance) - a step forward and backward (to and fro) until the eighth beat. This movement resembles the letter “Alif” in the Quran, a straight vertical line upwards. Ragam Alif signifies that a person should walk straight on the path favored by Allah. When a person deviates from Allah’s commandments, their life cannot be saved in this world. This ragam is used as an introductory dance for Zapin, presented at regular events rather than official occasions such as meetings with honored guests, dances before the sultan or king, and weddings.

2. Ragam Alif Sembah - standing straight like the letter “Alif,” in a squatting position signifies the beginning, respect, and reverence. This ragam means that everything starting with a good beginning should be accompanied by the blessing of the Almighty, and the best way to proceed is with intention and prayer to Allah so that what is done receives blessings and gifts from Allah.

3. Ragam Titi Batang: This ragam signifies resilience and the ability to manage patience. In life, a person must have resilience and patience in facing challenges and trials to ensure that what they desire can be realized successfully.

4. Ragam Pusing Tengah: This ragam carries the meaning of caring for the environment. As social beings, humans live and evolve alongside other people and living beings, necessitating care for others, especially those in need of assistance. Individuals also have personal problems that need to be addressed collectively, so as social beings, people are obligated to help one another.

5. Ragam Sut: Signifying justice and patience, patience is essential for a person to live life because, at times, they may not control their emotions. Similarly, justice is necessary for a person to achieve fairness in determining what is right and wrong, although these qualities are often underutilized for specific purposes.

6. Ragam Sut Depan: This ragam has the same meaning as Ragam Sut, representing justice and patience. In everyday life, individuals may often "listen" to their hearts to achieve a particular goal without using reason for a fair decision or patience in problem-solving. Therefore, emphasizing patience and justice in daily life is important.

7. Ragam Sut Maju Mundur: Still signifying justice and patience like the two previous Ragams Sut, this ragam emphasizes the significance of justice and patience in balance. It suggests the need to find a balance between excess and lack of justice and patience; as humans, we must be able to weigh everything to create a balance in justice and patience.

8. Ragam Siku Keluang: Depicting clear and decisive movements of the elbows, this ragam symbolizes strength in life, clarity, and firmness in behavior. This ragam resembles the dynamics of life, sometimes happy but at other times sad. Life is like a circle that revolves.

9. Ragam Siku Keluang Sembah: This signifies that a person must go through the dynamics of life on the path of Allah. In the dynamics of life, a person may sometimes perceive Allah as unjust or blame others, causing them to forget about Allah, the creator of everything. A person must stay on the path of Allah to be saved in this life and the hereafter.

10. Ragam Menyambar: Signifying determination and resilience, as a leader on Earth, a person must have a decisive and strong attitude toward life. Determination is crucial for control and order in social life. Resilience is needed to achieve the desired, of course, positively blessed by Allah.

11. Ragam Mata Angin or Pecah Lapan signifies mastery of the eight cardinal directions, representing all aspects of life. As humans, we must be able to master and cope with various life challenges. Therefore, mastery of all aspects of life is crucial for individuals to effectively and correctly solve different problems.

12. Ragam Pecah Lapan Sut: This ragam signifies mastery of the eight cardinal directions accompanied by justice and patience. Justice and patience are necessary for controlling life's challenges, and these qualities are key to success in problem-solving.

13. Ragam Anak Ayam Patah Kaki: This ragam signifies that a person should possess traits such as never giving up, high discipline, adherence to principles, and honesty. This philosophy is derived from the idea of a chicken that continues to walk even with broken legs. The aesthetics lie in being beautiful in one's thoughts and intentions, as well as having a strong will for motivation towards a purposeful life.

14. Ragam Minta Tahto (or Tahtim): Symbolizing that when a dancer gets tired, they make a gesture to take a break, and the musicians understand this, then they signal for the dancer to stop. The sign to stop the Zapin dance is performed

with a triple bow and signifies the final expression of respect. The meaning of Ragam Minta Tahto lies in being humble and respecting each other. These two qualities are necessary in a person's life as a social individual to avoid arrogance and a sense of self-righteousness, which can lead to life not being blessed by Allah (Kurnia M, 2016: 59; Izadri, 2020: 48-75; Cultural Heritage and Diplomacy Office, 2019).

Thus, the traditional dance "Zapin Siak" is a symbolic icon of the cultural heritage and spiritual development of the provincial society of Riau, an integral part of Indonesia. The ideals and spiritual values of society, historical examples of religious education – all are undoubtedly important in the life of modern individuals, calling for goodness, faith, peace, and harmony.

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年轻人的就业能力和创业问题：解决方案还是乌托邦？
EMPLOYABILITY OF YOUNG PEOPLE AND THE QUESTION OF ENTREPRENEURSHIP: SOLUTION OR UTOPIA?

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抽象的。 青年就业危机是非洲的现实，有大量受过教育的青年失业。 这项研究工作旨在找出非洲失业的真正原因以及企业家精神在对抗这一现象方面的贡献。 这项研究工作的结果是通过特定的方法得出的。 该方法基于通过社交媒体（主要是 Whatsapp 论坛）向一些非洲人进行一些调查问卷。 从向人们发出的调查问卷中，我们完成了一百三十三 (133) 份调查问卷。 这些调查问卷的答复来自不同的非洲国家。 然后，根据主题的来源，通过直接电话或 WhatsApp 电话对五十二 (52) 人进行采访。

从问卷调查数据来看，60.30%的受访者认为就业状况较差，38.20%的受访者认为就业状况尚可。 此外，1.50%的人认为自己国家的情况良好。 应该指出的是，文凭、创业精神、技能和关系等某些因素有助于在非洲大陆找到工作。 在这个层面上，32.4%的受访者坚持认为知识/关系在获得工作中发挥着主导作用，30.9%

的受访者更认为创业精神，而19.10%的受访者认为拥有必要的技能是必要的。 最后，17.6%的受访者更看重所获得文凭的质量。 此外，94.10%的受访者坚持认为，创业是应对非洲大陆面临的就业危机、应对日益严重的移民危机的最佳方案。 但值得注意的是，剩下的 5.90% 认为政府应该为年轻人和女性创造就业机会，无论他们的培训质量如何。

尽管创业被视为一种解决方案，但它也面临着一些挑战，例如经济机会不足、竞争、合格劳动力不足、金融机构不愿支持某些项目、缺乏国家补贴、政治服从、物价波动等。 市场上的商品在新冠肺炎、经典战争、恐怖主义或军事政变等祸害之后。

关键词：就业能力、创业精神、青年、失业。

Abstract. *The crisis of youth employment is a reality in Africa with a large scale of young unemployed educated people. This research work aims at finding out the real causes of unemployment in Africa and the contribution of entrepreneurship in fighting against this phenomenon. The findings of this research work are got through a peticuliar methodology. This methodology is based on addressing some questionnaires to some african people through social medias mainly whatsapp forums. From questionnaires addressed to people, one hundred and thirty-three (133) questionnaires were completed. The responses from these questionnaires are from different African countries. Then, fifty-two (52) people were called by direct telephone call or WhatsApp calls depending on the origin of the subject for an interview.*

From the datas collected from the administered questionnaires, it appears that 60.30% of respondents believe that the employability situation is bad while 38.20% think it is acceptable. Furthermore, 1.50% maintain that the situation is good in their countries. It should be noted that certain factors such as diploma, entrepreneurship, skills and relationships contribute to obtaining a job on the African continent. At this level, 32.4% of respondents insist that knowledge/relationships play a preponderant role in obtaining a job, 30.9% think more of entrepreneurship while 19.10% maintain that it is necessary have the necessary skills. Finally, 17.6% of respondents place more emphasis on the quality of the diploma obtained. Besides, 94.10% of those surveyed insist that entrepreneurship is the best solution to handle with the employment crisis faced by the African continent to combat the ever-increasing migration crisis. Let's note, however, that the remaining 5.90% think that it is up to the government to create jobs for young people and women regardless of the quality of their training.

Despite being considered as a solution, the entrepreneurship also embodies some challenges such as insufficient economic opportunities, competition, insufficient qualified labor, the reluctance of financial institutions to support certain projects, the lack of State subsidies, political obedience, the fluctuation in the price of goods on the market following scourges such as Covid19, classic war, terrorism, or military coup.

Keywords : *employability, entrepreneurship, youth, unemployment.*

Introduction

The issue of employability of young people today constitutes a major challenge for all countries around the world, particularly African countries. The majority of young Africans who have completed their university education are unemployed. According to the International Labor Organization (ILO), seventy-three (73) million young people in 2022 compared to seventy-five (75) million in 2021 are unemployed across the world. This situation is more alarming on the African continent with a youth unemployment rate of 12.7%. However, during the Covid19 pandemic, many young people no longer applied on the job market. In West Africa, the unemployment rate is 16% and, moreover, underemployment is estimated at 72% according to the Economic Commission for Africa (ECA). These rates have increased recently with the advent of terrorism in the Sahel.

Also, it should be mentioned that one of the major assets of the demographic structure of many countries as a whole remains the young nature of its population. This constitutes an asset to the extent that youth is the obvious sign of the vitality, strength and capacity of a country to face the future with optimism and serenity for economic growth. Thus, the employment of young people leads on the one hand, to the improvement of production and on the other hand, to the increase in consumption resulting from the distribution of income due to access to employment and subsequently the improvement of living conditions.

Furthermore, several factors are listed to explain this phenomenon. Among these factors, there is the inadequacy of training and the requirements of the job offer, the lack of a clear and sustainable policy for the professional integration of young people, the economic crisis of the countries, poverty, insecurity and poorly developed areas of industry and agriculture.

In addition to these factors, unemployment among young Africans is also dependent on the failure of African education systems. This state of affairs calls into question the real motivation of leaders regarding the education model put in place for the socio-professional integration of young people. At the World Conference on Education for All (EFA) in Jomtien from March 5 to 9, 1990, the resolution did not focus on elementary education as such but rather on basic educational needs. Thus, according to the Jomtien declaration: “These needs concern essential learning tools such as literacy and oral expression, but also problem solving and elementary education composed in its content of elements such as knowledge , the skills, values and attitudes required for people to survive, develop all their faculties, live and work with dignity, participate fully in development, improve the quality of their lives, make informed decisions and continue to learn.’’

This conference had the vision of producing new citizens meeting the demands of the modern world for more successful professional integration. In order to highlight the strong interactions between training, the economy and employment, Chirache (2014, p. 86) emphasizes that “the training-employment relationship is part

of the game of interactions between education, the economy and employment. The links between education and the economy work both ways. This is true for growth, employment and wages but also the level of training." From this statement, we can deduce that training conditions the employment that an individual exercises and this in combination with the education received.

Faced with this thorny situation, many experts maintain that entrepreneurship is the best option to boost the employability of African youth. It is on the strength of this that Sylvain DJAGBO (2023), young entrepreneur and specialist in entrepreneurship, during a scientific conference at the University of Abomey-Calavi (UAC), Benin stipulates that "the safest path for young people, particularly those from vulnerable groups, is entrepreneurship because it requires neither a diploma, nor knowledge nor membership of a political allegiance.

Approaching in the same direction, the African Union (AU) insists that entrepreneurship, without being able to solve all the problems of young people, appears to be a lasting solution to the employment crisis in Africa. Thus, entrepreneurship constitutes a promising avenue for alleviating the phenomenon of unemployment on the continent.

In the quest for appropriate perspectives in the face of this scourge which is undermining the African continent, our reflection focuses on the question: The employability of young people in Africa and the question of entrepreneurship: solution or utopia?

An adequate response to this question requires a careful and chronological examination of its points: the contextualization and justification of the problem, the methodological approach, the presentation on the employability of young people in Africa, entrepreneurship as a solution and the limits of entrepreneurship.

1. Context and justification of the problem

The issue of youth employment crisis is an absolute reality in Africa. This phenomenon gives rise to several unsavory situations, notably migration to the Mediterranean, cybercrime and prostitution. Worse, the instability of social security with the resurgence of terrorism in the Sahel consequently contributes to the employability crisis of young people.

Globally, following the Covid-19 crisis, the International Labor Organization (ILO, 2022) noted that thirty-four (34) million jobs were lost following the 2019-2020 restrictions; nearly four (4) million additional unemployed in 2020. Also, 8.2% of young people lost their jobs due to inexperience while that of adults was lower and nineteen (19) million jobs to fill for young people in 2022. Finally, seventy-three (73) million in 2022-2023 is the number of young unemployed globally, or six (6) million more than in 2019.

At the African level, the current population of the continent is 1.2 billion and is ¼ of that of the world and will double by 2050 according to Busan 2018 of the

African Development Bank (AfDB). Of this demographic, young people represent four hundred and twenty (420) million inhabitants and those aged 15-35 will increase to 820 million by 2050. Each year 10 to 20 million of these young people are added to the market. 'job. Unfortunately, only three (3) million formal jobs are created annually, which leaves a large employability gap to fill. Better still, 35% of young women have neither employment nor educational or professional training compared to 20% of men. Furthermore, from 2000-2015 in the face of unemployment, 14% of migrants were young Africans with 2.7% migrants annually.

These various data sufficiently prove the alarming observation made on the employability situation of young people in Africa. This phenomenon is causing thousands of young Africans to lose themselves in the Mediterranean, to drugs, alcohol or idleness. Being the compass of a country's economy through labor, production and its capacity for leadership and creativity, African youth die daily or strengthen other continents through migration to Europe, Asia, the Middle East or America. This state of affairs keeps Africa in certain underdevelopment.

Faced with this situation, the appropriate solution is the promotion of entrepreneurship. Indeed, entrepreneurship is the most proven path for a young person, whether they have a diploma or not, to find a job. Obviously this is not without certain twists and turns, however it deserves to be promoted. It is for this reason that certain African governments are implementing a national employability policy based on entrepreneurship through professional training, information and awareness programs/projects for young people. So let's have a glinse on the different actions of certain countries under implementation mainly :

In Burkina-Faso, there are structures such as the Fund for the Promotion of Industry (FPI), the Support Fund for the Informal Sector (FASI), the Support Fund for Youth Initiatives (FAIJ), the Employment Promotion Fund (FAPE) and the Vocational Training and Apprenticeship Support Fund (FAFPA).

In Benin, there is the National Employment Promotion Agency (ANPE), the National Microfinance Fund (FNM), the Entrepreneurship Development Center, Alafia Credit Project, Investment Promotion Agency and exports (APIEX) and the National Fund for the Promotion of Enterprise and Youth Employment (FNPEEJ).

In Cameroon, we have the Ministry of Employment and Vocational Training (MINEFOP) and the Ministry of Youth and Civic Education (MINJEC). Also, there is the National Employment Fund (FNE) and the National Action Plan for Youth Employment (Panej).

In the Democratic Republic of Congo (DRC), there is the Ministry of Youth, New Citizenship and National Cohesion (MJNCCN), the Ministry of Employment, Labor and Social Welfare (METPS), the Special Fund for Promotion, the entrepreneurship and youth employment (FSPEEJ), the National Employability and Apprenticeship Support Fund (FONEA) and the Social Fund (FS).

Apart from these state structures, other private structures such as NGOs and microfinance structures truly support young people's projects. For the case of Benin, this is UNICEF, Plan International Bénin, Care International, GIZ, the agency for the promotion and support of small and medium-sized enterprises (PAPME), the promotion and support for development of micro-enterprises (PADME)… also; in Burkina we have NGOs, GIZ, chambers of commerce, the agency for the promotion and support of small and medium-sized enterprises (PAPME) and programs/projects developed by the Ministry of Youth and Employment .

To elucidate these different actions undertaken by state and non-state actors in these countries, it will be wise to develop collection tools. Thus, the tools must be well informed, giving reliability to the content of the article. Achieving the objectives of this article cannot be done without an adequate data collection methodology.

2. Methodological approach

This article aims at analyzing the contribution of youth entrepreneurship in the fight against unemployment in Africa. The nature of this research is mixed qualitative and quantitative.

To carry out this work, an online questionnaire through Google Doc Form was designed and submitted through digital communication channels including WhatsApp forums and for others privately. Also, interview questions were sent to certain people to get their opinions on the issue. This is the case for administrative authorities, business leaders and heads of professional training workshops. The option of social networks allowed us to collect information across certain African countries with the sole aim of understanding the employment situation. It should be noted that no particulars were made regarding the target population.

From questionnaires administered, One hundred and thirty-three (133) questionnaires were completed. The responses from these questionnaires come from different African countries. Then, fifty-two (52) people were called by direct telephone call or WhatsApp calls depending on the origin of the subject for an interview.

For data processing, the Google Drive application gradually generated the results based on the form completion. At the end, these results were transferred to Word and Excel software for the design of tables and graphs. This allows for data analysis and related discussions.

3. The employability of young people in Africa

a. Presentation of the situation and the challenges faced by young people in terms of employment

The situation of youth employability in Africa is very worrying. From the responses from the administered questionnaires, it appears that 60.30% of respondents believe that the employability situation is bad while 38.20% think it is acceptable. Furthermore, 1.50% maintain that the situation is good in their countries.

It should be noted that certain factors such as diploma, entrepreneurship, skills and relationships contribute to obtaining a job on the African continent. At this level, 32.4% of respondents insist that knowledge/relationships play a preponderant role in obtaining a job, 30.9% think more of entrepreneurship while 19.10% maintain that it is necessary have the necessary skills. Finally, 17.6% of respondents place more emphasis on the quality of the diploma obtained.

Addressing the question of job quality, 48.50% of those interviewed are in a situation of underemployment compared to 33.80% who are unemployed. However, 13.20% of the sample are in a situation of temporary decent employment and the remaining 4.60% have permanent decent employment.

These jobs come from different employers, in this case central State structures, NGOs, private companies and self-employment. Thus, 36.80% of respondents had their jobs in the State while 27.90% created their own jobs. Furthermore, 19.10% of those interviewed are employed by private companies and 16.20% employed by non-governmental organizations (NGOs). These data prove that the central State remains the main provider of employment followed by self-employment. Also, despite the efforts of the State, the youth employment situation still remains critical.

Over the last five (05) years, the integration rate of young people and women has not experienced a considerable increase. At this level, 32.40% of respondents emphasize that the integration rate of young people and women is insufficient compared to 30.90% who prove that it is bad. However, 32.40% and 04.40% of respondents respectively maintain that the integration rate of young people and women is acceptable and good.

These various data clearly expose the face of the issue of youth employability on the African continent in general. Certain factors contribute to limiting the employability of young people.

b. Analysis of factors limiting the employability of young people

The increase in the unemployment rate among African youth is dependent on certain factors. Among these factors, we can mention the quality of training in relation to employability requirements, the economic situation of the countries, poor management of the country's resources, corruption, nepotism, the non-existence of a industrialization policy, the policy of outstretched hands, the lack of leaders of the people.

Many young people leave universities and vocational training centers each year whose automatic employability suffers from a lack of skills. This observation certainly calls into question the quality of curricula in the face of the demands of modern jobs, particularly with the use of ICTs. Also, the economic gloom of most nations despite the availability of natural resources calls into question the quality of management of the country through bilateral and multilateral agreements. In

addition, nepotism and corruption are the greatest scourges that plague job creation because most resources are diverted for personal purposes.

The fight against unemployment requires vigorous actions such as the promotion of entrepreneurship through sport, industry, agriculture, the adaptation of training curricula, the review of employability policies and the creation of jobs by the governement in line with the requirements of the job market. Thus, 83.80% of those questioned believe that it is very urgent to review training programs according to job offers. In addition, 79.40% think that we must simply promote entrepreneurship through the development of agriculture, industries, sport and ICTs.

4. Entrepreneurship as a solution

a. Presentation of the benefits of entrepreneurship for young Africans

In a continent where employment is rare, self-employment through entrepreneurship is the fit solution to cope with this situation which is a real phenomenon for young african people. Indeed, entrepreneurship contributes to the blossoming of the spirit of creativity, innovation, power management, job creation, self-management, financial autonomy, taking risks, contributing to the economic growth of the nation and eradicating unemployment.

For this question, 94.10% of those surveyed insist that entrepreneurship is the best solution to stem the employment crisis facing the African continent to combat the ever-increasing migration crisis. Note, however, that the remaining 5.90% think that it is up to the government to create jobs for young people and women regardless of the quality of their training.

In reality, entrepreneurship is the only one in terms of employability to considerably reduce the disparities observed between people from vulnerable families and those from wealthy families. Here, the factor of human relations or knowledge cannot be asserted even if it could be felt at a certain level.

b. Analysis of initiatives and policies promoting youth entrepreneurship

Governments are aware of their difficulty in satisfying all their populations in terms of employment, despite initiatives and policies promoting entrepreneurship among young people. These policies aim to create a prosperous entrepreneurial environment to enhance the potential of young people given the rise of technology and the business world. As a result, the actions implemented in certain countries are as follows:

In Benin, the National Employment Agency (ANPE), the National Microfinance Fund (FNM) and the National Fund for Youth Employment and Entrepreneurship (FNPEEJ) have been created and actions are also being developed. Better still, the Beninese state has opened a textile factory and processing raw materials such as cashew nuts, pineapples and soybeans where nearly two thousand (2,000) young people have already been recruited to work through the Glo- Djigbé Industrial Zone (GDIZ). Also, the Beninese State recently launched vocational training

for five thousand (5,000) young people in the professions of sewing, welding, mechanics, carpentry, plumbing, glazing, agriculture, fish farming, poultry farming, etc.

In Burkina Faso, the National Employment Agency (ANPE), microfinance (FAPE, FARFE). The Project to Support Youth Employment and Skills Development in Rural Areas (PADEJ-MR) which was designed to manage the issue of integrating young people into the world of work. Just like in other countries, great initiatives have been carried out.

5. The limits of entrepreneurship as a solution

a. Presentation of the constraints and obstacles encountered by young entrepreneurs

Entrepreneurship, in addition to its advantages, is full of difficulties that young entrepreneurs face. It's a game full of pitfalls that requires the skills of perseverance, training, a flair for anticipation and a taste for risk.

Difficulties encountered include insufficient economic opportunities, competition, insufficient qualified labor, the reluctance of financial institutions to support certain projects, the lack of State subsidies, political obedience, the fluctuation in the price of goods on the market following scourges such as Covid19, classic war, terrorism, or coup d'état. From the opinions collected on this question, it appears respectively that 72.10% and 63.20% of the people surveyed argue that the lack of state subsidies and the lack of economic opportunities are the real obstacles encountered by young people. Furthermore, 51.50%, 45.60% and 42.60% of respondents cite respectively the reluctance of microfinance institutions, the insufficiency of qualified labor and above all competition in the market.

In addition to these aforementioned obstacles, there are other factors that constitute limitations for youth entrepreneurship. These factors are essentially tax burdens, the inadequacy of academic training and the requirements of entrepreneurship, the insufficiency of capacity building, the insufficiency of support policies and the impact of technology or its lack of mastery.

b. Analysis of risks and possible failures in the field of entrepreneurship

Entrepreneurship is not a guarantee of absolute success. Certain elements constitute potential risks and failures in entrepreneurship. As risk factors, respondents listed insecurity with the advent of terrorism, institutional change with coups or elections, climate change, soaring product prices, lack of raw materials, energy, water, illiteracy and cybercrime.

Among these factors, insecurity, cybercrime, climate change and institutional change seriously affect the entrepreneurial capacities of young entrepreneurs.

To alleviate certain situations, governments are called upon to take relevant measures to strengthen the capacities of young entrepreneurs, technical and financial support for start-ups, tax incentives, security resilience and training of young

people on the use of technologies, in this case social networks, to boost their purchases and sales strategy.

Conclusion

The employment crisis is a reality in Africa. This scourge is causing brains to flee from the continent to other continents. The development of Africa undoubtedly requires the maintenance of these scholars in different countries. This can only be achieved through a good policy for the management of human and natural resources and the redistribution of the continent's wealth. Also, youth must occupy a priority place in all policies. Failing to employ all young people and women who are qualified or able to work, the promotion of entrepreneurship through a flexible and monitoring mechanism is fundamental.

However, the various curricula currently implemented in training programs require a total overhaul to train citizens who meet the standards of today's job market requirements. Also, technologies and the application of technological tools are essential in the training of young people. Better, the promotion of life skills training schools through installation kits should be encouraged for better integration of young people.

Indeed, in view of the data collected, it is urgent to find solutions to certain phenomenons such as insecurity, cybercrime, climate change, the change in institutions which undermine the efforts of certain young people who take the significant risk of undertaking. Also, when States are going to suffocate young entrepreneurs with conditions of unsustainable tax burdens or these young people are going to lack advisory and financial support from their States, the question of entrepreneurship will obviously be a utopia with an unemployment rate that is too galloping. .

In view of the economic capacities and the level of development of the majority of African countries, entrepreneurship is undoubtedly the ideal solution to stem the rate of unemployment and especially underemployment, the rate of which is higher than that of unemployment. To do this, initiatives and policies to support young people in entrepreneurship must be strengthened for the good of all in order to avoid utopia.

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通过应用生物炭修复受扰动的土壤
RECLAMATION OF DISTURBED SOILS THROUGH THE APPLICATION OF BIOCHAR

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Degraded soils, such as urban soils, have reduced sequestration potential, which can lead to increased emissions of greenhouse gases [1]. According to GOST No. 17.5.3.04-83 "Nature Conservation. Earth. General requirements for land reclamation," specific methods for restoring soil cover are determined depending on the cause of soil degradation. The simplest way to restore the humus horizon of urban soils is by planting vegetation or laying down a ready-made grass lawn. However, the effectiveness of such a method depends on the overall soil preparation quality. One of the common causes of degradation is the compaction of the surface humus horizon, resulting in the destruction of soil structure. In soils with a heavy granulometric composition, such as chernozems, the problem of regulating the water-air regime due to compaction is particularly acute. Biochar can be used as an element to improve soil structure. Due to its porous structure and high carbon content, it has shown high efficiency on depleted agricultural lands [2].

The purpose of this study is to analyze the effect of biochar on CO2 emissions from degraded soils (brown soils). The study took place on the campus of the Far Eastern Federal University (Primorsky Territory, Vladivostok). Degraded soils (burozems) disturbed during the construction of the FEFU laboratory building

were selected as the object of study. Biochar from the Krasilov and K Company was used as soil improver from woody remains of birch Betula alba by pyrolysis at a temperature of 360–380^{0}C. The composition, properties and effects of the use of biochar were obtained previously [3, 4].

Biochar was introduced to the experimental sites at a dose of 0 kg/m2 (control), 1 kg/m2, 3 kg/m2. The sites were rectangular plots with a width of 0.75 m and a bottom of 3 m. To increase reliability, biochar was applied in triplicate to three separate experimental sites (there were 9 sites in total).

8 days after the application of biochar, oats were planted to restore the vegetation cover of degraded areas. Carbon dioxide emissions were measured from August to October 2023. Carbon dioxide emissions were measured by the chamber method using a portable gas analyzer Picarro G4301 (Picarro, USA).

To calculate the emission of carbon dioxide, a formula was used for the linear dependence of gas concentration on time. Emission calculation formula:

$$\mathbf{Fgas = \Delta[Gas]\Delta t * V * \rho A} \quad \mathbf{(1),}$$

where Fgas = Linear flow of test gas (CO2) in µmol CO2 m-2 s-1;

Δ[Gas]Δt is the number of gas particles at time t, expressed in µmol mol-1 s-1;

V – total chamber volume, m3;

A – area of the surface under study, m2;

ρ– molar density of air, defined as P/RT, where P is air pressure, Pa;

R – universal gas constant equal to 8.31 Pa*m3*mol-1K-1;

T – air temperature, K.

The reliability of the data was assessed in accordance with the value of the coefficient of determination R2.

The air pressure and temperature required to calculate emissions were determined simultaneously with on-site carbon dioxide measurements using a Vaisala Weather Transmitter WXT520 (Vaisala, Helsinki, Finland).

As the results of this study showed, when using biochar, there was a decrease in carbon dioxide emissions (Fig. 3)

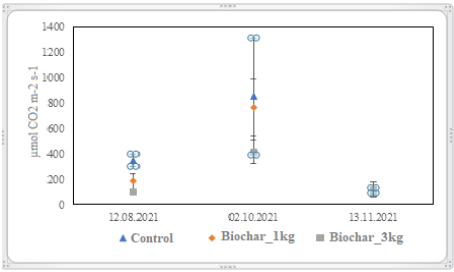

Figure 3. *CO2 flows in the area without the introduction of biochar (Control), with the addition of 1 kg/m2 of biochar (Biochar_1kg) and from 3 kg/m2 (Biochar_3kg) for 2023.*

At the time of measurement on August 12, CO2 emission in the area with the introduction of biochar at a dose of 1 kg/m2 was 184.96 mg CO2 m-2s-1, which is 47.5% less than in the control (352.25 mg CO2 m-2s -1). At the site with a biochar application dose of 3 kg/m2, CO2 emission was 101.76 mg CO2 m-2s-1, which is 71.1% less than in the control. The decrease in emission values in areas with added biochar compared to the control can be associated with several factors: an improvement in the water-air properties of soils, which can be observed in the work of Litvinovich A.V. with co-authors [5]; improving the sequestration potential of sites.

At the time of measurement on October 2, 2023, CO2 emission when adding biochar at a dose of 1 kg/m2 was 763.28 mg CO2 m-2s-1, which is 10.7% less than the control (854.74 mg CO2 m-2s-1). 1). At the site with a biochar application dose of 3 kg/m2, CO2 emission was 415.30 mg CO2 m-2s-1, which is 51.4% less than in the control.

The increase in values in all areas compared to the results for August can be associated with the peak dew stage of previously planted oats, since more than 80 days have passed since planting, which corresponds to the stage of full ripening of oats. However, in our areas a stage of milky ripeness was observed. This can be associated with a mismatch of environmental conditions (temperature, humidity). Despite this, at the time of this growth stage, the oats already have a fully formed root system. It has already been proven that the contribution of root respiration ranges from 5% to 50% of the total carbon dioxide emission [6].

At the time of measurement on November 13, 2023, CO2 emission when adding biochar at a dose of 1 kg/m2 was 128.45 mg CO2 m-2s-1, which is 12.1% more than the control (114.54 mg CO2 m-2s -1). At the site with a biochar application dose of 3 kg/m2, CO2 emission was 99.88 mg CO2 m-2s-1, which is 12.8% less than in the control. Low emission values at all sites compared to previous months can be associated with low temperatures. On average, during the measurements the temperature was 8°C, which is the temperature minimum for most microorganisms [7], which led to a decrease in the respiration of microorganisms.

Based on the data obtained on carbon dioxide fluxes at sites reclaimed with biochar, it can be concluded that the use of biochar has a positive effect on carbon dioxide fluxes. The best result in reducing carbon dioxide emissions was obtained in August at the site with the introduction of biochar at a dose of 3 kg/m2 (71.1%), compared with the control. The smallest reduction in carbon dioxide emissions was obtained in November at the site with the introduction of biochar at a dose of 1 kg/m2 (12.1%) compared to the control. A decrease in carbon dioxide emissions when applying biochar serves as an indicator of an increase in the sequestration potential of the soil. This fact is positive for soil reclamation, since it serves as an indirect indicator of improving soil fertility.

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掺入放射性核素的小剂量电离辐射对鱼血功能活性的影响
EFFECT OF SMALL DOSES OF IONIZING RADIATION FROM INCORPORATED RADIONUCLIDES ON THE FUNCTIONAL ACTIVITY OF FISH BLOOD

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抽象的。 本文介绍了掺入放射性核素的小剂量电离辐射对生活在技术废水影响区的鱼类血细胞功能活动影响的研究结果。

关键词**:** 放射性核素、辐射剂量、血细胞、活性氧（ROS）。

Abstract*. The article presents the results of a study of the effect of small doses of ionizing radiation from incorporated radionuclides on the blood cell functional activity of fish living in the zone of influence of technical effluents.*

Keywords: *radionuclides, radiation dose, blood cells, reactive oxygen species (ROS).*

As a result of the operation of the reactor and radiochemical production at the Mining and Chemical Combine (MCC), which used water from the Yenisei River for cooling, the riverbed became contaminated with technogenic radionuclides [1]. Even after the shutdown of the last MCC reactor in 2010, technogenic radionuclides continue to be detected in the water, sediment, and hydrobionts of the Yenisei River, although their diversity and maximum activity have significantly decreased [2, 3]. During extreme flood situations and large-scale water releases from the Krasnoyarsk Hydroelectric Power Station, the surface layers of floodplain soils may be disturbed, exposing buried layers containing radioactive deposits from past years [4], creating conditions for the entry of radionuclides into the bodies of hydrobionts

The entry of radionuclides into the fish body both through food and adsorption [5] leads to probability of internal exposure in small doses to incorporated radionuclides even with slightly above the background level [1]. At the same time, over time, the formation of the dose rate of internal irradiation of fish moves from short-lived radionucdides 32P, 24Na in 2000-2010 to long-lived 60Co, 137Cs, 239,240Pu in 2011-2019. [1-3].

The impact of low doses of ionizing radiation on the cellular and molecular structures of the body is assessed ambiguously. First of all, ionization of the internal environment is accompanied by the formation of free radicals and reactive oxygen species, which causes various structural changes in cells that persist for a long time after irradiation and lead to changes in the functional activity of cells, and subsequently their systems [6, 7]. For such parameters of the functional activity of the cell as the activity of enzymes: superoxide dismutase, glutathione peroxidase, the rate of formation of superoxide anion radicals, the composition and oxidative activity of lipids, etc., a bimodal dependence on the dose was found: an increase at low doses, a decrease and then an increase again with increasing dose [6] .

The generation of reactive oxygen species (ROS) is a mandatory accompaniment of the activation of normally functioning phagocytic cells – the leading elements of nonspecific resistance and specific immunity [8]. Undoubtedly, the physiologically determined processes of ROS generation by immunocompetent cells, regulated by the activity of the body's pro- and antioxidant systems, are sensitive to the effects of even low concentrations of radionuclides and low doses of ionizing radiation [7, 9]. The consequence of such changes may be a decrease in the body's protective properties or the development of autoimmune inflammatory processes. The kinetics of the ROS generation process in response to antigenic introduction in vitro, recorded by the chemiluminescent method in unfractionated blood, reflects not only the activity of the cascade-activated pro- and antioxidant enzymes of the cell membranes of phagocytic cells, but also the entire set of pro- and antioxidant factors in peripheral blood [9].

Purpose of the work: to evaluate changes in the kinetics of ROS generation by fish blood cells under the influence of low doses of ionizing radiation from incorporated radionuclides in the zone of technogenic influence of the gas chemical complex.

Materials and methods of research. The object of the study was commercial native fish (dace, roach, perch and grayling) of the Yenisei River, living in 2004-2005. in its various parts**:** control zone - 45-80 km upstream of the MCC process water discharge site; 1 - zone of influence of the gas chemical complex in 1-10 km below the point of technical water discharge; 2 - zone of influence of the mining and chemical complex in 15-20 km below the discharge point; 3 - zone of influ-

ence of the gas chemical complex in 35-40 km below the discharge point; 4 - zone of influence of the gas chemical complex in 45-50 km below the discharge point. Blood sampling was carried out by making an incision in the vein of the gill and collecting blood dropwise onto a watch glass moistened with a heparin solution. The functional activity of fish blood cells with and without antigenic stimulation of phagocytosis was assessed by the kinetics of ROS generation [10], registered by the method of luminal enhanced chemiluminescence using the hardware and software complex "Chemiluminometer CL-3604 - PC" [eleven], taking into account its informative parameters: the amplitude of the maximum activity of the chemiluminescent reaction (Imax, pulses/s) and the time to achieve it (Tmax, min.), the integrated light sum (S, pulses in 120 min.) as the total volume of generated ROS. The analysis of radionuclide content in fish tissues was carried out in the radioecological control laboratory of the Zheleznogorsk Mining and Chemical Combine [9]. The dose rate of internal irradiation of fish was calculated according to [12]. Method of component analysis of chemiluminescent kinetics according to Magrisso et. al [13] were used to identify characteristic changes in its species in fish from different habitats. Graphical and statistical processing of materials was carried out using applications in the Microsoft Excel environment. The results were assessed using the parametric method for unrelated samples (Student's T-test) at a significance level of $P \leq 0.05$. Data are presented as arithmetic means with standard errors of the mean.

Research results and discussion. In fish catching areas, the level of contamination of the aquatic environment and fish tissues with radionuclides did not exceed the maximum permissible level, but was higher than the background control indicators. The content of radionuclides in fish tissues decreased with distance down the river from the place of discharge of industrial waters [10]. The calculated dose rate of internal radiation from incorporated radionuclides, mainly 32P, 40 K, 90Sr, 60Co, 65Zn, 137Cs ranged from 0.04 μGy/hour for perch to 3.05 μGy/hour for grayling in the 1st zone of influence of the MCC (Fig. 1) . The results of a comparative analysis of hematological parameters and assessment of the functional activity of the cellular link of nonspecific resistance of fish indicate the difference between single-species individuals from the control zone and biotopes at different distances from the place of the discharge of MCC wastewater based on the content of radionuclides in tissues (the dose rate of internal radiation), on the content of leukocyte cells and their functional activity (Table 1). The use of the Magrisso component analysis method [13] to decipher the chemiluminescent curves of the kinetics of ROS generation by antigen-activated in vitro blood cells of fish from different zones revealed the peculiarities of the contribution of individual stages of the respiratory explosion to the integral volume in individuals from different zones. According to the methodological approach, each chemiluminescent

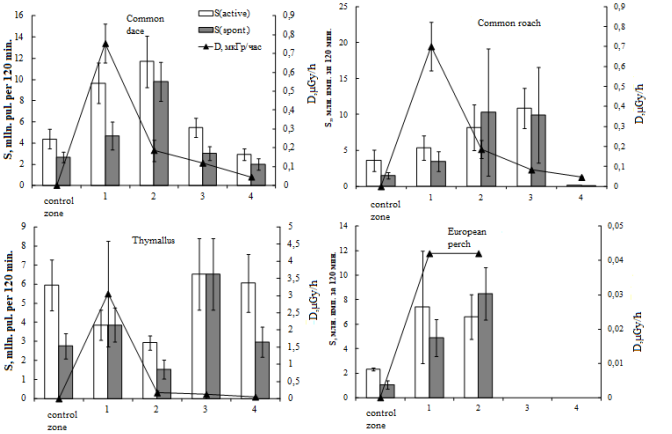

Figure 1. *The value of the dose rate (D, μGy/h) of internal irradiation with incorporated radionuclides and the parameter of the total volume of ROS production (S, million pulses per 120 min.) by blood cells in fish from the river. Yenisei in the zones of influence of gas chemical complex wastewater and in the control zone.*

kinetic curve can be represented as the sum of three statistical (Poisson type) distributions. Moreover, the first component (I) reflects the processes occurring near the plasma membrane, the extracellular generation of ROS associated with phagocytosis (Fig. 2). The second component (II) characterizes intracellular

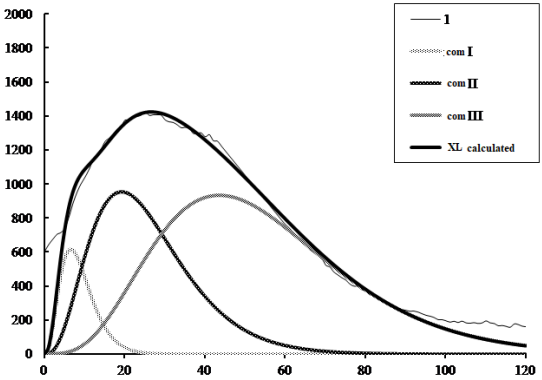

Figure 2. *Recorded chemiluminescent kinetics of ROS generation by in vitro antigen-activated grayling blood cells (1) and its model components (com I, com II and com III) according to the method of Magrisso et. al [13]*

processes associated with phagocytosis and intracellular generation of ROS. The third component (III) describes the kinetics of intracellular ROS generation, which is not directly related to phagocytosis. In dace, there was a significant ($P<0.05$) increase in antigen-activated ROS production by 2 and 3 times at an internal irradiation dose rate of 0.753 and 0.186 μGy/hour, respectively, compared to the control zone, as well as in comparison with indicators at dose rate levels in the 3rd and 4th zones of influence of MCC wastewater. A feature of the kinetics of ROS production by blood cells of dace and roach from zone 1 is a sharp increase in intracellular ROS generation (SII and SIII) compared to individuals from the control zone with a subsequent return of these values to the level of the control zone in zones 3–4 (Table 2) for dace, and for roach in zone 4. At the same time, the Activation Index, calculated as the ratio of the volume of ROS generation by antigen-activated cells in vitro and the volume of ROS generation by cells in the blood without activation (IA = Sactive/Sspont), has minimal values in individuals living in the 2nd zone due to a sharp increase in the level spontaneous generation of ROS. Grayling is characterized by lower rates of ROS generation by antigen-activated cells in vitro and the volume of ROS generation by cells in the blood without activation of the functional activity of cells during antigen stimulation at higher internal irradiation dose rates than dace and roach, in the zones of influence of hydrochemical chemicals closest to the discharge site . This fact indicates a decrease in the sensitivity of immunocompetent cells to foreign agents, which may result in a loss of resistance of the fish body to parasitic agents or the development of autoimmune inflammatory processes.

Table 1.

Indicators of peripheral blood and specific activity of ROS generation of leukocyte blood cells of fish caught in the control zone and zones influenced by mining chemical wastes in 2004-2005.

View	Place of catch	Hemoglobin, g/l	Red blood cells, million cells/ml	Leukocytes, million cells/ml	S/cl. (active)., imp./cl. in 120 min.	S/cl. (spontaneous), imp./cl. in 120 min.	Activation index, rel. units
Dace	control	56 ± 2	487 ± 41	40 ± 4	3.46 ± 1.19	2.45 ± 0.84	1.65 ± 0.37
	Zone 1	69±6	747±42	34±3	8.19±2.41	3.94±1.48	6.44 ± 2.12
	Zone 2	47±3	541±24	45±3	10.02±2.23	9.97±2.48	1.56 ± 0.42
	Zone 3	64±4	745±35	39±3	3.87±0.82	2.14±0.52	4.28 ± 0.82
	Zone 4	105±8	662±86	20±4	4.54±1.41	2.26±0.49	2.04 ± 0.36
Perch	control	57 ± 2	770 ± 43	65 ± 7	0.90 ± 0.30	0.32 ± 0.10	2.21 ± 0.56
	Zone 1	41±3	744±232	52±4	2.73±1.56	1.85±0.43	1.35 ± 0.53
	Zone 2	49±7	688±43	55±6	3.72±1.09	5.98±3.1	1.84 ± 0.29

Roach	control	57 ± 3	739 ± 113	50 ± 10	1.66 ± 0.39	0.79 ± 0.12	2.52 ± 0.62
	Zone 1	43±5	681±87	31±6	8.13 ± 4.38	5.93 ± 3.69	2.77 ± 0.71
	Zone 2	52±14	629±65	22±8	9.31 ± 3.98	14.14 ± 0.50	1.90 ± 0.93
	Zone 3	52±7	709±89	43±9	6.50 ± 1.78	5.98 ± 4.21	5.44 ± 1.61
	Zone 4	77	360	8	0.325	0.075	4.33
Thymal-lus	control	65 ± 3	723 ± 90	63 ± 8	4.03 ± 2.43	1.41 ± 0.25	2.38 ± 0.37
	Zone 1	118±7	471±32	18±2	4.37±0.95	4.0 ± 0.81	1.64 ± 0.21
	Zone 2	67±4	599±24	35±3	2.73±0.41	1.67 ± 0.64	3.49 ± 0.96
	Zone 3	150±10	945±92	38±7	5.56±1.84	3.67 ± 1.35	1.94 ± 0.31
	Zone 4	114±8	540±42	20±2	10.55±3.18	5.22 ± 1.77	5.32 ± 2.13

From the identified patterns it follows that in fish, physiologically determined processes of generation of reactive oxygen species by phagocytic cells in the process of functioning (for example, phagocytosis), which play an important role in antimicrobial and antitumor immunity and are regulated by the activity of pro- and antioxidant systems of the body, are sensitive to the effects of weak doses of ionizing agents. radiation from radionuclides incorporated into the body from the external environment of a reservoir.

Table 2

Values of the integral volume (S) and its components, calculated according to the method (Magrisso et al. 2000) [13], the kinetics of ROS generation by in vitro antigen-activated fish blood cells at different levels of internal irradiation dose rates in the control and 1-4 zones of influence of wastewater MCC

Zone	**D, μGy/hour**	**S, million imp. in 120 min.**			
		Integral	**Component I**	**Component II**	**Component III**
Dace					
control	0.003 ± 0.001	4.37 ± 0.95	0.41	1.57	2.22
1	0.753 ± 0.103	9.33 ± 1.9	0.41	4.56	4.13
2	0.186 ± 0.056	11.68 ± 2.44	0.35	4.03	7.19
3	0.119 ± 0.001	5.47 ± 0.91	0.19	1.68	3.44
4	0.045 ± 0.002	2.95 ± 0.55	0.27	1.20	1.26
Roach					
control	0	3.61 ± 1.48	0.09	0.19	1.17
1	0.701 ± 0.121	5.36 ± 1.69	0.54	3.99	3.56
2	0.184 ± 0.045	8.22 ± 3.19	0.20	1.14	1.40
3	?	10.84 ± 2.8	0.26	3.06	9.82
4	0.046 ± 0.001	0.13			

Thymallus					
control	0	5.94 ± 1.34	0.37	0.80	4.65
1	3.053 ± 1.532	3.86 ± 0.78	0.27	1.21	2.26
2	0.172 ± 0.049	2.92 ± 0.37	0.35	0.78	1.61
3	?	6.52 ± 1.89	0.47	1.25	4.23
4	0.125 ± 0.003	6.06 ± 1.52	0.21	2.07	3.93

From the identified patterns, it follows that in fish, physiologically determined processes of generating active oxygen forms by phagocytic cells during functioning (for example, phagocytosis), which play an important role in antimicrobial and antitumor immunity and are regulated by the activity of pro- and antioxidant systems of the organism, are sensitive to the effects of low doses of ionizing radiation from radionuclides incorporated into the organism from the external environment of the water body.

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从废技术溶液中电解分离镍粉

ELECTROLYTIC SEPARATION OF POWDERED NICKEL FROM SPENT TECHNOLOGICAL SOLUTIONS

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抽象的。 研究了在硫酸盐-硼酸盐电解液中电沉积镍涂层后，从回收浴废液中电解分离粉末形式的镍。 该过程在流动电解槽中进行，其中复合金属氧化物 Ti/Co3O4(Pb) 电极用作阳极，钛阴极不断暴露于超声波。 显示了在电流输出最大时确定给定特定安装的最佳镍浓度范围的可能性。

关键词：电镀生产、镍、电解。

Abstract. *Research is presented on the electrolytic separation of nickel in the form of powder from waste solutions of recovery baths after galvanic deposition of nickel coating in a sulfate-borate electrolyte. The process was carried out in a flow electrolyzer, where a complex metal-oxide Ti/Co_3O_4(Pb) electrode was used as an anode, and a titanium cathode was constantly exposed to ultrasound. The possibility of determining for a given specific installation the optimal range of nickel concentrations when the current output is maximum is shown.*

Keywords: *galvanic production, nickel, electrolysis.*

Introduction

Extraction of nickel from various waste technological solutions - chemical and electrochemical nickel plating baths, collection baths and rinsing baths, is possible using both chemical and electrochemical methods, with chemical methods becoming more widespread. Nickel can be extracted in the form of metal powder from solutions with a C_{Ni} concentration of 10^{-3} to 1 mol/l at *pH* 12-13 with aluminum in the presence of ammonia [1] or from waste alkaline solutions of chemical nickel plating in the form of coarse-crystalline powder at 60 -70°C and *pH* = 7.5-8 in the presence of a catalyst of fine nickel and ammonia powder, which stabilizes the pH and prevents the precipitation of nickel hydroxide [2].

There is a known method for extracting nickel in the form of metal powder from $NiSO_4$ solutions by reduction with hydrogen in an autoclave at 80-180°C in the presence of $FeSO_4$ as a catalyst [3]. Nickel can also be extracted in the form of various compounds: hydroxide or phosphate, respectively sodium hydroxide and sodium phosphate, in the form of green products $Ni(OH)_2\ 2H_2O$ and $Ni_3(PO_4)_2\ 8H_2O$. The first, upon calcination (350°C), turns into black nickel oxide, the second into anhydrous nickel phosphate (1000°C), yellow. All these products can be used as coloring pigments [4].

The work [5} shows the possibility of extracting nickel from a waste solution of chemical nickel plating with aminoacetic acid and sodium hypophosphite in the form of crystalline nickel(+2)-ammonium phosphates of the composition $NH_4NiPO_4\ 6H_2O$ and $NH_4NiPO_4\ H_2O$ at pH 5.5-6 ,7 and a molar ratio of ammonium phosphate to nickel of 4:1.

Nickel metal can be isolated from waste chemical nickel plating solutions by autocatalytic precipitation with sodium hypophosphite

$$NiCl_2 + 2NaH_2PO_2 + 2H_2O \rightarrow Ni\downarrow + 2NaH_2PO_3 + H_2\uparrow + 2HCl\,.$$

$[NiSO_4]$ = 3-11 g/l; NaH_2PO_2 : Ni = 1,1-1,15. Catalyst – dispersed nickel; seed (initiators) – coal, Fe, Al, Cu [6].

To extract nickel from spent electrolytes of chemical nickel plating, nickel sorption on an ion exchange resin filter can be used, and nickel can be isolated in the form of a salt solution after treating the filter with acid [7].

Nickel can be isolated in the form of nitrate from spent GIAP catalysts (5–8 wt.% NiO + Al_2O_3) used for air conversion of gaseous or liquefied hydrocarbons, for example propane or a propane-butane mixture, according to the following scheme:

$$ГИАП \xrightarrow{HNO_3} Ni(NO_3)_2 \xrightarrow{(NH_4)_2CO_3} NiCO_3 \xrightarrow{300-450^oC} NiO \xrightarrow{HNO_3} Ni(NO_3)_2\,.$$

Then the spent catalyst is impregnated with the resulting solution of nickel nitrate, dried and calcined at 450-500°C - thereby the catalyst is regenerated [8].

A method has been patented in which concentrated waste solutions of chemical or galvanic nickel plating are converted into nickel hydroxide using alkali, followed by electrical extraction of nickel. The process is carried out in an installation divided into five sections using tarpaulin or chlorine diaphragms, where the two outer sections are filled with a solution containing nickel sulfate, boric acid and sodium sulfate, two sections contain a similar solution with an excess of nickel hydroxide sediment, and the central section, where lead anodes are located, contains sulfuric acid. During electrolysis, the following conditions are maintained: current density D_k = 2-6 A/dm^2, D_A = 3-9 A/dm2 temperature 20-60°C, pH 4-5 in the cathode sections, pH 1-2 in the anode section, pH 8 -9 in the middle sections with nickel hydroxide [9].

The spent solution of chemical nickel plating can be utilized by electrolysis in a three-chamber electrolyzer with two cation exchange membranes, when the

anode and middle chambers contained a solution of sulfuric acid, which allowed the use of lead as an anode material, and the cathode chamber contained a spent solution of chemical nickel plating. It has been shown that increasing the pH of the catholyte to 5-6 and the cathodic current density to 3-6 A/dm^2 helps to increase the cathodic current efficiency and reduce the duration of the recycling process [10].

Experimental technique

Electrochemical reactor (electrolyzer) **1** was (Fig. 1) a ring assembly structure made of plexiglass (inner diameter Ø130 mm) with hermetically sealed electrodes - a cylindrical metal / metal oxide anode **2** ($Ti/Co_{2.985}Pb0_{.015}O_4$) and a ring titanium cathode 3 (Ti). Anode dimensions – D = 57 mm, H = 90 mm (working surface area excluding external leads from the electrolyzer Sa, slave = 0.032 m^2), working (inner) surface of the cathode D = 130 mm (Sk, rab= 0.0133 m^2). The current I = 28 A was maintained in the circuit; respectively, the cathode and anode current densities were 2100 and 100 A/m^2. The nickel-containing electrolyte was pumped through the reactor by circulation pump **4**, and container **5** with a magnetic trap was installed on the pumping line to separate the nickel powder. To prevent the nickel sill from sticking to the cathode, the latter was exposed to ultrasound (ultrasonic generator **6** and emitter **7**). The pumping speed of the nickel-containing solution was 12 dm^3/min, and the nickel powder was caught in a magnetic trap.

The anode was prepared as follows. A cylindrical titanium substrate was treated in H_2C2O_4 for 1 hour at 90°C, then the anode was treated several times in a solution of nitrates - $Co(NO_3)_2$ and $Pb(NO_3)_2$ with drying after each treatment; as a result of subsequent calcination at 300°C, the result was Co_3O_4 coating containing 1.5 at.% Pb.

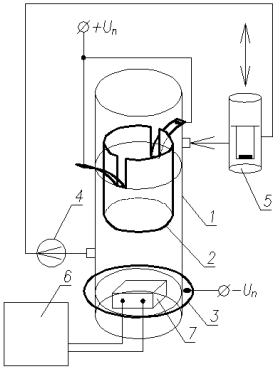

Figure 1. *Scheme of the installation for producing powdered nickel from nickel-containing solutions: 1 – reactor; 2 – anode; 3 – cathode; 4 circulation pump; 5 – intermediate container with a magnetic trap; 6 – ultrasonic generator; 7 – ultrasonic emitter.*

Results and discussion

The working solution was a solution of a washing bath after sulfuric acid nickel plating with a volume of 12 dm^3 with a nickel concentration of 3.30 g/dm^3, also containing boric acid and sodium sulfate. During the process, samples were taken every 10 minutes to photometrically determine the concentration of nickel in the solution; the change in concentration is shown in Fig. 2.

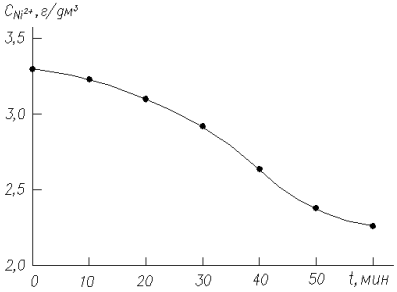

Figure 2. *Change in the concentration of nickel in the solution depending on the duration of electrolysis.*

Based on the data on concentration changes in the nickel content in the pumped solution, the estimated mass of nickel release was determined using the formula

$$m_{расч} = \frac{M_{Ni} \cdot I \cdot t}{n \cdot F} = \frac{58{,}7 \cdot 28 \cdot 60}{2 \cdot 96500} \cdot t = 0{,}51 \cdot t\,, \quad (1)$$

where M_{Ni} – atomic weight of nickel (M_{Ni} = 58,7); I – circuit current, A (I = 28 A); n – number of electronic transitions (n = 2); F – Faraday's constant (F = 96500 Kl/g-equ); t – time, min.

The mass of isolated nickel according to experimental data was determined as

$$m_{эксп} = \Delta C_{Ni^{2+}} \cdot V = 12 \cdot \Delta C_{Ni^{2+}}\,, \quad (2)$$

where $\Delta C_{Tu^{2+}}$ - change (decrease) in concentration Ni^{2+} in solution for a specific period of time, mol/dm^3; V – volume of pumped solution, dm^3 (V = 12 dm^3).

Using formulas (1) and (2), current outputs (VT, Table 1) were calculated relative to the beginning of electrolysis (t = 0) up to specific time cutoffs t_i = 10, 20, ... min according to

$$BT = \frac{m_{эксп}}{m_{расч}} \cdot 100\%\,, \quad (3)$$

as well as current outputs related to time intervals t = 10 min (BT_i, Table 1 - in parentheses).

The latter were calculated according to

$$BT_i = \frac{\Delta C^{(i)}_{Ni^{2+}}}{5{,}1 \cdot t} \cdot 100\%\,. \quad (4)$$

Table 1.

Indicators of the process of electrolytic extraction of nickel

Time; t, min	Concentration Ni^{2+}, g/dm	Weight of nickel extracted, g		Current output; BT (BT_i), %
		$\Delta m_{расч}$	$\Delta m_{эксп}$	
0	3,30	-	-	-
10	3,23	5,1	0,84	16,5
20	3,10	10,2	2,5	24,9 (30,5)
30	2,92	15,3	4,6	29,8 (42,3)
40	2,64	20,4	7,9	38,8 (65,8)
50	2,38	25,5	11,0	43,3 (61,0)
60	2,26	30,6	12,5	40,8 (26,2)

Data on current outputs are presented in Fig. 3.

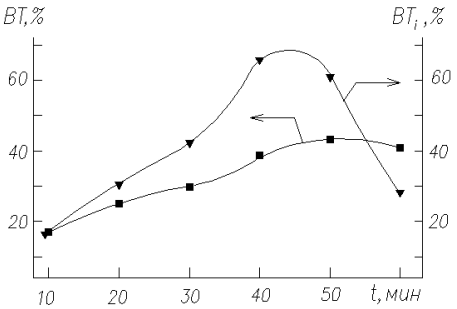

Figure 3. *Change in time of the current current output values: BT – current output relative to the beginning of the time count; BT_i – current output in time intervals of 10 minutes.*

From the results obtained, we can conclude that for a given specific installation and a given mode of pumping a solution through it, it is possible to find a region of optimal Ni^{2+} concentrations, when the yield of powdered nickel is maximum. This area is located near concentrations of 2.5 g/dm^3. Purification of wastewater from galvanic production is not the purpose of the electrolysis process; the intended purpose of the device is to extract powdered nickel from the solution of the collection bath after the nickel plating bath. The device must be used to operate in the region of optimal nickel concentration values, when the current output is maximum.

The performance of this type of device, a flow electrolyzer, was also tested for separating powdered fines from ammonia copper plating solutions, only in this case, filtration and sedimentation in a settling tank were used to separate powdered copper, since copper, unlike nickel, does not have the ability to be magnetized.

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7.1~18岁儿童急性肾功能衰竭少尿期每搏血量昼夜节律
CIRCADIAN RHYTHM OF STROKE VOLUME OF BLOOD IN THE OLIGOANURIA PHASE OF ACUTE RENAL FAILURE IN CHILDREN AGED 7.1-18 YEARS

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抽象的。 对 20 名 7.1-18 岁患有急性肾功能衰竭的儿童进行了每小时心搏量 (SV) 监测数据的研究。 第一天，第 3 组儿童出现了 SV 降低的趋势。 在第 3 组 7 岁以上的儿童中，在昼夜节律 SV 的中叶指数、顶相和深相变化中发现了急性心力衰竭的可靠显着迹象。 第 3 组儿童的 SV 昼夜节律倒置时间最长（12 天）。

关键词：昼夜节律、每搏量、急性肾衰竭、儿童。

Abstract. *Data from hourly monitoring of stroke volume (SV) were studied in 20 children with acute renal failure aged 7.1-18 years. On day 1, a tendency to decrease SV was revealed in group 3 of children. Reliably significant signs of acute heart failure were found in changes in the mesor index, acrophase, and bathyphase of the circadian rhythm SV in children of group 3 over the age of 7 years. The longest inversion of the circadian rhythm of SV (12 days) was found in children of group 3.*

Keywords: *circadian rhythm, stroke volume, acute renal failure, children.*

Relevance. The circulatory system is a gigantic hierarchy of systems and subsystems that have common and specific features, the functioning of which is subordinated to a single goal - maintaining, in accordance with the principle of optimality in biology, blood flow in the organs and tissues of a living organism. At the same time, only a step-by-step solution to this global problem is possible: studying separately the features of the functioning and regulation of each of the subsystems

of the circulatory system, and then, through establishing relationships between them, building a model of blood circulation as a whole. In this hierarchy, the central place is occupied by the subsystem of the heart and its associated vessels, the aorta and pulmonary artery. Stroke volume (SV) is the volume of blood that the heart pushes into the vessels during one contraction. This indicator is directly related to the condition of the heart muscle and its ability to contract with sufficient force. An increase in stroke volume occurs as the pulse increases. Stroke volume characterizes the strength and efficiency of heart contractions. From available literary sources it has been established that the value of systolic volume depends on age, gender, level of physical fitness, fitness, and body position. Thus, in children aged 6–9 years, the systolic volume is 32 ml, in children aged 10–12 years – 44 ml, in children aged 13–17 years – 60 ml.

According to researchers, stroke volume, as one of the indicators of central hemodynamics (CH), in children with first-degree shock, on the day of admission to the hospital is 97% of the age norm. In patients with second degree shock it is 105%. In children with third degree shock, upon admission to hospital it averages 110% of normal. In children with a terminal condition, SV is 128% of normal. Particularly significant changes in the cardiovascular system were observed in patients with unfavorable outcome conditions, when CV was 125 ± 14.67 ml. Renal oligoanuria is characterized by parenchymal renal failure and can occur as a result of damage to the renal parenchyma by various damaging factors. Indications for renal replacement therapy (RRT) include hyperkalemia, acidosis, pulmonary edema, drug toxicity, progressive uremia or pericarditis, encephalopathy, seizures, and coagulopathy due to uremia. One of the factors aggravating the patient's condition, leveling the effectiveness of RRT, is acute heart failure. However, in the literature there is insufficient information on the characteristics of the response of the circadian rhythm of stroke volume (SV) in acute renal failure, which developed in children aged 7.1 to 18 years [1-4].

Goal of the work. To study and evaluate the response of the circadian rhythm of stroke volume in acute renal failure at school age.

Material and research methods. We studied the data of hourly monitoring of body temperature in 20 children with acute renal failure who were admitted to the ICU of the Russian Research Center for Emergency Medicine with anuria at the age of 7.1 to 18 years. Before admission to the clinic, all patients received anti-inflammatory therapy aimed at treating acute glomerulonephritis, pneumonia, acute respiratory infections, and acute intestinal infections. Due to severe progressive respiratory failure, patients received invasive mechanical respiratory support as indicated on the first day. All patients underwent hemodialysis, under the control of hemodynamics, acid-base balance, respiratory system, supportive, antibacterial, anti-inflammatory, syndromic corrective intensive therapy in accordance with

existing recommendations in the literature. A favorable outcome with restoration of full functional activity of the kidneys and discharge from the hospital was observed in 13 children (groups 1 and 2), an unfavorable outcome – in 7 children (group 3). The first group consisted of patients (6) who received intensive therapy in the ICU for up to 10 days, the second group included children (7) with a favorable outcome after intensive therapy for 11–45 days.

Data from hourly monitoring of the parameters of the circadian rhythm of SV are presented. The assessment of changes in the components of the circadian rhythm was carried out by obtaining mesor indicators - the average daily level, the amplitude of circadian fluctuations, the range of daily fluctuations, indicators of acrophase and bathyphase of the circadian rhythm, and the duration of inversion of the studied hemodynamic parameters. The research data were processed by the method of variation statistics using the Excel program by calculating arithmetic means (M) and errors of means (m). To assess the significance of differences between two values, the parametric Student's test (t) was used. The relationship between the dynamics of the studied indicators was determined by the method of paired correlations. The critical significance level was taken equal to 0.05.

Results and their evaluation. On day 1, a tendency towards a decrease in the mesor of the circadian rhythm SV in the 3rd group of children was revealed (Table 1). In the dynamics of observation in group 1, an increase in the mesor indicator of the circadian rhythm SV on the 8.9th day was found by 10, 15 ml, but within the permissible age norm. In group 2, a significantly significant decrease in blood volume was noted on the 28th day of intensive therapy by 12 ml. A distinctive feature of patients in the group with an unfavorable outcome was a statistically significant decrease in the circadian rhythm mesor of SV on days 7–16 by 13–11 ml; in the subsequent 20–30 days, the circadian rhythm mesor decreased by 21–24 ml (Fig. 1).

Table 1.

Dynamics of the mesor of the circadian rhythm UOK

Days	1 group	2 group	3 group
1	42±4	50±5	39±6
2	41±5	51±3	41±4 ‴
3	40±3	47±3	39±5
4	38±2	50±5	42±4
5	41±3	48±5	36±4‴
6	37±5	47±4	29±5‴
7	46±5	48±5	26±2*‴
8	52±2*	50±3	27±3*‴
9	57±3*	50±3	28±3*‴

10	50±6	51±3	26±3*‴
11		52±2	27±2*‴
12		51±4	27±2*‴
13		48±3	27±2*‴
14		47±4	27±3*‴
15		48±6	30±3‴
16		50±8	28±3*‴
17		41±2	19±2*‴
18		46±4	22±3*‴
19		46±3	28±6‴
20		42±4	18±2*‴
21		44±3	20±2*‴
22		42±5	16±2*‴
23		48±7	17±2*‴
24		43±4	15±2*‴
25		42±3	15±1*‴
26		42±3	16±2*‴
27		41±4	14±2*‴
28		38±3*	14±3*‴
29		40±5	14±2*‴
30		40±4	15±1*‴

Table 2.

Average circadian rhythm SV

Hours	1 group	2 group	3 group
8	43±7	43±6	22±6 ¤‴
9	45±7	45±5	23±7¤‴
10	43±6	43±5	24±7¤‴
11	43±5	45±6	24±7¤‴
12	44±6	45±5	24±8¤‴
13	42±6	45±5	26±8¤‴
14	43±7	45±4	24±7¤‴
15	44±6	45±5	23±7¤‴
16	46±6	46±5	25±7¤‴
17	44±6	47±5	25±8¤‴
18	44±7	46±5	25±7¤‴
19	44±9	45±5	24±7¤‴
20	46±6	46±5	25±8¤‴
21	43±7	46±5	25±7¤‴
22	43±6	46±5	24±8¤‴

23	46±6	47±5	24±7¤‴
24	43±5	47±5	26±9¤‴
1	46±8	48±6	25±8¤‴
2	49±8	48±6	26±8¤‴
3	46±7	48±5	27±9¤‴
4	44±6	48±5	26±7¤‴
5	45±7	47±5	26±8¤‴
6	48±10	47±5	24±9¤‴
7	43±8	46±6	25±8¤‴

*-change is significant relative to the indicator on 1 day
‴- the difference is significant relative to the indicator in group 2
¤ - the difference is significant relative to the indicator in group 1

That is, the ineffectiveness of complex intensive therapy with hemodialysis in group 3 progressed, mainly expressed in the worsening of acute heart failure, which led to a fatal outcome. As presented in Table 2, the SV indicator in the average circadian rhythm in children of group 3 turned out to be significantly lower than in groups 1 and 2 (Fig. 2). Perhaps, in the most severe patients with ARF, therapy should be more actively aimed at restoring myocardial function in conditions of disturbances in the homeostasis systems characteristic of acute renal failure. First of all, the question arises of the adequacy of anti-inflammatory therapy for myocarditis, correction of the disorder and restoration of ATP synthesis by myocardial cells, which requires increased delivery of increased oxygen demand, improvement of capillary blood flow, sufficient supply of energy substrates, significantly increased due to hypercatabolism, coenzymes involved in energy production and synthesis ATP. In clinical practice, mandatory antihypertensive therapy is carried out according to recommendations with antihypertensive drugs of various mechanisms of action (calcium channel blockers, beta-blockers, angiotensin-converting enzyme inhibitors, myotropic and others) until the set goal is achieved. At the same time, the compensatory value of arterial hypertension, as well as the rapid depletion of the energy resources of the myocardial cell, are not sufficiently taken into account. The side effects of drugs are of no small importance, especially when combining drugs with different mechanisms of pharmacological effect. It is possible that in conditions of impaired water-salt metabolism, changes in osmolarity, and blood rheology in general, the pharmacological effect of drugs is significantly reduced. As a result, it can be hypothetically assumed that the contractility of the myocardium, impaired in connection with myocarditis due to the systemic inflammatory reaction in acute renal failure, general intoxication in conditions of adverse effects on the metabolism of myocardial cells, accumulation of waste products of altered metabolism in the blood, disturbances in water-elec-

trolyte balance, toxic effects on cell membranes and intracellular structures of free radicals during antihypertensive therapy is disrupted to an even greater extent, which leads to irreversible progression of acute heart failure. Perhaps, against the background of early hemodialysis detoxification therapy, it makes sense to earlier correct acute heart failure when diagnosing a decrease in cardiac output, taking into account the etiopathogenetic mechanisms of the development of this severe complication.

Table 3.

Average values of circadian rhythm parameters SV at 7.1-18 years old, ml

Groups	Mezor	SV in acrophase	SV in bathyphase	Circadian SV rhythm amplitude	Range of daily changes in SV
1	44±4	56±8	35±5	11±5	21±9
2	46±4	57±5	37±4	11±4	20±6
3	25±3‴ º	33±9‴ º	18±6‴ º	8±3	14±5

‴ - deviation is reliable relative to the indicator in group 1

º= difference is significant relative to the indicator in group 2

As presented in Table 3, the average mesor value of the circadian rhythm SV of children of group 3 turned out to be significantly less than in group 1 by 43%, in group 2 by 48% ($p < 0.05$, respectively). It should be noted that in acrophase there was a significant decrease in cardiac output by 41% in group 1, by 42% in group 2. A decrease in stroke volume in the bathyphase was also revealed in group 1 by 50%, in group 2 by 51%. The discovered features indicate reliably significant signs of acute heart failure both in the acrophase and in the bathyphase of the average circadian rhythm of SV at the age of over 7 years.

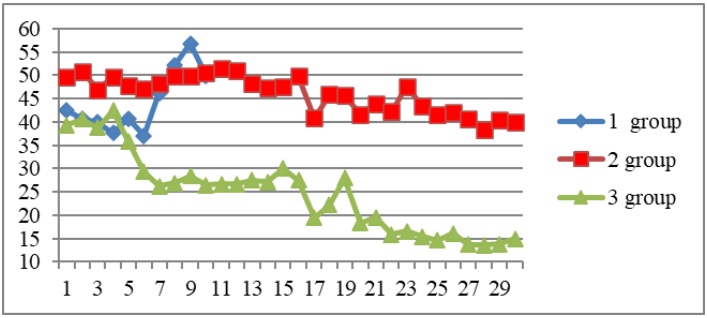

Figure 1. *Dynamics of mesor circus rhythm SV in 7.1-18 l with acute renal failure, ml.*

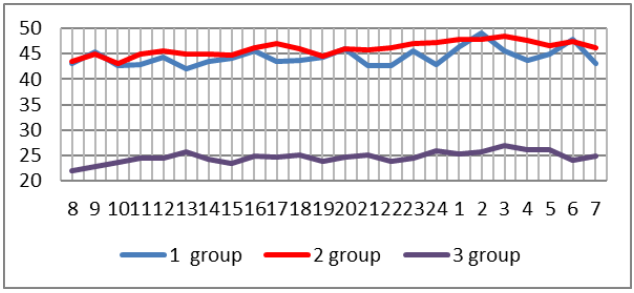

Figure 2. *Average circadian rhythm SV at 7.1-18 years, ml*

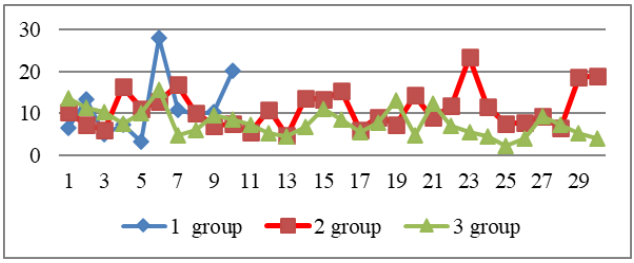

Figure 3. *Dynamics of the amplitude of the circadian rhythm SV, ml.*

Changes in the amplitude of the circadian rhythm SV occurred in waves, representing altered periweekly biorhythms of cardiac output with a wavelength of 5–6 days. Only the dynamics of changes in the amplitude of the circadian rhythm SV differed in group 3 by the smallest amplitude, which confirmed the progression of heart failure, especially after 20 days of observation. Changes in daily fluctuations in stroke volume occurred almost synchronously with changes in the amplitude of the studied indicator (Fig. 3, 4).

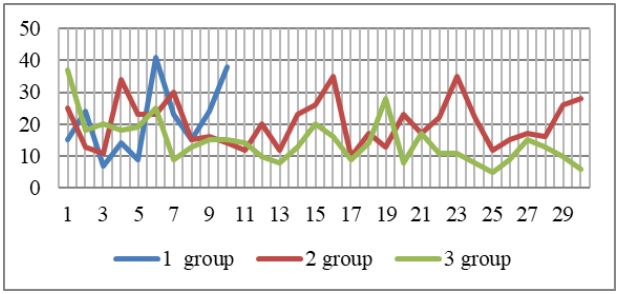

Figure 4. *Range of daily fluctuations in SV, ml*

The study and assessment of the duration of the inversion of the circadian rhythm of SV allowed us to state the longest inversion in children of group 3 (12 days) 40%, in group 2 a mirror change in the circadian rhythm of SV was observed within 9 days (30%) and in group 1 - inversion of the circadian rhythm SV detected within 3 days (30%). The discovered features of the reaction of the circadian rhythm of SV in acute renal failure at the age of 7.1 = 18 years corresponded to the severity of the condition (Fig. 5).

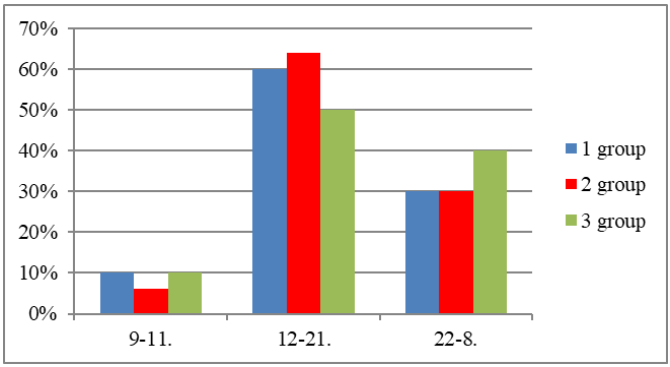

Figure 5. *Duration of circadian rhythm inversion SV*

A strong negative correlation between SV and MAP was found in all groups (group 1 - -0.84; 2 - -0.91; group 3 -0.85), a strong negative correlation between SV and DBP in 1 (-0.88) and 2 (-0.91) groups, weakened in group 3 (-0.54). The negative correlation between the dynamics of SV and body temperature in group 1 (-0.70) turned out to be significantly significant (Fig. 6). The discovered correlations showed that a decrease in the level of the circadian rhythm mesor MAP corresponds to an increase in the value of the circadian rhythm mesor SV in all patients with acute renal failure over 7 years of age. A decrease in body temperature had a positive effect on the dynamics of SV only in group 1. A decrease in DBP in groups 1 and 2 of children had a positive effect on the level of cardiac output, while in group 3 this mechanism decreased significantly.

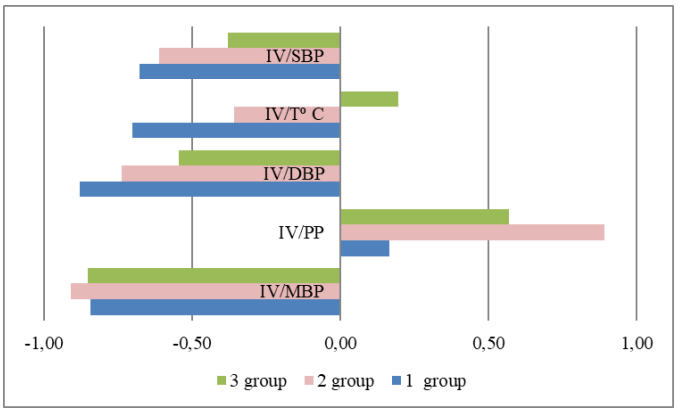

Figure 6. *Correlation connections of SV*

Conclusion. On day 1, a tendency to decrease SV was revealed in group 3 of children. Reliably significant signs of acute heart failure were identified in both the mesor, acrophase, and bathyphase of the circadian rhythm SV in children of group 3 over the age of 7 years. The longest inversion of the circadian rhythm of SV (12 days) was found in children of group 3.

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综合性颅面外伤治疗

INTEGRATED APPROACH IN THE TREATMENT OF COMBINED CRANIOFACIAL TRAUMAS

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抽象的。 鉴于颌面部骨骼创伤发生率的增加，颅面部复合创伤的问题仍然紧迫。 这些伤害的发生频率迅速增加，达到每 1000 名居民 0.6 例，这凸显了寻找最佳治疗策略的必要性。 奥什跨地区联合临床医院颌面外科进行的研究为开发新方法为该领域的复合损伤提供合格护理做出了重大贡献。 目的：为各种形式的颌面外伤合并颅脑损伤患者选择合格的护理策略。 材料和方法：对 2021 年 1 月至 2023 年 11 月在奥什跨地区联合临床医院颌面外科住院治疗的 754 例患者的病史进行回顾性分析。结果：骨折检查、早期重新定位和固定的算法的制定颌面和颅脑联合损伤时的上面部和中面部区域。 此外，在存在硬膜下血肿、脑内血肿等多种并发症的情况下，已经实现了联合手术的协调，这是颌面外科医生和神经外科医生需要关注的重要方面。 结论：这项研究的结果不仅提出了有效检查和治疗的算法，而且强调了不同背景的专家之间合作以获得最佳结果的重要性。 鉴于创伤日益复杂以及医学界协调努力的需要，这一点变得有意义。 奥什跨区域多学科临床医院组建了包括神经外科医生、创伤科医生、颌面外科医生和眼科医生在内的特殊医疗团队，为颅面部创伤患者提供全天候护理，并在治疗颅面部创伤方面取得了优异的成绩。 患者类别。

因此，针对颅脑外伤背景下颌面部复合损伤优化治疗的科学研究是提高医疗实践效率和效果的重要一步。

关键词：颅脑外伤，颧骨骨折，上颌骨骨折，下颌骨骨折，接骨术。

Abstract. *The problem of combined craniofacial traumas remains urgent in the light of the increasing incidence of trauma to the maxillofacial skeleton. The rapid increase in the frequency of these injuries, reaching 0.6 cases per 1000 inhabitants, emphasizes the need to find optimal treatment strategies. Studies conducted in the maxillofacial surgery department of the Osh Interregional United Clinical Hospital represent a significant contribution to the development of new approaches to the provision of qualified care for combined injuries in this area. Aim***:** *to choose the tactics of qualified care for patients with various forms of maxillofacial trauma in combination with traumatic brain injury. Materials and methods***:** *retrospective analysis of medical histories of 754 patients who underwent inpatient treatment in the maxillofacial surgery department of Osh Interregional United Clinical Hospital from January 2021 to November 2023. Results: development of algorithms of examination, early repositioning and fixation of fractures of bones of the upper and middle facial zone in case of combined maxillofacial and craniocerebral injuries. In addition, coordination of joint operations in the presence of a variety of complications such as epi-subdural hematoma and intracerebral hematoma has been realized, which represent important aspects that require attention from maxillofacial surgeons and neurosurgeons. Conclusion: The results of this study not only suggest algorithms for effective examination and treatment, but also emphasize the importance of collaboration between specialists of different profiles to achieve optimal results. This becomes relevant in light of the increasing complexity of trauma and the need for coordinated efforts of the medical community. The creation of special medical teams, including a neurosurgeon, traumatologist, maxillofacial surgeon and ophthalmologist, providing round-the-clock care to patients with craniofacial trauma in the Osh Interregional Multidisciplinary Clinical Hospital is accompanied by the achievement of outstanding results in the treatment of this category of patients.*

Thus, scientific research focused on optimizing the treatment of combined injuries of the maxillofacial region in the context of craniocerebral trauma is an important step in improving the efficiency and effectiveness of medical practice.

Keywords: *craniocerebral trauma, zygomatic bone fracture, maxillary fracture, mandibular fracture, osteosynthesis.*

Treatment of patients suffering from combined injuries of the bones of the face and skull is an urgent and still not fully solved problem in medicine. The significance of this problem is due to both the increasing number of injuries of this localization and the frequency of insufficiently satisfactory results of therapy. Due to such combined injuries, various posttraumatic facial defects and deformations occur. First of all, when providing medical care to such patients, doctors have

to solve the problems associated with resuscitation, repositioning and fixation of bone fragments.

Injuries of the maxillofacial skeletal region, in particular the facial skeleton, show a high tendency to increase their frequency, reaching a level of up to 0.6 cases per 1,000 inhabitants. Despite the period of existence in the conditions of the world, most often injuries and fractures affect the lower jaw, making up from 65 to 93% of the total number of victims. A significant increase in the number of combined injuries of the maxillofacial region has been recorded, the annual increase of which varies from 1 to 18%. The peculiarity of combined craniofacial injuries is a significant load on vital functions of the organism, especially in injuries of the middle-lower facial zone [1, 2, 3].

When selecting methods of repositioning and fixation of detached facial bone sections, there are difficulties in treatment tactics due to the severity of the patient's condition in combination with craniocerebral trauma. It should be noted that delayed surgical intervention in such injuries leads to the development of both local and remote posttraumatic complications, as well as complications from the brain. The direct correlation between professional training of medical personnel and compliance with the unified tactics of treatment of patients with the above-mentioned injuries is an important aspect. Effective work of specialists of different profiles, such as traumatologists, neurosurgeons, resuscitators and doctors of other specializations, is necessary for successful treatment. Currently, traumatic brain injury (traumatic brain injury (TBI) remains an urgent and unresolved problem in the field of neurosurgery. The importance of traumatic brain injury is emphasized by the risk to the health and life of patients, and recent epidemiological studies indicate an increase in the incidence of traumatic brain injury, ranging from 1.99 to 3.0 cases per 1000 adults [4, 5, 6].

The aim of our study is to choose the tactics of qualified care for patients with various forms of maxillofacial trauma combined with traumatic brain injury.

Materials and methods of the study

Include the analysis of case histories of 754 patients who underwent inpatient treatment in the department of maxillofacial surgery of the Osh Interregional United Clinical Hospital from January 2021 to November 2023. Different types of injuries were considered, including domestic, motor vehicle, industrial and sports injuries. Localization of fractures and general condition of the injured, age and gender were also analyzed.

Results of the study and their discussion

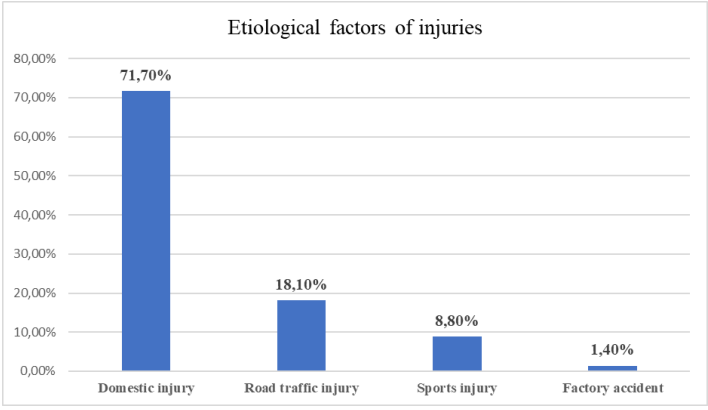
During our study, it was observed that the age of the trauma patients ranged from 15 to 68 years. Out of the total number, 706 (93.6%) belonged to male gender while only 6.4% (48) were female gender. Note that the major proportion of the victims were between the ages of 21 and 40 years, which was 562 patients or

74.6%. Patients aged 41 years and above, including those 61 years and above, accounted for 192 patients, representing 25.4% of the total. Thus, the main mass of victims belongs to the age group of able-bodied population.

№	denomination	quantity	21-40 y.o.	41 y.o. and older
1	Males	706 (93,6%)	562 (74,6%)	192 (25,4%)
2	Females	48 (6,4%)		

The predominant etiologic factor leading to injuries of the maxillofacial region are household and street injuries, accounting for 71.7%. The second place is occupied by transportation injuries - 18.1%, and the third place is occupied by sports injuries, which occur in 8.8% of victims. It is important to note that in Kyrgyzstan the main part of sports injuries occurs when participating in national equestrian games such as “Kok-Boru” and “Ulak-Tartysh”, which is 8.8%, while literature data from world sources indicate the share of sports injuries of the maxillofacial region in the amount of 2-3%. Industrial injuries occupy only 1.0%, which is due to the lack of factories and plants in the country.

When analyzing case histories, an increase in the number of combined craniofacial injuries is noted with an annual increase of 10 to 15%. It should be emphasized that the peculiarity of combined craniofacial injuries is mutual aggravation and disorder of vital functions of the body. The complexity of the choice of the method of repositioning and fixation of facial bone fragments is associated, first of all, with the severe general condition of the patient due to concomitant cranial and cerebral trauma.



Of the total number of 754 patients studied, 32.7% (247 patients) had combined craniofacial trauma with fractures of the middle zone of the face, multifac-

eted fractures of the zygomatic bone and fractures of the upper jaw, characterized by a high degree of severity

It should be emphasized that delayed repositioning of bone fragments of the facial skeleton not only worsens the course of combined craniocerebral trauma, but also actively contributes to the development of posttraumatic complications affecting both the facial bones (in the form of wound suppuration, osteomyelitis, delayed consolidation and formation of deformities) and the state of the brain. However, it should be emphasized that the effectiveness of specialized care in combined injuries depends to a large extent on the high level of professional competence of physicians and strict adherence to the principles of unified treatment tactics.

The optimal timing of specialized care was selected depending on the degree of brain injury. Early interventions within the first 2 days were recommended only for mild brain injuries, such as concussion and mild cerebral contusion. In cases of more severe injuries, such as moderate cerebral contusion without gross disturbances of consciousness (SSC 10-12 points) and patient's psyche, specialized treatment was postponed for a period of 3 to 5 days, or corresponded to the phases of traumatic brain injury, especially in cases of severe brain injury.

Of the 507 patients diagnosed with mandibular fractures, closed head injury was identified in 23%. The condition of these patients was characterized by an average degree of severity or was assessed as satisfactory. These patients underwent osteosynthesis of the mandible using the extraoral or itraoral method as an emergency procedure.

Conclusions. Thus, a retrospective analysis of case histories of patients with maxillofacial trauma emphasizes that the treatment of upper and midface fractures is a challenge for modern maxillofacial surgery. This problem poses a challenge to neurosurgeons and maxillofacial surgeons to create clear and consistent interventions for polytrauma.

The development of algorithms for examination, early repositioning and fixation of fractures of bones of the upper and middle facial zone in cases of combined maxillofacial and craniocerebral injuries, as well as coordination of joint operations in the presence of epi-subdural, intracerebral hematoma and other complications, are key aspects that require the attention of maxillofacial surgeons and neurosurgeons.

Special medical teams including a neurosurgeon, traumatologist, maxillofacial surgeon and ophthalmologist have been created and successfully provide round-the-clock care to patients with craniofacial trauma in the Osh Interregional Multidisciplinary Clinical Hospital, achieving high results in the treatment of this category of patients.

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秋明市第二成熟女性合并症的 QUETELET 指数
QUETELET INDEX IN WOMEN OF THE SECOND MATURE AGE IN TYUMEN WITH COMORBID PATHOLOGY

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抽象的。 本文通过两种计算方法对秋明州两组女性第二成年期的体重指数（Quetelet）研究进行了比较分析。 第一组（MG - 主要组）包括因冠心病（CHD）和缺铁性贫血（IDA）而接受门诊治疗的女性。 第二组（CG - 对照组）由检查时没有任何躯体疾病的同龄女性组成。 作者在内科疾病临床中首次将第二个成年期划分为相等的五年时间段。 形态学上的“剪刀”已经被确定，随着女性护照年龄的增加，她们的体重增加，身长减少。 提出用两种计算方法来评估Quetelet指数。

关键词：女性，第二个成年期，冠心病，缺铁性贫血，体重指数。

Abstract. *The article presents a comparative analysis of the study of body mass index (Quetelet) by two calculation methods in two groups of women during the second adulthood in Tyumen. The first group (MG – main group) included women receiving outpatient treatment for a combination of coronary heart disease*

(CHD) and iron deficiency anemia (IDA). The second group (CG - control group) consisted of women of the same age who did not have any somatic diseases at the time of the examination. For the first time in the clinic of internal diseases, the period of the second adulthood was divided by the authors into equal five-year periods of time. Morphological "scissors" have been identified, when as women's passport age increases, their body weight increases and body length decreases. It is proposed to evaluate the Quetelet index in two calculation methods.

Keywords: *women, second adulthood, coronary heart disease, iron deficiency anemia, body mass index.*

Relevance. One of the indicators characterizing physical development (PD) is the body mass index (BMI), the value of which evaluates the degree of correspondence of a person's body weight to his height, which allows indirect assessment of whether the weight is normal, insufficient or excessive (obesity) in relation to established age norms. Knowledge of the dynamics of age-related body weight values allows the doctor to quickly decide on the possibilities of reducing excess weight through the use of diet and various types of physical therapy. Note that the assessment of BMI has been the subject of comprehensive study for many years in various types of physical activity [16, 22], assessment of physical development [10], coronary heart disease [1, 8], thrombosis [2], pregnancy [6, 11], diabetes mellitus [20], arterial hypertension [3, 15], menstrual irregularities [12, 23], periodontitis [18], injuries and diseases of the musculoskeletal system [19]. BMI is considered depending on the region of residence [4, 7, 21, 32] and the nature of nutrition [9, 17], as well as in students [5, 13].

In modern scientific research, when assessing PD, the mass growth indicator proposed in 1869 by the Belgian sociologist and mathematician, statistician Lambert-Adolph-Jacques Quetelet (February 22, 1796 - February 17, 1874) is widely used, currently used name - Quetelet index. We calculated BMI using the formulas:

$$\text{BMI} = \text{weight (in kg)} : \text{height (in cm)}$$
$$\text{BMI} = \text{weight (in kg)} : \text{height (in m}^2\text{)}$$

The US National Institute of Health (NIH) has developed a body mass index score that has been endorsed by the World Health Organization (Table 1).

As for the BMI indicator in women of the second adulthood in Tyumen with comorbid pathology in the form of IHD and IDA, then, firstly, there are no such studies in the literature available to us, which was the reason for its study. Secondly, there are no studies that shed light on age-related BMI values in women of the 9th period of ontogenesis, which we first divided into equal 5-year life spans. Thirdly, there are no comparative differences in BMI in women with comorbid pathology with their healthy peers.

Table 1

Estimation of body mass index in humans.

Body mass	BMI (kg/m^2)	Risk of disease
Underweight	18.5	Increased
Normal body weight	18.5–24.9	Absent
Excess body weight	25.0–29.9	Increased
Obesity I degree	30.0–34.9	High
Obesity II degree	35.0–39.9	Very high

Material and research methods. BMI assessment was carried out in two groups of women. The first group (MG - main group) included 28 women of the second mature age (48.4 ± 2.9 years), undergoing outpatient treatment at RCH No. 2 in Tyumen for a combination of chronic coronary artery disease without signs of heart failure (first functional class) and IDA. The second group (CG - control group) using a random sampling method consisted of 30 women of the same age (47.8±2.7 years) who did not have clinically and instrumentally confirmed diseases of the cardiovascular system and blood at the time of the examination.

When assessing the age of women, we adhered to the scheme of age periodization of human ontogenesis, adopted at the VII All-Union Conference on Problems of Age-Related Morphology, Physiology and Biochemistry of the Academy of Pedagogical Sciences of the USSR in Moscow in 1965. According to this periodization, the period of the second mature age lasts from 36 to 55 years, i.e. 20 years. It is quite natural to assume that during this period of life in women, for example, at the age of 36 years, morphofunctional indicators not only can, but should also differ from the age, for example, 54 years. We divided the period of the second adulthood into 5-year intervals. MG: from 36 to 40 years (38.3±1.7; n = 8), from 41 to 45 (43.4±1.6; n = 6) years, from 46 to 50 (47.2±1 .5; n = 7) years and from 51 to the age of 55 (52.5±1.6; n = 7) years. CG: from 36 to 40 years (38.6±1.6; n = 8), from 41 to 45 (44.2±1.7; n = 8) years, from 46 to 50 (48.1±1 .7; n = 7) years and from 51 to the age of 55 (52.8±1.5; n = 7) years.

From the anamnesis it was revealed that due to the illness and an increase in the passport age, the level of physical activity decreased in all women. It was also found that 78% of women in the MG and 63% of women in the CG led a sedentary, mostly sedentary lifestyle associated with the conditions of professional activity. In addition, 57% of women in the MG and 34% of women in the CG noted the presence of domestic and work-related stressful situations. 18% of women in the OG and 21% of women in the CG had a night work schedule. The duration of night sleep in 53% of women in the MG was 8 hours, in 41% – 7 hours, and in 6% less than 7 hours. The duration of night sleep in 62% of women in the CG was 8 hours, in 33% – 7 hours and in 5% less than 7 hours.

In this study, we used our proposed "Method for assessing the physical development of people" (Certificate of state registration of computer programs No. 2008615639). Body length was determined using our proposed stadiometer (RF Patent for utility model No. 153076) with an accuracy of 0.5 centimeters.

The examination was carried out in the first half of the day with the following microclimate parameters in the room: humidity - 56%, air speed - 0.3 m/s, temperature - 19-22.50 C.

The principles of voluntariness, individual rights and freedoms guaranteed by Articles 21 and 22 of the Constitution of the Russian Federation, as well as Order of the Ministry of Health and Social Development of Russia No. 774n of August 31, 2010 "On the Ethics Council" are observed. The study was conducted in accordance with the ethical standards set out in the Declaration of Helsinki and the European Community Directives (8/609EC) and the informed oral consent of the women.

Results and discussion. Characterizing age-related changes in the basic RF indicators of women in the MG and CG, i.e. length and body weight within the same age period of ontogenesis, we note them as so-called. "morphological scissors". Their essence is that the body weight of women in absolute values, due to an increase in the passport age, increased, and body length decreased. Thus, over the period from 36 to 55 years, i.e. over 20 years, body length (Table 2, Fig. 1) in absolute values decreased by 1.7 and 1.9 cm, respectively.

Table 2

Indicators of physical development and BMI of women from the MG and CG of Tyumen during the second adulthood (M±m)

Group	Body weight, kg	Body length, cm /Body length, m^2	BMI
36 – 40			
MG	64,26±2,30	168,6±2,4 /3,36	0,381 /(19,01)
CG	63,86±2,26	169,4±2,4 /3,38	0,377 /(18,89)
41 – 45			
MG	66,83±2,39	168,1±2,4 /3,36	0,397 /(19,88)
CG	66,13±2,32	169,0±2,4 /3,38	0,391 /(19,68)
46 – 50			
MG	67,74±2,33	167,3±2,3 /3,34	0,405 /(20,28)
CG	67,69±2,30	168,2 ±2,4 /3,36	0,402 /(20,14)
51 – 55			
MG	69,31±2,41	166,9±2,3 /3,34	0,415 /(20,75)
CG	71,07±2,34	167,5±2,4 /3,35	0,424 /(21,21)
Average values			

MG	67,18±2,26	167,72±2,35 /3,34	0,400 /(20,11)
CG	64,26±2,30	168,52±2,40 /3,35	0,381 /(19,18)
Difference	2,92	0,80 /0,01	0,019 /(0,93)

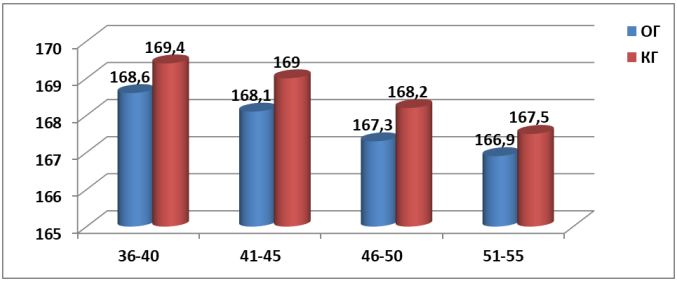

Figure 1. *Changes in body length within one age period of ontogenesis in women of the second mature age in the MG and CG.*

Over the same period of time, the body weight of women in the compared groups increased (Fig. 2). Thus, over the period from 36 to 55 years, the body weight of women in the MG increased by 5.05 kg in absolute values, and in women in the CG by 7.21 kg.

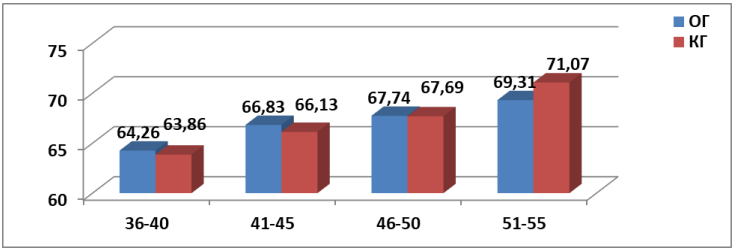

Figure 2. *Changes in body weight within one age period of ontogenesis in women from the MG and CG of the second mature age.*

The calculated values of BMI within one age period of ontogenesis in women from the MG and CG during the second mature age indicated its increase as the passport age increased (Fig. 3).

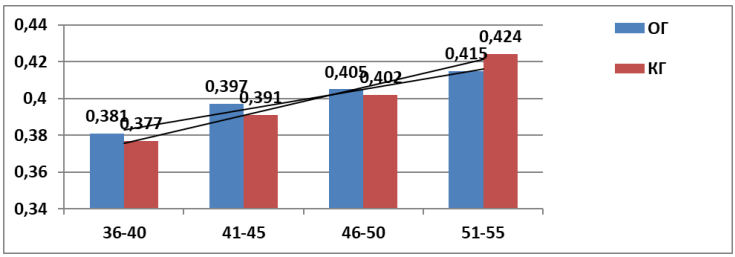

Figure 3. *Calculated BMI values within the same age period of ontogenesis in women from the MG and CG.*

The normative values of the Quetelet index in women are taken to be 325-375 g/cm^2, so we can conclude that in all the women we examined it exceeded the normative values. Thus, in women from the MG for the period from 36 to 55 years, the age-related increase in the Quetelet index in absolute values was 0.034 g/cm, in women from the CG it was 0.047 g/cm.

If we take the body length in m2 as the calculated values, then the Quetelet index will look as follows (Fig. 4). Consequently, according to this calculation, the Quetelet index in women of the compared groups corresponds to normal body weight, since it ranges from 18.5 to 24.9 g/m^2. Thus, we note that a body mass index of less than 25 kg/m^2 is "ideal" for the cardiovascular system and, naturally, health, which is consistent with the opinion of [24].

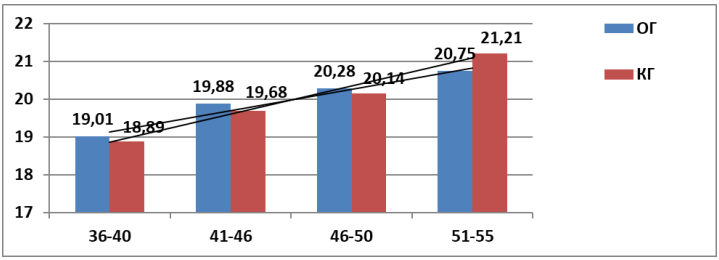

Figure 4. *BMI values within the same age period of ontogenesis in women from the MG and CG.*

Thus, based on the study, we can conclude that BMI in women of the second mature age of the MG and CG, including those with a combination of IHD and IDA, depends on the passport age. At the same time, "morphological scissors" are reliably observed ($p<0.05$), when women's body weight in absolute values increases, and body length decreases. For the first time in cardiological practice, the conditional division of the studied 9th period of human ontogenesis, lasting 20

years, into four time intervals of equal duration showed a significant age-related increase in the Quetelet index. In women with a combination of coronary artery disease and iron deficiency anemia, more pronounced age-related changes in the Quetelet index are detected in comparison with healthy women.

Conflict of interest. The authors declare no conflict of interest.

Research transparency. The study had no sponsorship. The authors are solely responsible for submitting the final version of the manuscript for publication.

Declaration of financial and other relationships. All authors participated in the development of the topic, study design and writing of the manuscript. The final version of the manuscript was agreed upon and approved by all authors. The authors received no royalties for the study.

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机械工程产品计算机辅助设计系统决策的方法和算法
METHODS AND ALGORITHMS FOR MAKING DECISIONS IN COMPUTER-AIDED DESIGN SYSTEMS FOR MECHANICAL ENGINEERING PRODUCTS

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抽象的。 本文根据指定标准讨论机械工程产品的设计过程。 为了快速、高质量的产品开发，需要在开发阶段对设计对象进行全面的分析和计算。 第一个设计任务是开发正确的工程解决方案，以确保产品发挥其功能。 为了找到唯一的最终结果，需要从一组替代方案中做出决定。 这样，在获得智能决策支持模型的基础上，为CAD中的机械制造产品设计过程提供信息。 为此，首先需要分析现有的CAD系统类型，并确定提高其子系统智能化的可能性。

关键词：工程产品、数学模型、数学建模、优化算法、专家系统、决策、设计过程、自动化、优化问题、系统方法。

Abstract. *This article discusses the design processes of mechanical engineering products according to specified criteria. For fast and high-quality product development, a comprehensive analysis and calculation of the designed object at the development stage is required. The first design task is to develop the correct engineering solution to ensure that the product performs its functions. To find the only final result, it is necessary to make a decision from a set of alternative solutions. Thus, obtained on the basis of models of intelligent decision support, the process of designing machine-building products in CAD is provided with information. For this, first of all, it is necessary to analyze the existing types of CAD systems and determine the possibility of increasing the intelligence of their subsystems.*

Keywords: *engineering product, mathematical models, mathematical modeling, optimization algorithms, expert system, decision making, design process, automation, optimization problems, system approach.*

Introduction. The increase in the level of technical progress is accompanied by the complication of manufactured technological products and methods of obtaining them. For fast and high-quality product development, a comprehensive analysis and calculation of the designed object at the development stage is required. The first design task is to develop the correct engineering solution to ensure that the product performs its functions. To find the only final result, it is necessary to make a decision from a set of alternative solutions.

Despite the significant mathematical capabilities of some software products, they only automate certain engineering tasks. Algorithms and methods that implement the automation of the design of mechanical engineering products according to the specified criteria have not yet been determined.

The creation of any mechanical engineering product is preceded by design, i.e. a description of the engineering products to be created. The purpose of the design process is, first of all, that on the basis of a priori (initial) information and a posteriori (additional) information obtained in the design process, develop the technical documentation required for the manufacture of the design object.

Problem statement. The process of designing mechanical engineering products can also be represented as a hierarchy of decisions, which is conveniently represented using a graph. Taking point O (Fig. 1) as the formulation of the problem, the options for its solution can be represented by the sections a_1, a_2, a_3, etc. Several subproblems correspond to each variant: v_{11}, v_{12}, v_{21}, v_{22}, v_{23}, v_{31}, v_{32}, v_{33}, etc. Sometimes it may be possible to obtain acceptable solutions for all subproblems, in which case the designer must choose the option that best suits the design purpose.

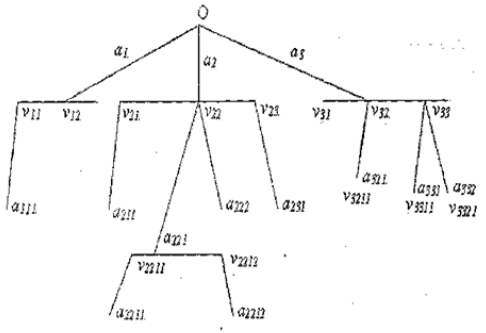

Figure 1. *Diagram of hierarchical solutions design process*

Suppose, for example, that after choosing option a_3 and solving all related subproblems v_{31}, v_{32}, v_{33}, it is found that there is no next level solution for subproblems v_{32}. Then it is necessary to discard option a_{321} and try to find a solution to other problems associated with options a_{331} and a_{332}. If, however, it turns out that none of the subproblems v_{3311} and v_{3321} can be solved, then it is necessary to return back to the branching point of the previous, higher level (in this case, to the point O).

The choice of ai options is a creative, difficult to formalize process. But as you move down the tree, the complexity of the formalization decreases and the implementation of its solution becomes easier.

It should be noted that the design process can be simplified and its quality can be improved if an expert decision support system is used to ensure the manufacturability of the product. Having clarified the conditions affecting machine-building products, as well as their relationship with other systems (technical means), it turned out to be possible to formulate optimization problems that are important for practice [1].

Taking into account the specifics of the design process of mechanical engineering products and the tasks to be solved, the main features of the approach used can be reflected in the following provisions.

1. As an optimized projected machine-building product, a certain complex of elements corresponding to the performance of functions is taken, endowed with specified properties and having abstract connections with external conditions and systems.

In this complex, in the process of research, each element can be given the desired properties without taking into account real characteristics in order to identify the possible contribution of these properties to the processes under study and, therefore, to justify the requirements for a promising solution of this element. In practical optimization problems, it is assumed that the properties of elements and their functional and technical characteristics are known, and therefore, the functioning processes are considered in the field of admissible (taking into account the adopted restrictions) solutions of systems. Both in the first and in the second, as well as in the case of software (development of algorithmic complexes), the evaluation of the complex under consideration is made taking into account the totality of known processes and phenomena and the relationship between them. All this brings to the fore such features of the model of designed machine-building products, which help to clarify the mechanism of functioning of this complex in order to choose the least weight or cost.

The most important thing is that in all cases the system includes the concept of a whole, consisting of interrelated, interacting and interdependent parts. Moreover, the properties of these parts depend on the system as a whole, and the properties of the system depend on the properties of its parts.

2. For specific designed engineering products, a place in the general structure of other systems must be determined. The systematic approach requires a reasonable allocation of the system under study in the general composition of systems designed to maintain normalizing parameters, dividing it into subsystems.

Mechanical engineering products are considered as an independent object of study and optimization, but taking into account the necessary exchange of information with adjacent and external systems and within it - between subsystems.

The selected general structure of systems should clearly outline the boundaries of the system under study and facilitate the selection (structuring) of such subsystems that are available for research in terms of their size and are homogeneous in description. All this ensures the organization of connections at each successive level of descent from the system to individual elements from top to bottom, with the subsequent transfer of the received aggregated information upward (bottom-up).

Integrity properties must be inherent in both the general structure of compensation systems and the subsystems of mechanical engineering products: changes that have arisen in any of their parts affect both other parts and their entire set.

3. Engineering products are presented as a model. When designing complex systems, such as engineering products, knowledge is required about the quantitative and qualitative patterns of behavior of the system and its individual elements, depending on the nature of changes in numerous factors (parameters).

The model should be similar to the original, but also different from it. Its distinctive features are manifested in the fact that it undergoes such transformations in the desired direction, which are impossible with a direct study of the original.

Mathematical modeling allows you to study only those parameters of the original that have a mathematical description that adequately reflects the behavior of the original. When developing a model, it is very important to get rid of connections and relationships that make it difficult to understand the object of research in accordance with the set goals. At the same time, it is important that fundamentally clear ideas do not become overgrown with heavy and cumbersome details.

The choice of a model is a central part of the work on the formation of the research methodology and depends on the main idea that determines the search for the extremum of the goal function.

To solve a number of optimization problems, the well-known mathematical methods of searching for the extremum of functions of several variables can be applied, for example, in classical mathematics, this is the solution of a system of linear equations obtained by equating to zero the partial derivatives of the function under study with respect to the optimized parameters, and the method of indefinite Lagrange multipliers. These methods are valid in the absence of restrictions on the optimized parameters or under equality constraints [2,3].

Conclusion. Thus, obtained on the basis of models of intelligent decision support, the process of designing machine-building products in CAD is provided with information.

For this, first of all, it is necessary to analyze the existing types of CAD and determine the possibility of increasing the intelligence of their subsystems;

Develop mathematical models of a decision support system for design development;

Develop an algorithm for optimizing the designed product;

Develop an expert decision support system to ensure the manufacturability of the product.

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处理来自社交网络的信息以分析紧急情况的后果的特征
FEATURES OF PROCESSING INFORMATION FROM SOCIAL NETWORKS FOR THE CONSEQUENCES OF AN EMERGENCY SITUATION ANALYZING

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抽象的。 近几个月来，地球不同地区出现了各种紧急情况：地震、海啸、洪水、火山爆发、异常气温。 所有这些事件都在社交网络上引起了热烈讨论，自然灾害受害者发布了大量信息。 本文介绍了对出版物的分析结果，其目的是确定受洪水影响最大和最小的地区。 分析结果既可用于简化后果的消除，也可用于进一步分析，以便在情况可能再次发生时减少后果。

关键词：紧急情况、洪水、洪水、风险、机器学习、地理编码。

Abstract. *In recent months, various emergency situations have been observed in different parts of the planet: earthquakes, tsunamis, floods, volcanic eruptions, abnormal temperatures. All these events were actively discussed on social networks, with a lot of information posted by victims of natural disasters. The article presents the result of an analysis of publications, the purpose of which was to identify the areas most and least affected by flooding. The results of the analysis can be used both to simplify the elimination of consequences, and for further analysis in order to reduce the consequences in case of possible recurrence of situations.*

Keywords: *emergency situations, floods, flooding, risks, machine learning, geocoding.*

In the fall of 2023, a series of floods occurred in a number of countries, as a result of which major cities such as Sochi, Tuapse (Russia), Istanbul (Turkey), Madrid (Spain) and many others were damaged. A number of coastal cities were flooded, buildings were seriously damaged, and some were partially destroyed. Given the large number of buildings that suffered major damage, due attention is not always given to buildings that suffered significantly less damage. However, even for such buildings, flooding can have long-term consequences, which can cause further destruction.

There are various studies aimed at predicting possible emergency situations, including using machine learning [1]. As a rule, long-term weather observations are used, and a correlation is established between changes in parameters and the occurrence of an emergency [2,3].

However, it is not enough to predict an emergency situation and evacuate people in a timely manner. It is also important to restore damaged objects after the situation has returned to normal.

The proposed tool allows you to collect and process messages posted on social networks. Even in cases where the owners of the premises did not contact the appropriate services, considering that the building was not damaged or the damage was minimal, they will share the information on social networks. This information can be used to assess the impact of a natural disaster on individual areas.

The approach involves 3 stages of working with data.

Stage 1 – selecting communities on a social network and specifying keywords or tags that correspond to the desired situation. Selecting a circle of communities allows us to exclude information about similar situations in other settlements that are not of interest to the researcher. This stage is carried out by the researcher.

Stage 2 – collection and processing of text information about the desired situation. This stage is implemented automatically. Pre-processing of text is an important step in working with natural language, since the texts that need to be processed may be unstructured, contain various noises and errors, and also contain a lot of unnecessary information. This can significantly affect the quality of the information obtained and the efficiency of natural language processing algorithms.

Conducting text preprocessing also helps reduce data dimensionality and improve the performance of natural language processing algorithms. The result is more accurate and reliable results, making this process important when working with text data.

Many publications left on the Internet contain a large amount of additional information that can interfere with the analysis. Such information is URL links; user tags – usually look like an "@" sign followed by the ID of the user mentioned in the post; hashtag signs - keywords marked with a "#" sign. You can clear the text from the described information using regular expressions. Also at this stage, the text is first cleared of punctuation marks and converted entirely to lower case.

Then the following stages of text preprocessing are carried out: tokenization, removal of stop words, POS markup, lemmatization, vectorization.

After preprocessing, the accuracy of text processing methods should increase, since all words are reduced to the same form, thus, forms of a word in different cases are considered the same word. The first four steps can be useful when applying statistical methods for text analysis, for example, identifying the most popular words, highlighting keywords, etc. The fifth stage is necessary for further text

processing, for example, when determining the significance of each word in the text using the TF-IDF method.

Stage 3 – geocoding and visualization. Geocoding is the process of converting an address or place name into map coordinates (latitude and longitude) and vice versa. The use of geocoding services is necessary to mark any geographical location on the map. There is also the concept of reverse geocoding - this is the process of converting the coordinates of a place on the map into its address. Usually in this situation, an address is returned that describes the marked location as accurately as possible, sometimes it can be a house number and street name, sometimes it can be the name of a region of the country, if there is nothing in the specified location.

To conduct the experiment, there was a study of floods in Sochi on November 26-27, 2023. A circle of communities dedicated to the city was identified as a data source, and users living in the city of Sochi were filtered, since it was found that many users post information only on personal pages, not in communities. Discussion statistics are reflected in the heat map (Fig. 1).

The analysis revealed the following feature of the analysis of messages posted on social networks. If a message contains a geotag, it may indicate the location where the user is currently located, which does not always correspond to the location that he mentions in the text. Preference should be given to addresses specified in the text, and geotags can be used as auxiliary data if the address is not specified in the text. To clarify the address, the information posted in the comments may be checked. In addition, the comments may provide information about the consequences of the emergency for other locations. In the above experiment, not only posts, but also comments on them were collected and processed. However, in the process of checking the received data, another feature of the analysis of messages from social networks was revealed: information can be duplicated, i.e. posted unchanged or slightly modified in several communities. Comments can also be repeated across different posts. The problem of duplication can be solved by matching records and deleting one of them if there is a match, but other methods can be proposed.

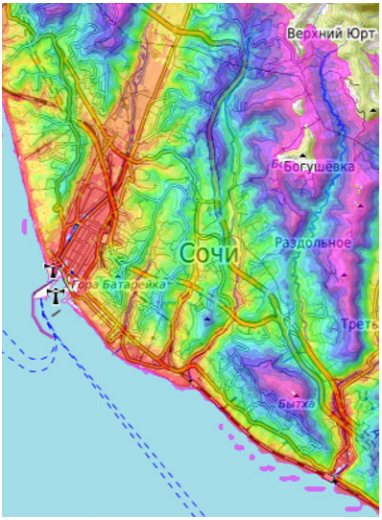

Figure 1. *Statistics of discussions about flooding in Sochi*

In conclusion, it was concluded that social media provides a wealth of useful data that can be used for disaster assessment and management. It must be taken into account that many users can participate in the discussion, including those located in areas not affected by the emergency situation. Therefore, it is necessary not only to extract addresses from messages, but also information about the situation, since extracting only addresses can distort the picture of the incident.

The results of the work may have practical significance for rescue services and first responders. The developments can be used as part of larger information analysis and decision-making systems. The work was carried out with the support of the Grant of the President of the Russian Federation MK-918.2022.1.6.

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寻找紧急信息的社区推荐系统
COMMUNITY RECOMMENDATION SYSTEM FOR FINDING EMERGENCY INFORMATION

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抽象的。 近几个月来，地球不同地区出现了各种紧急情况：地震、海啸、洪水、火山爆发、异常气温。 所有这些事件都在社交网络上引起了热烈讨论，自然灾害受害者发布了大量信息。 本文提出了一种实现推荐系统的方法，该系统用于收集并随后分析描述特定事件的消息。

关键词：紧急情况，推荐系统，冷启动，信息检索。

Abstract. *In recent months, various emergency situations have been observed in different parts of the planet: earthquakes, tsunamis, floods, volcanic eruptions, abnormal temperatures. All these events were actively discussed on social networks, with a lot of information posted by victims of natural disasters. The article presents an approach to implementing a recommendation system for collecting and subsequently analyzing messages that describe a specific event.*

Keywords: *emergency situations, recommendation system, cold start, information retrieval.*

According to statistics, about 49% of the world's population is actively involved in at least one social network [1]. Social media users interact with each other's content, send each other messages, participate in discussions in various communities, and so on. Often, user interactions are not only entertaining, but can also contain useful information in case of discussion of any events. It is believed that a certain event has a clear localization. Depending on the significance (visit of a media person) or intensity (emergency situation), the discussion can also extend to residents of the entire country or a particular region, or be limited to residents of one city or region. Depending on this, you can determine the circle of communities where the discussion takes place. Users are often recommended as possible friends to classmates, neighbors, or friends of those people who are already on the user's friends list. The same recommendation system can also be used to determine the range of communities to search for useful information.

Traditional approaches to building recommender systems include content filtering, collaborative filtering, and hybrid filtering. Modern approaches take into account location, context, and semantics.

Although much research has been done to improve the state of recommender systems using machine learning approaches, there are still many challenges affecting these systems today. Some of them are described below. Cold start problems occur when there is insufficient data. This could be a cold start, in which case there is a lack of information about the items or users. Cold start problem caused by data sparsity. As the number of customers and products increases, scalability issues arise.

Obtaining information about users and communities can be useful when building a recommender system. In many cases, semi-supervised graph-based learning algorithms are suitable [2].

Work [3] describes the use of implicit sentiment analysis, which further improves the performance of recommender systems. With this approach, it is possible to create more comprehensive user profiles than traditional content-based approaches.

The work [4] proposes to use a hybrid system based on content and collaborative filtering.

A persistent problem with such solutions is that they suffer greatly from cold start problems.

The proposed approach is based on the assumption that most social network users include detailed information about themselves, and communities have detailed descriptions. If you set the localization and keywords to describe the event, the system can suggest a range of communities that can be considered for information searches, and with the appropriate settings, a range of users will be suggested. For communities, the number of subscribers and the relevance of information (date and time of the last post and comment to it) are analyzed. This way you can exclude from consideration communities in which there is low activity of the administration and users.

Social media data is unstructured, so it needs to be pre-processed first using various techniques such as tokenization, stemming, stop word removal, and noise removal.

There are various feature extraction methods, including bag of words, TF-IDF, word embedding and natural language processing “NLP”.

After preprocessing, we perform topic extraction using LDA.

Popular processing tools were used to conduct the experiment, such as numpy for array manipulation, sklearn for feature extraction, re for formatting string data, and the nltk library for preprocessing.

This way, a learning model can be created that can predict the topic weight of new datasets to reduce build time and save resources. To do this, the data set was divided into training and testing subsets. In this case, the test data set constituted 20% of the entire data set.

Table 1.

Comparison of the proposed approach with other known approaches.

Approaches	Cold start	Safety	Sparsity
Filter by content	-	-	-
Collaborative filtering	+-	+	-
Hybrid filtration	+	-	+
Cross-language filtering	-	+	-
Proposed approach	+	+	+

The proposed approach can be used to implement an auxiliary tool for automated search of information about an emergency situation. If the user specifies a certain situation and its location (for example, a flood in Sochi), the system will analyze all communities that relate to the specified location, profiles of residential users and publications on this topic. In this case, the information will be automatically updated as new posts or comments are published. The user can accept all system recommendations or exclude some of them. This development, however, makes it easier to find communities where useful information has been published, and frees you from the need to manually search for communities.

If an analyst regularly searches and collects information about any emergency situations, especially in a certain location, the system can adapt to these requests and select the most informative communities.

It should be noted that in this work we are talking about the collection and analysis of text information only. However, the use of data such as images or videos may be a direction for future research.

The results of the work may have practical significance for rescue services and first responders. The developments can be used as part of larger information analysis and decision-making systems. The work was carried out with the support of the Grant of the President of the Russian Federation MK-918.2022.1.6.

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蔬菜原料的干燥方法
METHODS OF DRYING VEGETABLE RAW MATERIALS

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抽象的。 这篇文章描述了哈萨克斯坦南部辛辣蔬菜的有益特性。 为了确保辛辣蔬菜的适当质量，有必要观察该过程的技术特征。 为了确定最佳干燥方法，本文考虑了对流干燥、真空微波干燥以及对流干燥和真空微波干燥的组合。 考虑了干燥蔬菜原料的经典技术。 目前，世界实践中使用了多种干燥蔬菜原料的方法：对流、升华、使用微波和红外辐射及其各种改进。 描述了每种方法的特点，同时考虑了其优点和缺点。 现代干燥技术的技术特点是为了提高成品质量。 分析结果发现，最有希望降低成本的方法是使用高度冷却剂再循环和对干燥材料的联合供能。 根据分析审查的结果，确定了不同干燥蔬菜原料方法的使用程度。

关键词：方法、方法、干燥、蔬菜原料、辣味药材。

Abstract. *The article describes the beneficial properties of spicy greens of the south of Kazakhstan. To ensure the appropriate quality of spicy greens, it is necessary to observe the technological characteristics of the process. To determine the optimal drying methods, the article considers convective, vacuum-microwave and a combination of convective and vacuum-microwave drying. The classical technology of drying vegetable raw materials is considered. Currently, various methods of drying vegetable raw materials are used in world practice: convective, sublimation, using microwave and IR radiation and their various modifications. The features of each method are described, taking into account the advantages and disadvantages. The technological characteristics of modern drying technologies are given in order to establish an improvement in the quality of the finished product. As a result of the analysis, it was found that the most promising ways to reduce costs are the use of a high degree of coolant recirculation and combined energy supply to the dried material. As a result of the performed analytical review, the degree of use of different methods of drying vegetable raw materials was established.*

Keywords: *method, method, drying, vegetable raw materials, spicy herbs.*

The south of Kazakhstan is characterized by the growth of a large number of wild and cultivated herbs. Spicy greens have very useful properties. It contains vitamins: C, B, A, PP, E and a lot of potassium. These healthy greens also contain iron, sodium, calcium, phosphorus, magnesium, and zinc. Eating greens normalizes the metabolic processes of the body. By regularly eating spicy greens, the function of the gastrointestinal tract is normalized, toxins are eliminated from the body. All these substances are quickly digested and perfectly promote hematopoiesis. Due to its composition, greens strengthen the immune system, have a diuretic and anti-inflammatory effect, remove fat residues and participate in the breakdown of hard-to-digest food. Greens are very useful for people suffering from impaired kidney and liver functions, removes swelling. Green seeds are very rich in essential oils [1].

Thanks to the development of greenhouse farming in Kazakhstan, people have the opportunity to use greens in food all year round. But not all Kazakhstanis live in the city and have such an opportunity. There is a thought about the need to dry spicy greens in such a way as to preserve as many useful properties as possible. According to regulatory documents, dried spicy greens are a product of drying fresh greens. It is available in bulk or in powder form. The greens are dried to a moisture content of 14 and no more than 8%. The classic drying technology is as follows. The raw materials received by the enterprise are inspected, removing yellowed leaves, stems, foreign impurities, washed from contamination in running

water in baths, sent for rinsing in shower machines. After washing, the greens are fed to the brine drain nets and sent to dry [2].

The modern process of drying fruits and vegetables should ensure the maximum possible preservation of the initial properties of raw materials, increase the duration of the consumption period (more than 12 months) while simplifying storage (no special equipment is required) and transportation of finished products (lighter than fresh raw materials from 4 to 30 times).

Currently, various methods of drying vegetable raw materials are used in world practice: convective, sublimation, using microwave and IR radiation and their various modifications.

To prepare vegetables for long-term waste-free storage and subsequent use (which significantly reduces the seasonality factor in the processing of agricultural products), a technology for producing intermediate moisture products (PIMP) is used. In the production of PIMP, standard raw material preparation lines before drying, a universal dryer, and a freezer are used. The final operation is vacuum packing.

PIMP dryers of the Convective Drying (CD) series using a convective drying method are built on a modular principle, which allows them to vary their performance. The disadvantage of the method is a significant material and energy consumption [3].

Brief characteristics of modern drying technologies are given in Table 1

Table 1

Technologies for drying fruits and vegetables

Technologies	Brief description
Combined drying	Energy-saving up to 0.8 kWh in evaporated moisture when compared with convective. Reduction of drying time, preservation of nutrients and vitamins 92-98%, complete destruction of microflora
Production of intermediate moisture products	The use of dryers of the CD series (steam, gas, liquid fuel) for energy supply, the possibility of regulating the degree of recirculation of the coolant from 5 to 90%. Energy savings for the preparation of the coolant 20-25%
Production of dried fruits and vegetables by microwave vacuum method	The use of evaporated heat makes it possible to increase productivity by about 20%. Waste-free. Complete destruction of the microflora. The retention of useful substances is 92-98%
Conductive infrared drying of fruit and vegetable mash	It is 1.5-1.8 times more economical than convective drying in terms of energy costs, and by 30-40% in terms of specific metal capacity. Eliminates the burning of mashed potatoes. Does not require chemical additives

Cold vacuum drying	Conducting the process at positive temperatures of 5-10 °C and a pressure of 0.8-1.2 kPa makes it possible to reduce the drying time and specific energy consumption for evaporation of water by almost 10 times compared with sublimation, does not require deep pre-freezing of the dried product, which in its quality is practically not inferior to freeze-drying powder
Drying using infrared emitters	The use of periodic air purging in the drying process ensures the treatment of a dietary product with minimal loss of quality indicators.
Freeze drying	Blanching operation is excluded. The vitamin content in the resulting product is at least 96% of the raw material
Vacuum freeze-dried continuous drying with combined energy supply	Grinding and sorting take place in vacuum conditions, exposure to microwave and ultrasound fields, and a heated drying unit. The resulting products are close to the original raw materials in terms of vitamin C content – 93-94%

The main directions of improving drying technologies are improving the quality of the product and resource conservation, the latter is achieved by reducing the energy intensity of equipment and technological techniques. An analysis of the data in Table 1 shows that all technologies meet these requirements to one degree or another. However, the most promising ways to reduce costs are the use of a high degree of coolant recirculation and combined energy supply to the dried material. The use of ultrasound makes it possible to reduce the process temperature to values that ensure the safety of biologically active substances, increase the speed of the drying process and, consequently, reduce energy consumption, reduce the loss of the dried product. Ultrasonic drying equipment adapts to traditional drying plants (with a vibrating boiling layer, spray, tunnel, drum), significantly increasing productivity. In the ultrasound field and the atmosphere of an inert gas, in addition, the specific energy consumption of evaporated moisture is reduced by 3 times compared to contact drying [4].

Heinen (Germany) offers drying technology using high-performance belt drying plants designed for large enterprises. Their distinctive design feature is the gas-tight design, which avoids contamination of the dried products from the outside. For drying small batches of products, Striko (Germany) produces small-sized modular models up to 4 m long. Heating is carried out through the register by various heat carriers – steam, hot water or oil. Direct fire heating via gas burners is also provided. The temperature is continuously adjustable from 60 to 200 ° C. Depending on the type of product to be dried, the speed of transportation and the processing time can be changed from 5 to 25 minutes using a frequency converter. Along with a synchronously operating cleaning brush, high-pressure and non-selective cleaning systems are also provided at the end of the conveyor. If it is necessary to

increase the production capacity, the installation can be supplemented with several modules. For gentle drying and cooling of delicate products, as well as products with partially adhesive properties, Allgaier (Germany) produces vibrating vortex dryers with several drying and cooling zones, the advantages of which are high productivity with optimal energy use, constant temperature conditions, reliability in operation, ease of unloading and control, ease of temperature regulation. The operation of these dryers is especially effective with a wide granulometric composition or with a small average particle diameter of the processed product. There are also no problems when processing irregularly shaped particles in cases where there is a fear of stratification of the mixture or dealing with product heterogeneity. When processing a product with a large amount of solid particles or a long processing time, dryers in the form of two-mass resonance systems are used. The technological effect is that vibration prevents or reduces the formation of individual streams in the general flow of the product. The vibrating movement of the dryer body causes a «flinging» movement, thanks to which the product is transported at no additional cost. When working with products of high initial humidity or fibrous structure, dryers are equipped with an agitator in the loading zone, and if necessary, other agitators in subsequent zones to avoid baking and cratering [5].

A new plant for drying salads and greens with a mixing system developed at the Noord-Oost-Nederland (N.O.N.) enterprise is of interest. (Netherlands). Its distinctive feature is the ability to regulate the optimal energy demand. The basis of this regulation is the control of air and product temperatures, which occurs continuously during the drying process, ensuring economical energy consumption. The same company offers a promising technology for drying lettuce and vegetable leaves using infrared radiation. The combination of the innovative STIR drying system with a dry suction system avoids damage to processed products during the moisture removal process. All operations are automated and programmable, which reduces the use of manual labor to a minimum and ensures the constant quality of the resulting product [6].

In the article [7] is considered natural drying system. The sun drying system is not capable of providing the best drying performance and quality of dried products from leafy vegetables. To provide farmers with the best options, a greenhouse-type solar dryer developed by the authors is proposed to increase the stability of coriander leaf storage. It was found that the developed greenhouse-type solar dryer is superior in terms of better preservation of chlorophyll and ascorbic acid content, the degree of rehydration and the rehydration coefficient of the dried product, as well as reducing the drying time and increasing the drying speed compared to drying in the sun. Thus, a greenhouse-type solar dryer could be an acceptable solution for drying underused leafy vegetables in order to achieve greater returns .

At the work [8] the authors considered experiments where characteristics of drying dill leaves in a thin layer under conditions of a stationary, semi-liquid and

fluidized bed at air temperatures of 30, 40, 50 and 60 °C. To construct the drying curve, the humidity values of dill were used, 12 drying models were studied. The state of drying dill leaves in a thin layer was predicted. In order to obtain the optimal network for drying dill leaves, a different number of multilayer neural networks with direct communication with a different number of hidden layers and neurons were created and tested.

The best neural network feedback topology for predicting the drying of dill leaves (moisture ratio and drying rate) was the 3-45-2 structure with the trainlm learning algorithm and the logsig and purelin threshold functions. The coefficient of determination for this topology for training, validation and testing patterns was 0.9998, 0.9981 and 0.9.

Ketumbar java or jemuju tree is a plant with many advantages, especially in medical aspects. The influence of various drying methods (in the sun, in the oven and microwave) and different ratios of solvents (ethanol and water) on the physico-chemical and antioxidant properties of E. foetidum has been determined. Drying in the sun is carried out directly under the sun at temperatures from 25 to 35 °C. Oven drying used temperatures of 30, 50 and 70 °C to dry E. foetidum, while microwave drying used power outputs of 300 and 800 watts. Extraction of E. leaves foetidum was performed using different ethanol:air ratios, which were 100:0, 50:50 and 0:100. The total phenol content (TPC) was calculated to determine the phenol content in E. foetidum extract. Two methods were used to determine the antioxidant activity: radical removal assay (DPPH) and antioxidant ability to restore iron content (FRAP). The results showed that microwave drying is the most effective drying method compared to other studied drying methods. The drying method using a microwave oven and an oven at low temperatures (30 and 50°C) leads to a significant decrease in the color change of E. foetidum leaves ($p<0.05$). The total phenol content showed that both microwave drying methods with ethanol ratios:water 50:50 and 0:100 gave significantly higher values ($p<0.05$). In addition, significant DPPH values ($p<0.05$) can be observed with all drying methods, with the exception of oven drying at 70°C and ethanol solvents:water in a 50:50 ratio compared to fresh leaves of E. foetidum. The results also showed that extraction using the ethanol ratio:50:50 water and microwave drying at 800 Watts showed significantly higher antioxidant activity [9].

The study presents the effect of fertilizer application on the selected quality parameters of dried material obtained from lovage and coriander plants. In the process of crop production, the plants were treated with two fertilizers containing substances that potentially act as elixirs. The dried material was obtained during a drying process carried out under optimal conditions and based on the CD-VMFD method, which combines convective pre-drying (CD) at low temperature (40°C) with final vacuum microwave drying using 240 W microwaves (VMFD).

The quality of the dried material was assessed by measuring the total content of polyphenols, the total antioxidant potential (ABTS and DPPH method) and the profile of volatile compounds (headspace-solid-phase microextraction-HS-SPME), as well as color assessment. The study showed that the introduction of the first fertilizer contributed to the improvement of the quality indicators of the obtained raw materials [10].

Saffron extract was encapsulated in a gelatin matrix using electroforming and freeze-drying methods, and the kinetics of decomposition of biologically active compounds during their storage at temperatures of 4, 24 and 35 °C compared with the control without encapsulation was evaluated. The encapsulation efficiency, thermal properties, storage stability, morphology and diameter distribution of the encapsulated saffron extract were evaluated as output parameters. In general, both encapsulation methods demonstrated excellent preservation of biologically active compounds compared to samples without encapsulation during the entire storage period. Electroforming and freeze-drying methods allowed at least 96.2 and 93.7% of crocin to be preserved, respectively, after 42 days of storage at a temperature of 35 °C with 15% saffron extract. The time parameter of the half-life (t1/2) for the control sample (with 15% saffron extract without encapsulation) was 22 days at a temperature of 4 °C, while for the sample encapsulated by electroforming, -138 days, and this corresponds to the encapsulation efficiency of crocin, picrocrocin and safranal associated with gelatin fibers with by electroforming, it was 76.3, 86.0 and 74.2%, respectively, and for comparison, the encapsulation efficiency during freeze drying was relatively lower and amounted to 69.0, 74.7 and 65.8%, respectively. Electroformed gelatin fibers also had higher melting and denaturation temperatures - 78.3 °C and 108.1 °C, respectively, compared with 65.4°C and 93.2°C, respectively, for lyophilized samples. Thus, based on all aspects, it was concluded that electroforming is a better and more effective method than freeze drying in terms of preserving biologically active saffron compounds [11].

The behavior of dill leaf samples during drying in a thin layer at three different intensities of infrared radiation was studied. It was found that the diffusion approach is the best model describing the drying process of dill leaves. The effective values of the diffusion coefficient were 6.97 109, 6.84 109 and 8.96 109 m2/s at power intensities of 1790, 1970 and 2070 W/m2, respectively. According to the first and second efficiency laws, the infrared drying system was more efficient at a higher energy intensity ($p<0.05$). However, the overall color change was maximal at the highest radiation intensity. For the studied infrared drying conditions, a power of 1970 W/m2 was recommended as the best when using infrared radiation to dry dill leaves, taking into account both performance analysis and quality changes [12].

Drying of delicate red stigmas of Crocus sativus L. flower It is necessary to obtain saffron, the most expensive spice in the world. Until now, laborious methods

of sample destruction have been used to gain vital insight into this process after key physico-chemical changes. Vibration spectroscopy tools, which allow obtaining molecular prints of plant tissues using multidimensional data analysis, are still not used. This work highlights the novelty of combining non-destructive IR spectroscopy techniques using traditional methods to more accurately assess desired or undesirable changes after saffron drying. In addition, the spectral fingerprinting method offers an economical and environmentally friendly solution for fast and non-invasive control of raw materials of great interest for use in the food industry and nutraceuticals [13].

The purpose of this study was to determine the drying curves of the rhizomes of ground saffron (Curcuma longa L.) at various temperatures and ventilation conditions to correct nonlinear regression models and calculate effective diffusion coefficients and activation energies. Then they were measured, disinfected and cut into pieces with a thickness of 2.63 ± 0.1 mm. The rhizomes were dried in a forced-ventilation oven at temperatures of 45, 55, 65 and 75 ° C for 18, 14, 10 and 9 hours, respectively. As the temperature increased, the drying time decreased. Consequently, the moisture content also decreased, which facilitated the drying process by reducing the energy required to remove water molecules. Among the analyzed models, the Midilli model corresponded best to the data under various air drying conditions. The effective diffusion coefficients (D) were 9.17 × 10-11, 13.33 × 10-11, 20.09 × 10-11, and 35.89 × 10-11 m2 s-1 at 45, 55, 65 and 75 °C, respectively, increasing with increasing temperature. The activation energy of liquid diffusion during drying was 21.186 kJ mol-1 [14].

Based on the results of the review of available scientific, technical and patent information using search engines and the Internet, it is possible to judge the degree of technology and technique of drying vegetable raw materials. The most used drying methods have been established. They described the advantage of each method.

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13. Insights into the FTIR Spectral Fingerprint of Saffron (Crocus sativus L.) Stigmas After Gentle Drying Treatments /Fotini Kokkinaki1 · Stella A. Ordoudi

14. Modeling kinetics of convective drying of Curcuma longa /L.1Maria S. Lima, Samuel V. Ferreira , Lнgia C. de M. Silva , Daniel E. C. Oliveira , Paulo V. T. Leгo & Marco A. P. Silva

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利用磷工业废料制作墙体陶瓷
WALL CERAMICS USING PHOSPHORUS INDUSTRY WASTE

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抽象的。 使用基于磷硅的资源节约型技术获得高品质墙体陶瓷的可能性已经确定。 研究结果为陶瓷工业中人造原材料的使用领域的进一步研究开辟了前景。

关键词**:** 墙体陶瓷、磷硅、资源节约、强度。

Abstract. *The possibility of obtaining high-quality wall ceramics using resource-saving technology based on phosphosilicon has been established. The results of the study open up prospects for further research in the field of the use of man-made raw materials in the ceramic industry.*

Keywords: *wall ceramics, phosphorus silicon, resource saving, strength.*

The study of the possibility of obtaining wall ceramics based on man-made raw materials, such as phosphorus waste, is not only of scientific interest, but also of practical importance for the development of environmentally friendly and efficient production processes. This approach helps to reduce waste and reduce the negative impact on the environment, which corresponds to the basic principles of sustainable development.

In this work, special attention is paid to the production of wall ceramics with improved strength characteristics from a ceramic mass consisting of low-plastic loam, moderate plastic clay, bentonite and phosphosilicon.

The results of the systematization of industrial waste in the Zhambyl region by accumulation volumes made it possible to identify the emerging waste market and possible volumes of their involvement in economic turnover as raw materials for the production of building materials [1, 2]. Sanitary and epidemiological conclusions confirmed the possibility of using these wastes as mineral raw materials for all types of building materials without restrictions, since the total specific activity of radionuclides for each type of waste did not exceed 370 Bq/kg, which meets the requirements of NRB-99/2009 (Radiation Safety Standards) [3].

Many studies have been devoted to the use of phosphoric slag in the production of building materials, including wall ceramics. The research of the author of the work [4] showed that the optimal composition for the production of ceramic bricks is a composition containing, by weight, %: beidellite clay – 60, phosphoric slag – 25 and ash-slag material – 15. It was found that the introduction of phosphoric slag into the composition of ceramic masses significantly improves the physical and mechanical properties of bricks at a firing temperature of 1050°C, increases the frost resistance of bricks. However, the use of beidellite clay in large quantities limits the introduction of this technology into production, since reserves of plastic clay deposits in Kazakhstan are limited.

The author of the invention [5] obtained the composition of ceramic masses for the production of bricks, the technical result of which is an increase in the strength of products. The ceramic mass for the production of bricks contains a mixture of quartz sand, chalk, potash and/or soda ash, clay, fuel ash, previously fused with phosphogypsum and/or gypsum, in the following ratio, by weight%: phosphogypsum and/ or gypsum – 2.0-3.0; clay -54.0-61.0; fuel ash – 14.0-18.0; chalk – 3.0-5.0; potash and/or soda ash – 5.0-10.0; quartz sand – 10.0-15.0. However, the multicomponent composition, as well as the low waste content, does not classify this production as effective, since such a solution to the problem of ensuring environmental safety does not give a tangible result.

In connection with the above, the purpose of this work is to study the effect of silicon phosphorus on the properties of ceramic samples. The use of phosphosilicon makes it possible to improve the plasticity of the molding mass, which reduces the load on mechanical equipment when forming products, reduces the “fight” and produces ceramic bricks with increased physical and mechanical properties, as well as significantly reduce the firing temperature of products.

In this work, loam from “Kokterek” deposit, clay from “Karatau” deposit of the Zhambyl region and bentonite from “Ibata” deposit of the Turkestan region, whose reserves amount to 46.48 hectares, were used as the main clay components [6].

Since low-plastic loam is used as the main component, it is customary to introduce 3-10% bentonite into the composition as a plasticizing additive, as well as to improve sintering and increase the strength of ceramic samples (Table 1).

Table 1

Characteristics of clay raw materials

Raw materials	Number of plasticity	Coefficient of sensitivity to drying	Air shrinkage, %
"Kokterek" loam	3.57	0.11	3.6-4
"Karatau" clay	8	0.13	4-4.9
"Ibata" bentonite	30.5	1.82	8

In terms of plasticity, loam is classified as a group of low-plastic clay raw materials. The introduction of silicon phosphate into the composition of the ceramic mass significantly reduces its plasticity. Therefore, it is customary to introduce bentonite into the mass.

Phosphosilicon (Phosphorus-silicon) is a compound of phosphorus and silicon with the formula P_4Si. In this work, two types of phosphatized silicon are used: white and black, differing in their structure and properties. White phosphosilicon, with a content of P_2O_5 – 1.13%, has a crystalline structure and looks like a white powder. Black phosphosilicon, with a content of P_2O_5 – 3.89%, has an amorphous structure and looks like a dark gray powder. Black phosphosilicon can increase the adhesion of ceramic particles and increase the heat resistance of ceramic products, which will allow them to withstand higher temperatures without deformation and destruction.

Thus, white phosphosilicon and black phosphosilicon are completely different substances with different properties.

In most cases, pre-machining is used in the preparation of raw materials, including waste in the production of ceramic materials. During laboratory testing, the raw materials were crushed in a ball mill and sieved through sieves: clay – through a sieve No. 1, and phosphosilicon – through a sieve 0.5. As studies have shown, such granulometry is considered the most optimal in the production of wall ceramics.

The determination of the technological properties of the raw materials of the composition is carried out in accordance with State standard 21216-2014 "Clay raw materials". The water absorption and density of the burnt samples were evaluated according to State standard 7025-91 methods, strength – in accordance with State standard 530-2012.

To determine the optimal composition of the ceramic composition, cube samples with sizes 2*2 and 4*4 cm were formed. The samples were produced by plastic molding using techniques adopted in the technology of ceramic materials. After sorting, the molded samples were pre-dried in a drying cabinet (SNOL-58/350) at a temperature of 110°C to a constant mass. The samples were fired in a muffle furnace (SNOL 8.2*1100) at each set temperature with an interval of 50°C with

an exposure time of 15-20 minutes. The furnace was loaded at room temperature, unloading – no more than 60°C.

Compositions of ceramic masses were compiled for experimental work (Table 2). The content of phosphosilicon varied from 0 to 20%, bentonite – from 3 to 10%.

Table 2

Compositions of ceramic mass

Comp. no.	"Kokterek" loam	Phospho-silicon	Bentonite	"Karatau" clay	Molding moisture, %	
					phospho-silicon white	phospho-silicon black
1	100	0	0	0	15.67	
2	95	5	0	0	16.28	17.65
3	90	10	0	0	15.6	15.6
4	85	10	5	0	18.34	17.65
5	80	10	10	0	19.76	19.04
6	80	15	5	0	16.96	18.34
7	0	0	0	100	22	
8	**0**	**5**	**0**	**95**	**22.69**	**21.21**
9	0	15	0	85	21.9	21.21
10	0	20	0	80	20.5	18,3
11	**0**	**7**	**3**	**90**	**20.5**	**20.48**
12	0	5	5	90	21.21	20.48
13	**0**	**10**	**5**	**85**	23,46	22.7
14	0	10	10	80	25.78	23.45
15	0	15	5	80	21.95	22.7
16	0	20	5	75	21.21	19.76
17	30	15	10	45	21.95	21.21

Table 3

Change in compressive strength of samples of various compositions depending on the firing temperature, MPa

Comp. no.	Strength at firing temperature, °C			
	950	**1000**	**1050**	**1100**
1	1	1.5	2.2	3.3
2	3.1/3	4.2/4.4	4.5/3.9	3.7/1.5
3	3.4/3.2	5.5/4.8	3.2/4.3	2.6/2.4
4	8.5/8.3	8.8/8	9.5/8.3	19.3/14.4
5	6.9/6.3	4.9/4.3	5.8/5.6	11.4/9.9
6	6.4/5.8	6.3/5.3	7.5/4.3	10.7/10.1

7	4.8	5.5	6	8
8	22.53/22.53	24.3/15.6	26.63/26.03	21.4/18
9	6/5.5	6.5/6	6.3/6.3	11.5/10
10	5.6/5.5	6.5/6	6.3/6	11/10
11	7.7/7	9/8.9	11/9.5	13.5/12
12	25.2/21.3	34/26.37	25.67/21.37	24.3/21.1
13	12.9/12.6	27.27/25.2	20.5/14.9	16.7/14.7
14	20.5/10.2	27.37/19.5	21.3/15.25	18.8/13.8
15	20/19.75	23/13.5	19.6/17.5	14.7/12.25
16	17.8/17.7	16.6/15	19.3/13.3	17.05/16.7
17	-	16.5/14.6	24.3/23.4	16.48/14.5

*** In the numerator, the values using white phosphosilicon, in the denominator – with black phosphosilicon*

During the research, it was revealed that with an increase in the content of phosphosilicon above 10% (in the absence of bentonite and plastic clay “Karatau”), the coherence of the ceramic mass begins to lose, therefore, the formability deteriorates. In the presence of bentonite 5-10%, as well as with complete (compositions 9, 10, 15, 16) and partial (composition 17) replacement of “Kokterek” loam with “Karatau” plastic clay, the strength of the samples begins to improve. In addition, the firing temperature is reduced by 50 ° C (compositions 15, 16, 17). The data in Table 3 and Fig. 1 shows that ceramic masses made of pure “Kokterek” loam (composition 1 – 3.3 MPa) and pure “Karatau” clay (composition 7-8 MPa) without the use of corrective additives, maximum strength is achieved at a firing temperature of 1100°C.

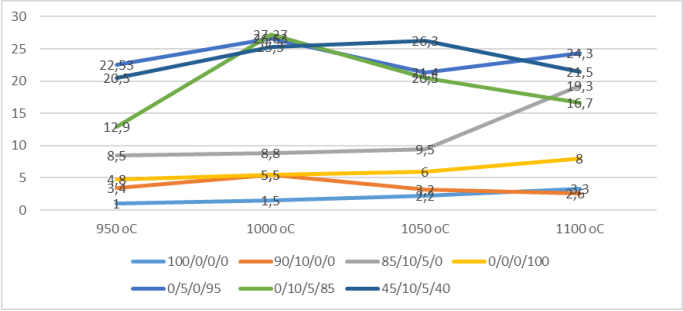

Figure 1. *Change in compressive strength of samples of various compositions (using white phosphosilicon) depending on the firing temperature, MPa*

Analysis of changes in the strength of heat-treated samples in the presence of a 5% phosphosilicon additive in the composition showed an increase in strength already at a firing temperature of 950°C (compositions 2 and 8), and at 1050°C a decrease in strength occurs. With the addition of phosphosilicon, the strength of the samples was only 5%, respectively (composition 2 – 4.5 MPa, composition 8 – 26.63 MPa), while the reduction in the firing temperature is 100°C. As a result of the interaction of silicon phosphorus with other components of the ceramic mass, gases can form at high temperatures. The resulting gases can create pressure inside the material, causing swelling.

With the addition of bentonite to the loam up to 5%, the strength of the samples increased markedly: at 1000°C – up to 8.8 MPa, and at 1050°C the strength was increased to 9.5 MPa and at 1100°C a strength of 19.3 MPa was achieved (composition 4). A ceramic shard with a strength of 8 MPa (composition 6) can be obtained from pure clay without additives at a firing temperature of 1100°C. With the addition of phosphosilicon to clay up to 5%, the strength of the samples increased markedly: at 950°C – up to 25.2 MPa, 1000°C – up to 34 MPa, and at 1050°C the strength was increased to 25.67 MPa and at 1100°C the strength of 24.3 MPa was achieved (composition 12).

According to the data obtained, with the addition of white phosphosilicon in an amount of 5-10% of the total mass of 20.5-25.2 MPa already at a temperature of 950°C (for example, compositions 12, 13, 14), which corresponds to the brand of brick M200-250, maximum strength of 27.27-34 MPa was achieved at a temperature of 1000°C. Further, with an increase in the firing temperature, the strength of the samples decreases, respectively, 1050°C – 20.5-25.67 MPa, 1100°C – 16.7-24.3 MPa (for the same compositions).

The combination of phosphosilicon and bentonite in a ceramic composition can lead to a synergistic effect, enhancing the influence of each of them. We can also note how the indicators differ depending on the type of phosphosilicon, respectively, when using black phosphosilicon, the strength is significantly lower in comparison with white phosphosilicon (Fig. 2).

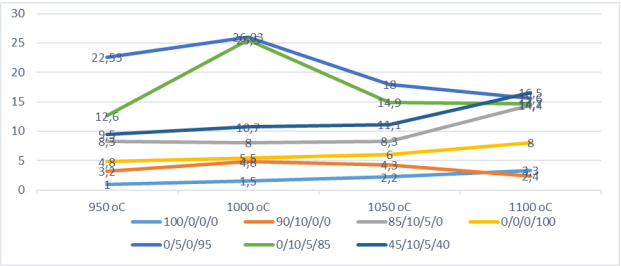

***Figure 2**. Change in compressive strength of samples of various compositions (using black phosphosilicon) depending on the firing temperature, MPa*

The above data confirm that phosphosilicon can act as an additive that strengthens the bond between the particles of the material due to the formation of phosphate compounds, which in turn can improve the structure of the ceramic mass and lead to an increase in strength with plastic clay.

Analysis of changes in the properties of the studied samples depending on the percentage of components (data from Table. 2 and Fig. 1) made it possible to optimize the compositions of the ceramic mass. The best indicators of physical and mechanical properties were obtained as a result of firing samples from composite composition 12, namely with the addition of white phosphosilicon (wt. %: loam-phosphosilicon-bentonite-clay 45-10-5-40) was selected as optimal. Thus, the possibility of obtaining high-quality wall ceramics with reduced energy costs using resource-saving technologies due to technogenic raw materials of phosphosilicon has been revealed.

Conclusion

1. It has been experimentally confirmed that the use of silicon phosphorus improves the strength of ceramic material.

2. It was found that the varieties of phosphosilicon, depending on the composition, affect the ceramic mass in different ways, respectively, white phosphosilicon strengthens the bonds between the particles of the material due to the formation of phosphate compounds, which ultimately improves the strength.

3. The optimal composition of ceramic mass containing low–plastic loam – 45%, white phosphosilicon – 10%, bentonite – 5%, clay - 1% was determined for the production of ceramic bricks by plastic molding. At the same time, a grade of at least M200-250 was achieved, while reducing the firing temperature by 50-100°C.

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以该地区 IT 行业的金融和经济状况为例，基于 IAD 方法和人工智能软件管理复杂的经济系统

MANAGEMENT OF COMPLEX ECONOMIC SYSTEMS BASED ON IAD METHODS AND AI SOFTWARE USING THE EXAMPLE OF THE FINANCIAL AND ECONOMIC STATE OF THE IT INDUSTRY IN THE REGION

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注解。 考虑创建一个基于开放数据源分析的软件综合体来管理行业的财务和经济状况（以罗斯托夫地区的 IT 行业为例）。 提出了一个用于开发数学模型、算法和软件的通用概念，这些模型、算法和软件允许基于收集各个组成部分的数据来分析和管理复杂的经济系统，以及基于指标的模糊集聚合进行分析。

关键词：复杂经济系统分析； 模糊集聚合； 集成软件包。

Annotation*. The task of creating a software complex that manages the financial and economic state of the industry (using the example of the IT industry in the Rostov region) based on the analysis of open data sources is considered. A universal concept is proposed for the development of mathematical models, algorithms and software that allow the analysis and management of a complex economic system based on the collection of data on its individual components, as well as their analysis based on fuzzy set aggregation of indicators.*

Keywords: *analysis of complex economic systems; fuzzy set aggregation; integrated software package.*

Introduction

Currently, the direction of mathematical modeling is actively developing, aimed at analyzing complex socio-economic systems. Among the most actively used models are: dynamic models that describe the dependence of changes in vari-

ables over time and are aimed at identifying long-term trends and dynamics of the system [1], [2], [3]; network models aimed at describing the interaction between various agents in the system and allowing one to analyze network effects and the influence of one agent on another [4], [5]; agent-based models that describe systems as collections of individual "agents" interacting with each other based on certain rules and strategies, and allowing one to analyze the behavior of individual agents and its impact on the entire system [6], [7]; stochastic models that take into account random variables and uncertainty in the system and allow one to estimate the probability of various development scenarios [8], [9]; optimization models that can be reduced to problems of optimization methods and allow one to find optimal solutions for complex economic problems [10], [11]. Models based on data mining (DM), which include models based on machine learning, regression, variance, cluster analysis, time series analysis and forecasting, text analysis, etc., are especially in demand at present. Which type of model is used in a particular study depends on the research objectives, available data, the specifics of the area under study, etc. [12], [13].

Analysis of sources shows that there are no universal ready-made algorithms for analyzing the state of complex socio-economic systems, such as the regional economic sector. In the case when a researcher is faced with a question (dictated, as a rule, by a request from management): to analyze the state of a system consisting of individual subjects about which there is scattered information in open data sources, many problems arise related to the search, collection and systematization of information, methods for processing it, and most importantly - with mathematical models and methods that would allow, based on data analysis, to obtain integrated estimates suitable for practical use. Accordingly, there is a shortage of software tools that allow such studies to be carried out.

This paper proposes a universal concept for the development of mathematical models, algorithms and software that allow the analysis and management of a complex economic system based on the collection of data on its individual components, as well as their analysis based on fuzzy set aggregation of indicators.

The purpose of this research is to develop a software package that analyzes the financial and economic state of the industry (using the example of the IT industry in the Rostov region (OKVED 62)) based on open data sources in order to optimize management, including through government investment based on mathematically correct and grounded models and algorithms of DM.

Research objectives

To develop a methodology for automated data collection from open Internet sources, allowing for an analysis of the financial and economic state of a given industry based on significant indicators of individual enterprises.

To develop methods for analyzing the financial and economic state of a given industry based on a set of significant indicators of individual enterprises based on

DM methods, including assessing the state of the industry in a given year, as well as the dynamics of its state over a number of years.

To develop the necessary mathematical apparatus of DM for this, including fuzzy-set classification; systematize, develop and adapt for this purpose existing methods of fuzzy multiple classification; present mathematical justifications for the correctness of the proposed choice.

To present a model for selecting a set of indicators that are significant for evaluation, as well as their ranking based on DM methods.

To develop a methodology for multi-criteria decision-making for industry management based on the results of the analysis, suitable for use in optimizing industry management.

To create software that implements methods for analyzing the financial and economic state of a given industry based on a set of significant indicators of individual enterprises, has a user interface and is suitable for use in practice.

To test the created software using the example of financial and economic analysis of the IT industry of the Rostov region, OKVED 62 “Computer software development, consulting services in this area and other related services” in the Rostov region, by groups Micro-enterprises, Mini-enterprises, Small enterprises, Medium enterprises, Large enterprises.

Novelty of the research. At present, there are practically no methods for the corresponding analysis of individual sectors of the regional economy, with the exception of the simplest statistical estimates. The presented study fills this gap and offers a complete, mathematically based methodology for assessing the financial and economic state of the industry and managing it based on the intelligent analysis of data from open sources. The novelty of the research also lies in the use of data scraping methods on the network to solve research problems, while existing data collection methods are used, as a rule, to solve purely practical immediate problems.

The theoretical significance of the study is to develop a methodology for processing data from open sources to solve applied research problems aimed at a comprehensive assessment of the state of the industry and its management based on the apparatus of fuzzy logic, including fuzzy multi-level [0,1] classifiers as a particular the case of Younger’s OWA classifier, as well as its control using fuzzy controllers.

The reliability of the study is ensured by comparison with the results obtained by the authors of other studies, the rigor of constructing mathematical models, and testing the developed software on control samples.

The research methodology is based on the application of models, data mining algorithms, including fuzzy logic, as well as software packages that implement them, to assess the state of complex systems and control them based on complexes of ranked indicators.

Proposed mathematical models, methods and algorithms

An analysis of the available mathematical tools for assessing the state of complex systems was carried out. It has been revealed that to assess the state of complex systems, there is a detailed concept of classifiers, including fuzzy classifiers, which allow, based on a sample of data, to build a system of fuzzy logical inferences for data aggregation. Based on the developed rules, fuzzy set aggregation of data is carried out, which has significant advantages for constructing complex assessments of systems based on sets of heterogeneous indicators.

Some of the most developed classifiers are the ordered weighted averaging (OWA) operators, Yager classifiers, which provide a parameterized class of average-type aggregation operators [14], [15]. The mathematical theory of OWA operators is currently well developed, but a number of theoretical aspects need to be improved, such as the definition of membership functions, as well as methods for reasonably determining weight coefficients that allow ranking indicators taking into account their significance in the algorithm under consideration. The practical application of OWA classifiers is generally characterized by the absence of uniform approaches and algorithms. In each specific situation, a unique algorithm is compiled. which is customized based on the objectives of the study. One of the most transparent and well-developed schemes is fuzzy multi-level [0,1] classifiers. However, in order for their theory to be used for comprehensive research, it needs to be supplemented and developed. A universal concept of fuzzy multi-level [0,1] classifiers has been proposed that allow assessing the state of complex systems based on sets of indicators, as well as their specification for assessing the financial and economic state of the industry [16]. An algorithm for data aggregation is formulated for fuzzy-logical assessment of the state on a standard five-point scale based on standard fuzzy five-level [0,1] classifiers

An asymptotic modification of a fuzzy five-level [0,1] classifier based on sigmoid membership functions that approximate standard trapezoidal functions is proposed. The modification is characterized by the absence of cusp points on the curves, which facilitates the work when solving the problem of optimizing classifier weights, as a special case of the Yager OWA classifier. Depending on the problem being solved, two types of fuzzy multi-level [0,1] classifiers are proposed: static and dynamic.

Static classifiers are proposed to be used in the case where there is a single observation of the system, as well as information about which ranges of numerical values correspond to which of the designated five terms. Dynamic classifiers are proposed to be used in cases where time series of indicator values are given, and based on them it is necessary to evaluate the dynamics of the system state. Obviously, in this case, information is needed on how changes in specific indicators affect the assessment of the state of the system as a whole. For static classifiers,

methods for specifying membership functions are indicated: based on expert assessments (as in Nedosekin V.A. [17]); based on the so-called transformer functions, which take a numerical value from zero to one and indicate the normalized distance of a given numerical value from the optimal one; through the so-called response functions of systems to external influences, obtained on the basis of a study of statistical analysis of the sample; based on fuzzification of clear expert assessments for selected indicators. The latter method was tested on the tasks of this study.

A fuzzy-set modification of the spectrum-point "Methods for analyzing the financial condition of an organization" Audit-IT [18] (Software "Your Financial Analyst") is proposed. A detailed description of the proposed methodology can be found in article [19].

It is proposed to evaluate the financial and economic state of the industry by groups of enterprises (Microenterprises, Minienterprises, Small enterprises, Medium enterprises, Large enterprises). Each group is assessed in three blocks (the block of financial stability of the organization, the block of solvency, the block of profitability of activities and the block of business activity indicators). The assessment of each block is formed on the basis of three standard coefficients, the values of which are available on the TestFirm website for individual enterprises.

For each of the coefficients, aggregation is carried out into a group based on fuzzy five-level [0,1] classifiers. The term membership functions for each coefficient are fuzzy trapezoidal numbers.

The weighting coefficients of each of the three indicators are 1/3. As a result, three assessments are obtained: Q1 = "assessment of the financial stability of a group of XXX enterprises"; Q2= "assessment of the solvency of a group of XXX enterprises"; Q3= "assessment of the profitability of the group of XXX enterprises." After this, the scores for the three blocks and the final score are aggregated (balanced, weight – 0.25). The result is an aggregated TOTAL score.

Depending on the term to which the aggregated TOTAL value belongs, recommendations are output that correspond to the Audi-IT methodology.

For dynamic fuzzy classifiers, an algorithm is proposed for calculating aggregated estimates for N periods under study, as well as obtaining a final aggregated estimate based on them. The corresponding algorithm is adapted to assess the dynamics of the financial and economic state of the industry based on time series of significant indicators. Algebraic formulas are also proposed for constructing integrated estimates that allow assessing the dynamics of industry development.

A method is proposed for ranking indicators and calculating their weighting coefficients based on calculating correlation coefficients between indicators and an objective assessment of the well-being of the enterprise - the increase in the net profit rate. In this case, its own correlation coefficient on the general sample of

enterprises, related to the sum of the correlation coefficients of all used indicators, acts as a weighting coefficient. Based on Chiu's machine learning method, a mathematical model for selecting significant indicators was developed to assess the financial and economic state of the region's industry based on open data sources [20]. The algorithm was tested on data for 2021 for the IT industry in the Rostov region. It has been established that expanding the system of indicators for aggregation does not lead to a significant change in the assessment of the system, that is, the initial set of indicators is optimal.

The cognitive model of industry management is based on the standard methodology of V.B. Silov. [46]. ***Stages of applying the methodology for generating recommendations for state regulation of the industry***: 1) collecting data on the financial and economic state of the industry in the region based on open data sources, cleaning them and breaking them down into groups of enterprises (by number of personnel - Micro-enterprises, Mini-enterprises, Small enterprises, Medium-sized enterprises, large enterprises); 2) calculation of aggregated values of financial and economic assessments of individual groups based on fuzzy multi-level [0,1] classifiers; 3) calculation of correlation matrices (Pearson) of financial and economic coefficients by year, assessment of the degree of closeness of connections, formation of matrices of aggregated estimates of the degree of connection; 4) conducting a structural and scenario-target analysis of the industry, generating a list of recommendations.

Software package for analyzing the financial and economic state of the industry

Software tools have been developed that implement the proposed mathematical models and methods for assessing the financial and economic state of the industry based on sets of indicators.

Software has been developed for automated collection of key financial indicators of individual enterprises in the region's industry [21]. The software is focused on solving the research problem of collecting data necessary and sufficient to analyze the financial and economic state of the industry based on specific indicators, which distinguishes it from currently widespread scraping programs. The developed software has optimized performance and meets modern requirements for the correct use of information from the network. The following technical techniques can be noted as technical innovations of the program: pressing buttons and collecting information after pressing, delay time to bypass time restrictions on the number of clicks, checking parsing using keywords, and orderly saving the collected data.

An integrated software package has been developed to analyze the financial and economic state of the industry in the region. In order to automate labor-intensive research calculations, the design and development of an integrated software

package was carried out, processing and importing data from external sources, analyzing financial and economic indicators, their graphical presentation and export. Several software modules have been developed and integrated to load, process and generate output data in accordance with the operator's requirements: 1) data processing module; 2) data import module; 3) data module; 4) data analysis module; 5) module for analyzing the dynamics of indicators.

In the context of this task, it is advisable to create a comprehensive structural model based on two groups of modeling tools: 1) DFD data flow diagrams (data flow diagrams), which illustrate the system's business processes and their interfaces. The main purpose of such diagrams is to show how information flows circulate within the system, from the moment they arrive from external sources until they are received by external receivers; 2) entity-relationship diagrams ERD (Entity Relationship diagrams), which model the relational structure of data and their relationships.

The most important connecting part of the complex conceptual model [22] is the DFD diagram, which shows data recipients external to the system, highlights internal logical functions (business processes), information flows connecting them, as well as data storage (Fig. 1).

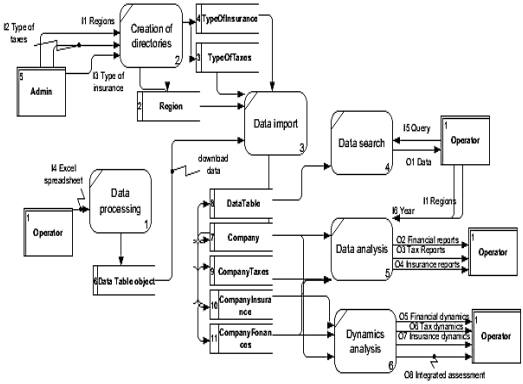

Figure 1. *DFD model of the first level*

Here $\sum_{i=1}^{6} I_i$ – is the sum of all input information flows (Inputs) entering the system from external sources E_i;

$\sum_{i=1}^{8} O_i$ - the resulting output stream (Outputs) of the system, expressed in on-screen and printed forms of reports: O1 (data) – indicators of the financial and economic condition of the company, the structure and content of which is formed dynamically in response to a request operator E_1; O_2 (financial reports) – financial and economic reports for the selected region for the year specified by the E1 op-

erator, including O_{2j} - distribution of companies by groups, amount of income by group, amount of expenses by group, amount of profit by group; O_3 (tax reports) – reports on tax payments for the selected region for the year specified by the operator E_1, including O_{3j} – amounts of payments to the National Tax Service by groups, income tax by groups, land tax by groups, transport tax by groups, property tax by groups, as well as summary amounts of all types of tax payments by group; O_4 (insurance reports) – reports on insurance payments for the selected region for the year specified by the E_1 operator, including O_{4j} - amounts of payments for social insurance, health insurance, pension insurance, as well as summary amounts of all types of insurance payments by group; O_5 (financial dynamics) – assessment of the dynamics of changes in the main financial and economic indicators of the region for the period (3 years) specified by operator E_1, including O_{5j} – total, relative and aggregated profit values by year; O_6 (tax dynamics) – assessment of the dynamics of indicators for tax payments in the region for the period (3 years) specified by operator E_1, including O_{6j} – summary and relative values of tax payments by group of companies, as well as their fuzzy-set aggregated estimates; O_7 (insurance dynamics) - assessment of the dynamics of indicators for insurance payments, including O_{7j} - summary, relative values of insurance payments by group of companies, as well as their fuzzy-set aggregated estimates; O_8 (integrated assessment) – a comprehensive assessment of the dynamics of industry development in the region based on a system of indicators "profit, taxes, insurance".

$\sum_{i=1}^{6} A_i$ – system processes that transform and redistribute input information flows corresponding to basic functions: creating directories (A_1), loading and validating data (A_2), importing into a database (A_3), filtering data (A_4), data analysis (A_5), assessment of indicator dynamics (A_6).

$\sum_{i=1}^{7} D_i$ – a system of related data stores, mainly implemented in the form of separate relational database entities (D_1, D_3-D_7) or DataTable objects (D_2).

Further decomposition of the DFD diagram of the first level requires detailing block A_3 into component processes A_{3j} (j=1..5) (Fig. 2).

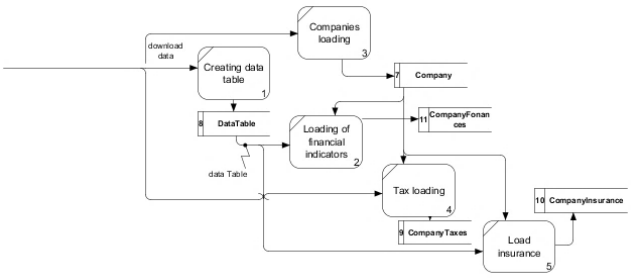

Figure 2. *DFD – second level model (detail A3 – Data Import)*

The second component of a complex conceptual model of an information system, according to [22], includes an ERD - a model, the construction of which involves identifying entities and relationships (connections between them), normalizing the resulting structure in order to achieve 3NF in accordance with the rules of relational algebra [23]. Integration into a complex structural model requires coordination and alignment with the previously constructed DFD diagram.

Stage 2. Selection of architecture and development tools. The architecture of the software solution must provide multi-user parallel mode within a local computer network. This is achieved by using client-server technology and a remote access model. In the remote access model, the architecture is organized so that the database (DB) is stored on the server, and the core of the database management system (DBMS) is also located there. Presentation and business logic is implemented on the client side [24]. The relational nature of the database used involves interaction between the server and client parts of the application through the structured query language SQL.

The client application provides human-machine interaction through a graphical user interface (GUI), as well as the implementation of modules for loading, processing and analyzing data. The application's cross-platform requirements are met through the use of the .Net Core platform. This is an open, completely autonomous platform that does not require dependence on the kernel of Windows-based systems, which allows you to run .Net applications on Unix-like systems without the use of third-party technologies (in particular, Mono) [25].

Integration with the database is provided by ADO.Net technology (ActiveX Data Objects) - the main technology for accessing relational databases for the .Net platform, supporting the client-server architecture [25]. The ADO.Net object model consists of 2 main classes: Data Provider and Data Set [26].

The Data Provider class is responsible for communicating with data sources (in particular, a database) and manipulating data. Data Set is a set of data in client memory, which is an image of one or more related tables with data that is loaded from the database. Working with data in Data Set can be done autonomously, without constantly maintaining a connection to the server, which provides a more efficient mode of operation within the network.

To integrate with a third-party Excel application, Object Likring and Embedding (OLE) technology is used - a COM-based mechanism that allows applications to interact with each other. It improves productivity by leveraging the capabilities of other programs into the application. The data processing logic is implemented based on the object-oriented programming language C#.Net 9.0, which, being a powerful language, has a number of additional advantages [9]: flexibility, object orientation, type security, "garbage collection", "syntactic sugar" and much more other.

Stage 3. Implementation of the software solution.

1) Data loading module. The initial data loading is performed from Excel spreadsheets of a given structure through a dialog box, providing the necessary GUI requirements. To implement the functionality of this module, the ImportExcel class was created, which encapsulates all methods and properties for selecting and loading xls files.

2) Data import module. The module checks the correctness of data loaded into the Data Table and imports it into the database using a set of stored procedures. Algorithms for checking and correcting imported data implement several tasks to prevent errors in working with data:

3) Data module. The module implements a user interface for working with data. Working with a large volume of downloaded data is ensured by filtering it according to various criteria: region, accounting period, company size, etc., as well as the ability to select a list of displayed fields. The main functionality of the module is provided by the *getFields(), searchVedom(), searchData(), getFilter() methods* of the Main class.

4) Data analysis module. The module implements the basic task of the program, performing analysis and graphical presentation of data in three categories: general, taxes and insurance in accordance with the external output interfaces O_2 - O_4 DFD model.

Using the developed software package, an assessment and analysis of the financial condition of companies was carried out (using the example of companies in the IT sector of the Rostov region) [28].

The module for correlation analysis of financial and economic coefficients is under development, and the analysis of the presented research was carried out in Excel. Structural and scenario-target analysis of the industry was carried out on the basis of the AI decision support system "Igla" [29], designed for synthesis, analysis and modeling of management strategies for complex, weakly structured systems, as well as the formation and support of hypotheses related to the behavior of these systems during various external influences. A detailed description of the used methodology for forming decisions on industry management can be found in the article. A detailed description of the used methodology for forming decisions on industry management can be found in article [30].

Conclusion

A software implementation of computational algorithms for analyzing the financial and economic state of the industry in the region is presented based on data on the financial state of enterprises in the region, tax and insurance payments. In order to automate labor-intensive research calculations, the design and development of an integrated software package was carried out, processing and importing data from external sources, analyzing financial and economic indicators,

their graphical presentation and export. Using the developed software package, an assessment and analysis of the financial condition of companies was carried out (using the example of companies in the IT sector of the Rostov Oblast).

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加权支架空间中奇异积分算子范数的估计

ESTIMATE OF THE NORM OF THE SINGULAR INTEGRAL OPERATOR IN WEIGHTED HOELDER SPACES

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抽象的。 我们考虑作用于两个加权 Hoelder 空间之间的奇异积分算子，并给出其范数的估计。

关键词：奇异积分算子、加权Hoelder空间、上度量维数。

Abstract. *We consider the singular integral operator acting between two weighted Hoelder spaces and give an estimate for its norm.*

Keywords: *singular integral operator, weighted Hoelder spaces, upper metric dimension.*

1) When estimate the norm of the operator of singular integral over an countable set of either rectifiable curves with infinite sum of lengths or non-rectifiable curves we will use the following characteristic which is a generalization of the sum of lengths of curves from the contour considered.

We will call the β-length of a set Γ the value

$$l_\beta(\Gamma) = \sup_{2^{-k}\le d} m_k(\Gamma)2^{-k\beta},$$

where $m_k(\Gamma)$ is the number of squares $[(n-1)2^{-k}, n\cdot 2^{-k}]\times[(p-1)2^{-k}, p\cdot 2^{-k}]$, $n,p\in\mathbb{Z}$, of side length 2^{-k} intersecting Γ and $d = \operatorname{diam}\Gamma$.

From the definition of the upper metric dimension $\alpha(\Gamma)$ (see, e.g. [1]) it follows that $l_\beta(\Gamma)$ is a finite number, if $\ge \alpha(\Gamma)$.

If Γ is a single curve of length l, then the number of squares of side length 2^{-k} does not exceed the value $9(l\cdot 2^k+1)$, i.e. $m_k(\Gamma)\le 9(l\cdot 2^k+1)$. Then for $\beta = 1$ we obtain

$$l_1(\Gamma)\le C\left|l + \sup_{2^{-k}\le d} 2^{-k}\right| \le C(l+d),$$

and we can estimate the β-length of Γ via the usual length:

$$l_\beta(\Gamma)\le 9\sup_{2^{-k}\le d} 2^{-k\beta}(l\cdot 2^k+1)\le 9(d^{\beta-1}l + d^\beta)\le 18\cdot l^\beta, \qquad \beta\ge 1.$$

We have

Lemma 1. Let Γ be a countable set of rectifiable curves Γ_j having a limiting point z_0. Let $N(r)$ denote the number of curves having common points with the set $\{z: |z - z_0| > r\}$, and let $l(\Gamma_j)$ be the length of Γ_j. If $N(r) \le Br^{-\beta}$, $r > 0$, and

$$\left(\sum_{j=1}^{\infty} l^{\beta}(\Gamma_j)\right)^{1/\beta} = l^* < \infty,$$

then $\alpha(\Gamma) \le \beta$ and for the β-length of Γ we have the estimate

$$l_{\beta}(\Gamma) \le C\left(d^{\beta} + B + l \cdot B^{(\beta-1)/\beta}\right).$$

We note that the upper bound for $\alpha(\Gamma)$, given by the estimate $\alpha(\Gamma) \le \beta$ from Lemma 1 is not often achieved. Consider, for example, the set Γ that is the union of the boundaries Γ_n of the squares

$$Q_n = \left\{z = x + iy : |x| \le n^{-\frac{1}{p}}, |y| \le n^{-\frac{1}{p}}\right\}, \qquad p > 1.$$

The requirements of Lemma 1 hold if and only if $\beta > p$, therefore, Lemma 1 gives $\alpha(\Gamma) \le p$.

Detailed analysis shows that $(\Gamma) = \frac{2p}{p+1}$.

2) Now we will consider the action of the singular integral operator between two weighted Hoelder spaces on a simple closed rectifiable curve Γ. As weight functions, we will take power functions of the form

$$w(z) = |z - z_0|^{\rho}, \qquad \omega(z) = (z - z_0)^{\rho}, \quad 0 < \rho < 1.$$

The first function $w(z)$ belongs to the Hoelder class $H_{\rho}(\Gamma)$. For the second function to belong to the Hoelder class, we will use the following geometric condition. First we note that the function $\omega(z)$ is multi-valued analytic functions and we need to make a slit for fixing its single-valued regular branch. Applying if necessary a shift, we can assume that $z_0 = 0$. We will require that the domain D^+, bounded by Γ, does not have common points with the following parabolic horn:

$$S_m = \{z = x + iy : 0 < x < \infty, -bx^m < y < bx^m\};$$

here $b > 0$ is a constant depending on Γ and $m \ge 1$. In this case, we will say that Γ satisfies the m-horn condition.

Theorem 1. Let a curve Γ satisfy the m-horn condition at the point z_0. If we choose the slit, fixing its regular branch, inside the parabolic horn S_m, then $\omega(z) \in H_{\rho/m}(\Gamma)$.

Denote by A_{ρ} the set of functions v, continuous in $\overline{D^{\mp}}$ and continuously differential in $\overline{D^{\mp}} \backslash \{z_0\}$, such that $v \asymp |z - z_0|^{\rho}$ near the point z_0. Let $A_{\rho}^{\mu} = A_{\rho} \cap H_{\mu}(\overline{D^{\mp}})$.

We note that the Hoelder class $H_{\rho} = H_{\rho}(\Gamma)$ provided with the norm

$$\|f\|_{H_{\rho}} = \|f\|_{C(\Gamma)} + h_{\rho}(f),$$

where

$$h_\rho(f) = \sup_{t',t''\in\Gamma,t'\neq t''} \frac{|f(t') - f(t'')|}{|t' - t''|^\rho}$$

is the Hoelder semimnorm of *f,* is a Banach space. For a given function v on Γ we put

$$H_v^v = \{f : vf \in H_v(\Gamma)\}.$$

Let Γ be a simple rectifiable contour and D^+ is a bounded domain with the boundary Γ. Let $z_0 \in \Gamma$, $d = \operatorname{diam}\Gamma$, l is the length of Γ, $\delta(z) = \operatorname{dist}(z,\Gamma)$ is the distance from z to Γ,

$$S_\Gamma f(t) = \frac{1}{\pi i}\ \text{v.p.}\int_\Gamma \frac{f(\tau)d\tau}{\tau - t},\quad t\in\Gamma.$$

We note that if Γ is a simple smooth curve, then from Sokhotskii formulas it follows that

$$S_\Gamma f(t) = (K_\Gamma f)^+(t) + (K_\Gamma f)^-(t), \tag{1}$$

where $(K_\Gamma f)^+(t)$ and $(K_\Gamma f)^-(t)$ are the limiting values of the Cauchy type integral

$$K_\Gamma f(z) = \frac{1}{2\pi i}\int_\Gamma \frac{f(\tau)d\tau}{\tau - z},\quad z\in\mathbb{C}\backslash\Gamma$$

as z tends to a point t from the inside and outside of Γ. In the case when Γ is a rectifiable curve, we can consider (1) as a definition of singular integral.

Lemma 2. Let Γ be a simple closed rectifiable curve, $z_0 \in \Gamma$, $v \in A_\rho^\mu$ and $2v > \rho + 1$. Then the singular integral operator S_Γ, defined by (1), acts from H_v^v to H_λ^v where λ is any number satisfying

$$0 < \lambda < \min(\mu, 2v - \rho - 1). \tag{2}$$

Theorem 2. Let Γ be a simple closed rectifiable curve, $z_0 \in \Gamma$, $v \in A_\rho^\mu$ and $2v > \rho + 1$. If (2) holds then we have the following estimate for the norm of S_Γ:

$$\|S_\Gamma\|_{H_v^v \to H_\lambda^v} \le 1 + C_1 l^{v-\lambda} + C_2 l^v + C_3 l^{v-\rho} h_v(v).$$

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二元体系 NaHSO4 – NaH2PO4 的高压电导率
HIGH-VOLTAGE ELECTRICAL CONDUCTIVITY OF THE BINARY SYSTEM $NaHSO_4 – NaH_2PO_4$

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注解。 以持续时间约 35 μs 的脉冲模式研究了固相 (370 K) 和液相 (460 K) 四种成分的 NaHSO4 – NaH2PO4 二元系统的高压电导率。 电解质的电导率随着电场强度 (EFS) 的增加而增加，并趋于极限值，与脉冲电压的幅度无关。 电导率增加 30-250%，具体取决于温度和成分。 研究了脉冲放电期间电解质电导率随时间的变化，由此得出电解质在脉冲放电期间发生活化的结论。

在电场的作用下，过量的电导率会持续很长时间。 非平衡载流子的弛豫时间约为 104-105 秒，并且还取决于温度和成分。

关键词：脉冲高压放电、固体电解质、熔体、电导率、击穿、活化、弛豫。

Annotation. *The high-voltage electrical conductivity of the $NaHSO_4 – NaH_2PO_4$ binary system of four compositions in the solid (370 K) and liquid (460 K) phases was studied in a pulsed mode with a duration of about 35 μs. The electrical conductivity of electrolytes increases with increasing electric field strength (EFS) and tends to limiting values, independent of the amplitude of the pulse voltage. The increase in conductivity is 30-250% and depends on temperature and composition. The change in the conductivity of electrolytes during a pulsed discharge over time has been studied, from which it follows that the activation of electrolytes occurs during a pulsed discharge.*

Induced by an electric field, excess conductivity persists for a long time. The relaxation time of non-equilibrium charge carriers is of the order of 104-105 s and also depends on temperature and composition.

Keywords: *pulsed high-voltage discharge, solid electrolyte, melt, electrical conductivity, breakdown, activation, relaxation.*

Medium-temperature solid electrolytes such as alkali metal hydrosulfates and dihydrogen phosphates (PTE) are proton-conducting [1]. Currently, they find wide practical application, in particular: as electrochemical sensors; to create chemical current sources; as optical gates such as Kerr cells (rubidium and cesium dihydrogen phosphates) in the chemical and food industries, etc. Their main advantage is that the transition temperature to the highly conductive phase is much lower (about 350 K) than other classical solid electrolytes (for example, SrC_{l2} – more than 750 K).

Based on the results of high-voltage studies of the electrical conductivity of molten salts (MS) and solid electrolytes (SE), a number of reviews and monographs have been published [2-4]. The objects of these studies were mainly halides of alkali and alkaline earth metals, sulfates and dihydrogen phosphates of alkali metals.

The mechanism of activation of MS and SE by high-voltage pulsed discharges (VIR-activation) still remains unclear. Therefore, additional accumulation of experimental material on the high-voltage behavior of molten and solid electrolytes is relevant.

This work is devoted to high-voltage electrical conductivity and its relaxation in the $NaHSO_4 – NaH_2PO_4$ binary system of various compositions and to the study of the time dependence of resistance (conductivity) during the discharge process using current and voltage oscillograms. The experiments were carried out according to the method described in [3].

The high voltage source was the AI-70 generator. Oscillograms of the current and voltage of the high-voltage discharge were recorded using a pulsed digital two-channel storage oscilloscope AKTAKOM ASK-3106 with a computer output. Before and after the application of high-voltage pulses, low-voltage electrical conductivity was measured by the immittance of E7-20 at a frequency of 20 kHz.

Salts NaH_2PO_4 and $NaHSO_4$ of chemically pure grade were used in the experiments. The remaining water was removed by slow evaporation in vacuum to 1000C. In order to simultaneously study electrolytes in the liquid and solid phases, a quartz test tube was used, into which platinum wires passed through a two-channel porcelain tube were lowered. The ends of the electrodes protruded from the end of the two-channel tube by approximately 0.5 mm, which made it possible to create reliable contact with the electrolyte. The gap between the electrodes was about 1.5 mm. Dry electrolyte powder of a certain composition was poured into a quartz test tube. The entire system was lowered into a muffle furnace. The furnace temperature was regulated by voltage supplied through an autotransformer. First, the studies were carried out with a melted electrolyte at a temperature of 460 K, and then the temperature was lowered to 370 K. At a temperature of 370 K, electrolytes of all compositions were in the solid state. Since the ends of the electrodes

were immured in the fuel cells, reliable contact was maintained. Typical oscillograms of voltage and current in the binary mixtures of sodium hydrogen sulfates and dihydrogen phosphates we studied are shown in Fig. 1.

Figure 1. *Typical oscillograms of current (curves 1) and voltage (curves 2) of a high-voltage discharge in melts of binary mixtures of sodium hydrogen sulfate and sodium dihydrogen phosphate: a – breakdown-free discharge (MS - 460 K); b – breakdown (SE - 370 K).*

The oscillograms show that the current and voltage before breakdown of the electrolyte reach a maximum after approximately 1.5 μs with a slight lag of current (a). During breakdown of the fuel cell (b), the maximum current before breakdown significantly lags behind the voltage (more than 7 μs) and increases smoothly. This may be due to the generation of protons due to the intensive destruction of H-bonds and even with the possible inclusion of sodium ions. The discharge process occurs over time, therefore, by measuring the distance from the zero lines of current and voltage to points corresponding to a given time, and knowing the sensitivity of the installation for voltage and current, it is possible to monitor the change in the conductivity of the electrolyte (or resistance) depending on time during the discharge process . The current in this case is quasi-stationary, since the discharge time is tens of microseconds, and the Maxwellian relaxation time in these media is less than 10-6 microseconds. We calculated the conductivity or resistance depending on the NEP at the moment when the current reaches a quasi-stationary value (dI/dt=0).

The influence of strong pulsed electric fields on the conductivity of individual proton solid electrolytes $NaHSO_4$ and NaH_2PO_4 was studied in [5, 6]. In sodium hydrogen sulfate in the solid phase at 430 K, the conductivity increases by 156%, in the liquid phase at 476 K by 18%, and in sodium dihydrogen phosphate by 90 and 65%, respectively. The increase in conductivity in fuel cells is significantly higher than in the melt. More interesting are the binary systems of these electrolytes, which have, first of all, greater ionic conductivity than individual electrolytes, and on the other hand, the temperature of transition to the highly conductive solid phase in them decreases.

We have studied the dependence of the electrical conductivity of the binary system $NaHSO_4$ – NaH_2PO_4 of various compositions (20, 40, 60, 80% NaHSO4) in the solid and liquid phases at temperatures of 370 (SE) and 460 K (melt) on the NEP. Electric discharge in all electrolytes occurred without breakdown phenomena with exponential charge drainage at applied voltages of up to 6 kV in the PC and up to 5 kV in the SE. At pulse voltages of more than 5 kV, breakdown of electrolytes of all compositions is observed in fuel cells. Using current and voltage oscillograms (Fig. 1), the conductivity of electrolytes was measured when the current reached a value corresponding to the maximum conductivity of the electrolyte during the discharge process.

Experiments show that with increasing NEP, the conductivity of both the solid proton electrolyte $NaHSO_4$ – NaH_2PO_4 and its melt increases and tends to limiting values ("saturation"). These results are shown in Fig. 2. It can be seen that the relative increase in the limiting conductivity in all compositions of binary mixtures in melts is less than in solid electrolytes, as well as in individual electrolytes [5, 6]. The relative increase in ultimate conductivity in SE is greater than in MS, and this difference decreases with decreasing NaHSO4 content.

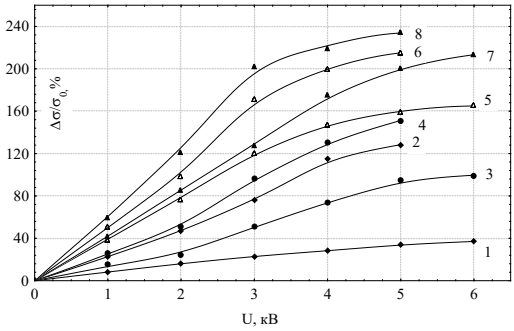

Figure 2. *Dependence of the relative change in conductivity of the $NaHSO_4$ – NaH_2PO_4 binary system on the electric field strength: 1, 2 - 20% $NaHSO_4$; 3.4 – 40% $NaHSO_4$; 5.6 – 60% $NaHSO_4$; 7.8 – 80% $NaHSO_4$ at temperatures 370 (curves 2,4,6,8 -TE) and 460 K (curves 1,3,5,7 - P).*

The obtained results of limiting electrical conductivities, their relative increases depending on composition and temperature are given in Table 1. Values σ_E PTEs are given before breakdown phenomena at the moment of maximum current. The table data shows that with a decrease in the mole fraction of sodium hydrogen sulfate, the high-voltage electrical conductivity increases, and in the liquid phase much faster. The relative increase in conductivity with a mole fraction of

20% NaHSO4 in the melt is 216.4%, which is significantly greater than in individual sodium hydrogen sulfate, in which the increase was about 18% [5].

Table 1.

Limiting electrical conductivity of a binary system solid electrolyte $NaHSO_4 – NaH_2PO_4$ and its melt

Compound	T, K	σ_0,ms	σ_E,ms	$\Delta\sigma / \sigma_0$, %	note
NaHSO4 – NaH2PO4 (80 mol% NaHSO4)	370 (TE) 460 (R)	0.56 0.78	1.29 1.08	130.4 38.2	breakdown
NaHSO4– NaH2PO4 (60 mol% NaHSO4)	370 (TE) 460 (R)	0.62 0.96	1.55 1.88	149.6 95.8	breakdown
NaHSO4 – NaH2PO4 (40 mol% NaHSO4)	360 (TE) 460 (R)	0.82 1.06	2.58 2.82	215.3 165.7	breakdown
NaHSO4 – NaH2PO4 (20 mol% NaHSO4)	370 (TE) 460 (R)	0.91 1.44	3.06 4.54	235.8 216.4	breakdown

* P – melt; TE – solid electrolyte

At pulse voltage amplitudes of more than 5 kV, the PTE breaks through (Fig. 1, b).

During breakdown, the electrical conductivity of the electrolyte increases by 2 or more orders of magnitude, which indicates the appearance of a significant proportion, most likely, of the cationic component of sodium ions in the conductivity, since with the appearance of the electronic component, the conductivity should increase significantly more, at least by 105-106 times [7]. In our experiments, we took into account the increase in the conductivity of the solid electrolyte with increasing NEP until breakdown phenomena. The ionic nature of conductivity is preserved only in this case [4]. In melts up to voltages U = 6.0 kV, the high-voltage discharge occurred without breakdown phenomena.

The change in the resistance of electrolytes over time during a high-voltage discharge was studied. From the current and voltage oscillograms (Fig. 1a), the voltage U(t) and current I(t) were measured every 2.0 μs. From them, the electrolyte resistance R(t) during the discharge process was calculated, determined by Ohm's law R = U(t)/I(t). The validity of calculating resistance from instantaneous values of voltage and current is explained by the quasi-stationary nature of the current.

The resistance of the electrolyte over time, measured from oscillograms during the discharge process, practically reaches its lowest value after reaching a quasi-stationary current, when dI/dt = 0. The time to establish the minimum resistance in the discharge channel varies within 2 - 3 μs and slightly depends on the amplitude of the pulse voltage, attached to the sample. The greater the amplitude of the

pulse voltage, the shorter this time is. Figure 3 shows the change in SE resistance over time during the discharge process in sodium hydrogen sulfate and sodium dihydrogen phosphatevarious compositions at 370 K and pulse voltage amplitude of 4.0 kV.

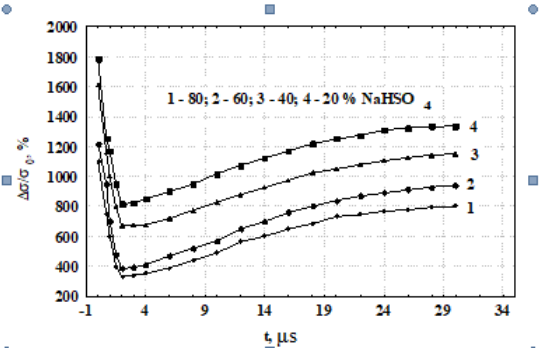

Figure 3. *Change in the resistance of $NaHSO_4$ - NaH_2PO_4 over time during the discharge at 400 K with pulse voltage amplitude of 4.0 kV.*

Quasi-stationary current and minimal resistance is practically reached simultaneously after the start of the high-voltage discharge. This indicates that during the discharge process, the current and voltage drop synchronously. At the same time, the minimal resistance at pulse voltage amplitude of 4.0 kV in an electrolyte with a composition of 80% $NaHSO_4$ - 20% NaH_2PO_4 is 3.36 times lower than the initial value (the increase in conductivity is 235.8%). Subsequently, the resistance of the electrolyte during the discharge process begins to increase and stabilizes after approximately 30-35 μs, without returning to the initial value. The activation level of this electrolyte is 37%. These results suggest that the activation of electrolytes occurs precisely during the process of a pulsed high-voltage discharge. With increasing amplitude of the pulse voltage, the level of activation increases. It should be noted that similar results were first obtained in the binary system of sodium and cesium hydrosulfates [8]. Table 2 shows the data on the relative change in conductivity at the moment of reaching maximum conductivity and at the end of the voltage pulse (activation level) of binary mixtures of sodium hydrogen sulfate and sodium dihydrogen phosphate at 370 K. As can be seen from this table, the greatest activation is observed for the composition 60% $NaHSO_4$ -40% NaH_2PO_4.

Table 2.

High-voltage activation of binary mixtures of potassium hydrogen sulfate and potassium dihydrogen phosphate

Electrolyte	T, K	$\Delta\sigma / \sigma_0$, %	
		at moment max. prov-ti	At the end of the impulse
20% NaHSO4	400	235.8	33.6
40% NaHSO4	400	215.3	29.8
60% NaHSO4	400	149.6	40.2
80% NaHSO4	400	130.4	37.4

These results suggest that the activation of electrolytes occurs precisely during the process of a pulsed high-voltage discharge. With increasing amplitude of the pulse voltage, the level of activation increases. It should be noted that similar results were first obtained in the binary system of sodium and cesium hydrosulfates [8].It should be noted that the most promising, in our opinion, composition in this system is 60% $NaHSO_4$, in which the greatest activation is observed.

The activated state of electrolytes after high-voltage discharges persists for a long time (VIR - activation). The kinetics of the relaxation process of excess conductivity has been studied. Experiments show that with increasing amplitude of the pulse voltage, the level of activation increases. The greatest change in excess conductance occurs at the very beginning after VIR (the first five minutes). This region of conductivity relaxation obeys the kinetic equation of the second-order reaction. The further return of the system to the equilibrium state is subject to the first order kinetic equation:

$$\sigma(t) = \sigma'(0)\exp(-t/\tau), \quad (1)$$

Where τ - relaxation time, $\sigma'(0)$ – electrolyte conductivity value extrapolated to t=0 in the linear section of the curves $\ln(\sigma/\sigma_0) = f(t)$. This equation, as shown in [10], is valid in the absence of generation of carriers during the relaxation process. Experiments show that conductivity relaxation is still of an oscillatory nature with a decreasing amplitude, i.e. generation of carriers still takes place, i.e. additional activation of carriers occurs during the relaxation process. This is especially clearly detected in the solid phase of electrolytes. In the linear relaxation section, the lifetime of non-equilibrium charge carriers was determined using the least squares method. The life time of non-equilibrium carriers in the NaHSO4 system is - NaH-2PO4 in the solid phase less than in the melt. These data are shown in Table 3. With increasing sodium hydrogen sulfate content, the lifetime of excess carriers, both in solid and liquid phases, increases. Compared to other electrolytes (for example, [9]), the relaxation time of conductivity with sodium hydrogen sulfate is an order of magnitude higher.

Table 3.

Relaxation time of excess conductivity of binary systems $NaHSO_4 – NaH_2PO_4$

Electrolyte		T, K	τ_{Wed}·10-5, s	δ,%
$NaHSO_4 – NaH_2PO_4$ 20 mol% $NaHSO_4$	SE	370	0.35	3.0
	melt	460	0.86	3.0
$NaHSO_4 – NaH_2PO_4$ 40 mol% $NaHSO_4$	SE	370	0.56	3.5
	melt	460	1.07	4.0
$NaHSO_4 – NaH_2PO_4$ 60 mol% $NaHSO_4$	SE	370	1.03	4.0
	melt	460	1.68	4.1
$NaHSO_4 – NaH_2PO_4$ 80 mol% $NaHSO_4$	SE	370	1.17	4.0
	melt	460	2.14	5.5

The works [2,4,7] describe in detail all possible reasons for the increase in the conductivity of electrolytes during high-voltage discharges: 1) breakdown of the electrolyte; 2) the appearance of the electronic component of conductivity; 3) thermal effects associated with heating during discharge; 4) release of a proton or alkali metal at the cathode; 5) electrolyte decomposition; 6) increase in the concentration of proton defects; 7) increase in charge carrier mobility. The analysis showed that the main reasons for the increase in conductivity in our case are the increase in the number of carriers due to the breaking of H-bonds and the increase in carrier mobility due to the removal of relaxation inhibition. The contribution of other possible causes does not exceed 3=5%.

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汉密尔顿原理的拉格朗日
LAGRANGIAN FOR HAMILTON'S PRINCIPLE

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抽象的。 显示了汉密尔顿原理在材料演化中的基本作用。
关键词：结构； 位错结构； 铁磁共振； 电子显微镜研究； 不变量。

Abstract. *The fundamental role Hamilton's principle at evolution of materials is shown.*

Keywords: *structures; dislocation structure; ferromagnetic resonance; electron-microscopic researches; invariants.*

Introduction. Currently, in materials science, condensed state physics, tribotechnics and other branches of knowledge, the fundamental principle based on the properties of space and time symmetry, namely, the principle of least action or Hamilton's principle, is not applied [1, 2]. All physicochemical and biological processes take place in space and time, the properties of which should be reflected in these processes as well. If so, there must be invariants that help researchers to see the underlying regularities. In chemistry it is the law of conservation of mass of matter formulated by M.V. Lamonosov [3], graph invariant [4], chemical elements of D.I. Mendeleev's table [5], where each element is characterized by an ordinal number (invariant) with a set of certain parameters (mass, charge, number of valence electrons, etc.) that do not change during chemical reactions, in biology it is Mendel's second law [6], in nuclear and quantum physics all processes occurring in the microcosm are subject to the law of conservation [7]. Where are these invariants in nanomaterial science, in condensed state physics, in tribology, in technical sciences? The problem of the lack of a fundamental principle [8, 9] in tribology, condensed state physics, materials science and other natural sciences causes the search and establishment of invariants of the kinetics of structural transformations of surface layers of metals (steel, cast iron, bronze, noble metals) under various external influences: ultrasound, rolling, triboloading, etc. [10].

Experimental Details. Polycrystalline nickel of 99.99% purity, armco-iron, bearing steel, bronze, and cast iron were investigated. The nickel samples in the

form of thin disks were polished electrolytically and annealed in a vacuum of 0.133 mPa at 973 K. The friction test of Ni – Mo pair was carried out on the machine AE-5 according to the finger-disk scheme with precise setting of the contact area at a specific load of ≈ 84 kPa and linear speed of ≈ 0.5 m/s. Electron microscopic studies of nickel were carried out on a microscope EVM-100AK and Hitachi-H800 by the method of thin foils on "lumen". The resolution of the Hitachi-H-800 is ≈ 0.1 nm. References to monographs, articles, patents and materials of international conferences describing the idea of using HP, methods and ways of research of metal interfaces, rolling and sliding supports are described in the abstract [2].

The broadening of the ferromagnetic resonance (FMR) line of nickel samples was recorded using a developed and automated setup. Metallographic studies were carried out using a MIM-7 microscope. Studies of the dislocation structure of nickel under friction were carried out comprehensively using the main methods: ferromagnetic resonance (FMR) and transmission electron microscopy [2]. The correctness of these methods and the reliability of the results in solving this problem have been confirmed by the studies of a number of works, including those by other authors [11-12]. X-ray structural analysis, high- and low-energy electronography, microhardness measurement, and metallographic and electrophysical methods were used as additional methods providing useful information [9]. The error of wear rate measurement by the weight method was 10^{-9} kg. The systematic error of the FMR line broadening measurement was 3 %.

Were the found regularities of dislocation structure kinetics in nickel typical only for metals with face-centered cubic lattice or are they more universal and extend to other metal systems? In this paper, references are given to the results of similar studies for metals with volume-centered cubic lattice [13]. Samples from steels: St 45, St12X1, 65G, steel SHX-15, etc., which are used for the manufacture of rolling and sliding bearings, as well as cast iron (Сч-21-40); bronze (БрОЦС 5-5-5) were studied [2, 9]. Studies have shown that there are no fundamental differences in the formation of dislocation structure for these metal [2].

Results and Discussion. It is known that the principle of least action or Hamilton's principle is used to formulate the equations of motion of a material point in mechanics [1]. Why cannot this fundamental principle be used to describe the kinetics of processes of structural transformations in materials occurring in the same continuum of space and time? A question naturally arises, namely: where there is symmetry, should there be invariants to describe the kinetics of various structural transformations in multilevel, hierarchically organized processes occurring on the surface of metals? The kinetics of the transition of the system from one structural state (A) to another (B) is carried out in accordance with the principle of least action (Fig. 1).

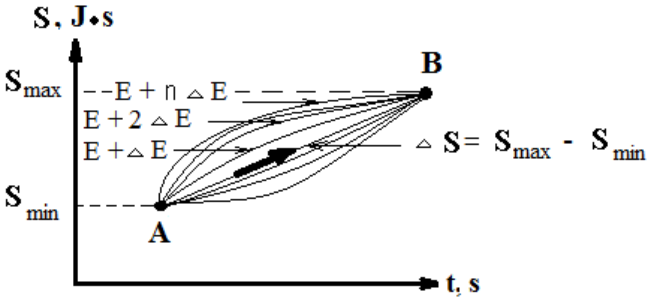


Figure 1. *Kinetics of system transition from one structural state (A) to another (B) in accordance with the principle of least action, where S – action, t – time*

It is known that the mathematical formulation of Hamilton's principle has the form [1, 14]:

$$\delta S = 0\,, \tag{1}$$

where

$$S = \int_{t_1}^{t_2} L(q, q', t)dt\,, \tag{2}$$

where q, q/ are independent parameters characterizing the system, t is time. Then the expression is valid:

$$\delta S = \int_{t_1}^{t_2} (\frac{\partial L}{\partial q}\delta q + \frac{\partial L}{\partial q'}\delta q')dt = 0 \tag{3}$$

Suppose that the expression is true:

$$L = E_{external} - E_{inside}, \tag{4}$$

where $E_{external}$ – is the energy of external influence, a E_{inside} – is the energy accumulated or stored in the system (material or materials). The energy difference or entropy is given by the expression [14]:

$$H = \frac{\zeta(\nabla T)^2}{T^2} + \rho\frac{Z\Sigma}{T} \pm \frac{\rho}{T^2}([\alpha, \Omega], \nabla T, t) \tag{5}$$

where ς - thermal conductivity, ρ - material density, Z - defect flux density, Σ - hydrostatic stress in the defect phase formation zone, parameters α and Ω characterize the energy flux through the surface. The first summand in expression (S) is entropy production associated with heat generation. The second summand determines the work of defects flux when they move in the stress field. The third summand is related to the energy flow of the mechanical field of the crystal through the surface. The plus or minus sign determines the direction of the energy flow [15]. The change of the flow direction is determined by the energy advantage of

the self-organization process or, in a broader sense, by the principle of least action. The latter implies the search and establishment of invariants.

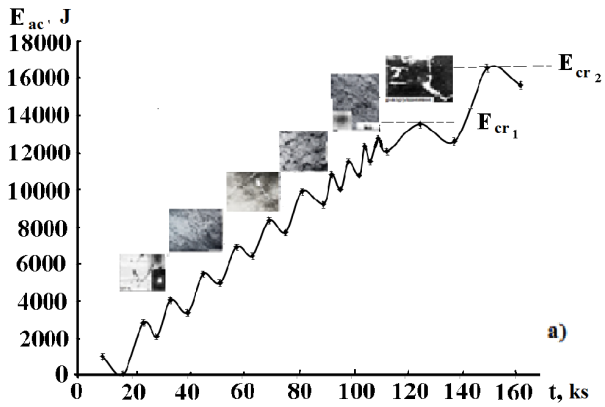
It was shown in [15, 16] that the formation of nanocrystalline (NC) structures at $t = 0.9 \cdot 10^3$s (0.9 ks) proceeds in accordance with the above principle. Relaxation of energy into the underlying layers is impossible due to the fact that the samples were previously annealed in vacuum and the surface is energetically favorable to form NC structures. As calculation shows, the amount of substance expressed in moles grows by two or three orders of magnitude during the formation of NC structures. The increase in the area of the formed NC structures by orders of magnitude causes an increase in energy dissipation by the surface layer.

The distribution of dislocations in a polycrystalline crystal under external influences occurs in accordance with the energy advantage or, in a broader sense, the least action. The fields of interacting dislocations distribute them in accordance with the energy advantage, which is most clearly evidenced by the formation of twins, where the field energy reduction occurs due to its localization between dislocations of opposite sign. The formation of slip strips under the action of deformation is energetically advantageous, as it is aimed at facilitated sliding of the material during plastic deformation, which reduces the value of the work of the defect flux during their movement in the stress field in accordance with the position on the minimum of entropy production. Thus, there is a decrease in the strain energy accumulated in the metal.

NC and SMC structures are also formed on the nickel surface in a highly fragmented crystal lattice, not only at t = 0.9 ks, but also at t = 108 ks of triboloading. The formation of such structural NC and SMC states under severe plastic deformation is described in [2]. Thus, the principle of energetic advantage or least action is realized, as soon as possible at 0.9 kc, and NC structures are formed under conditions of non-equilibrium deformation, when the rate of stress increase is greater than the rate of its relaxation. In a fuller understanding, it means, based on the properties of symmetry and homogeneity of space and time, the existence of invariants or basic regularities of structure formation kinetics, including nanomaterials [17]. The latter undoubtedly determines the relationship between the properties of space and time and the properties of materials that are created in the space-time continuum. Undoubtedly, this is a novelty and a fundamental, fundamental approach to the study of materials.

The kinetics of structural transformations depicted in Fig. 2 proceeds in accordance with the energy advantage, or, in a broader sense, with the principle of least effect. The latter implies the search for and establishment of invariants of the kinetics of structural transformations. The upper part of Fig. 2, A shows the kinetics of the surface layer structure change from undeformed and pre-annealed nickel samples, the beginning of the formation of slip bands, reset bands, fragmented

SMC (submicro) and NC (nanocrystalline) structure, porosity formation, and inter- and transcrystalline fracture. The dependence of the accumulated energy (E_{ac}) on time (t) is shown in Fig. 2, A. This dependence ($E_{ac}(t)$) has a monotonically increasing character due to the accumulation of energy over time under triboloading or the work expended to overcome the friction force. The oscillatory decrease of the dependence ($E_{ac}(t)$) is determined by periodically repeating local lobe fracture in time. It is obvious that there is a limit of energy accumulation by the surface layer ($E_{critical}$ - dashed line in Fig. 2, A), the achievement of which is accompanied by a selective destruction mechanism covering the surface layer up to a hundred micrometers thick. The destruction process is an integral part of the evolution or selforganization of the material in accordance with the principle of least action. The type of dependence ($E_{ac}(t)$) resembles the dependence of the Gibbs potential (F) on the molar volume (υ) of structural elements, which is given in the works of V.E. Panin [18]. The latter is not accidental, since the free energy is a component of the accumulated or stored energy in the surface layer of metals. The mathematical expression (4) given in the form of the difference between the energy of external influence (E_{exter}) and the energy accumulated or stored in nickel is determined by the fact that the structure formation of NC states is determined by the difference of energies and not their absolute value. The NC states were first observed at the beginning of triboloading at t = 0.9 ks, when E_{exter} and E_{ac} were insignificant values (Fig. 2) [2]. The same NC states were observed at t > 108 ks [2].



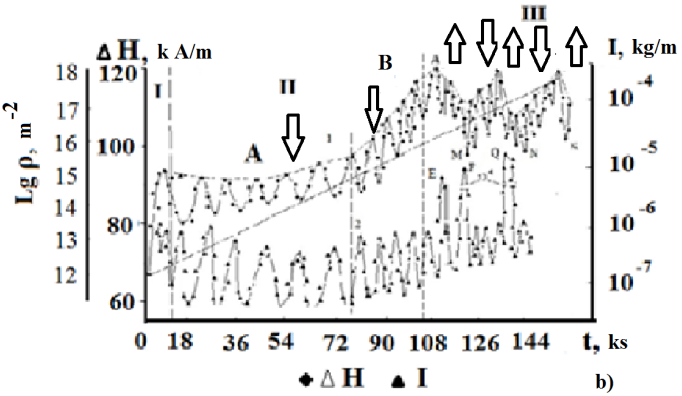


Figure 2. *Dependence of kinetics of structural changes of nickel surface layer under triboloading: a) - dependence of accumulated energy (E_{ac} on time (t), where $E_{cr\,1}$ and $E_{cr\,2}$ values of critical energy for destruction of meso- and macroscale level of deformation; b) - dependence of broadening of ferromagnetic resonance line (ΔH), dislocation density (ρ), wear intensity (I) on time (t) of triboloading*

The mathematical expression of least action for the processes of structure formation kinetics depicted in Fig. 2 is given by expression (6):

$$S = \int_{0}^{160000} (\Delta(E_{exter}) - \Theta(E_{ac}))dt\,, \qquad (6)$$

where $\Delta(E_{exter})$ is a function given by a directly proportional dependence on time, since the value of E_{ac} is numerically equal to the work of triboloading forces, and the function $\Theta(E_{ac})$ is given by a monotonically increasing oscillating dependence on time (Fig. 2). The use of least action for structure formation kinetics, means that the action value given by expression (6) takes the minimum possible value according to a given load-velocity mode of triboloading or external action.

Under the action of applied stresses, micropores themselves become stress concentrators and can cause intercrystalline (along grain boundaries) and transcrystalline (directly through the grain) fracture (Fig. 3, D). The nucleation stage is characterized by a complex stress state of the material at the junction of the three grains. Relaxation of tangential stresses along grain boundaries during their slippage, especially at the joints of three grains. As can be seen from Fig. 3 (position G), this type of fracture is due to the brittle splitting of the boundary material in the presence of numerous pores. The shift along the grain boundaries leads to an increase in local deformation in the pores. This can explain the appearance of wedge-shaped microcracks at the base of the pores on the boundaries and directed

with a thin edge toward the nearest microcavities (Fig. 3, position G). This clear direction of fracture is due to the weakening of the strength of the material along the intergranular boundaries and the interaction of pores lying at critical distances, when their elastic fields overlap. The stated point of view is confirmed by the factor that pores of the same size lying outside the boundaries, even at smaller distances, can unite only by simple collision without formation of wedge-shaped cracks (Fig. 3, position B). Based on our experimental data, it follows that the conditions for the formation of microcracks from pores located at the grain boundaries are that they reach a critical size for growth of ~ 0.1 μm and that they converge to a distance sufficient for elastic interaction of ≈ 0.25 μm [19]. Achievement of the critical stress level in pores of GPa value determines, in accordance with the principle of least action, the formation of microcracks with length of 0, 25 μm between pores (fig. 3, pos. E, F). Fatigue processes lead to continuous sharpening of microcracks, and the deposition of vacancies and hydrogen transport from the lubricating medium into their tip ensure brittle fracturing of the material [20].

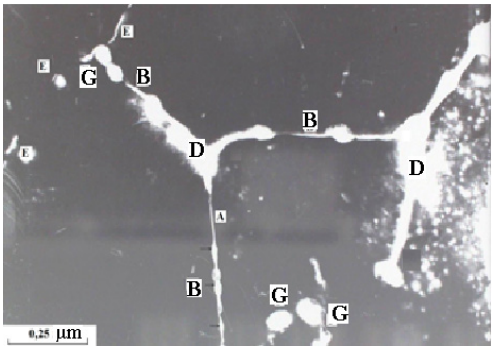


Figure 3. *Inter- and transcrystalline fracture*

In [2, 15] it was convincingly shown that in region III of Fig. 2 the amorphization of the nickel surface layer occurs as a result of an order of magnitude decrease in the activation energy level of the processes of formation of defect structure elements at all structural and scale levels of deformation. The material has special properties: high density of structural defects: split dislocations ($\rho \approx 1 \cdot 10^{18}$ m^{-2}), disclinations with discrete disorientation boundaries, pores, atom-vacancy structural states, twins, point defects, etc. ; local orientation gradient of the boundaries of structural elements $\chi \approx 1 \div 3$ deg/nm; high values of stresses, comparable and exceeding the elastic modulus of the crystal lattice of nickel ($\approx 2 \cdot 10^{11}$ Pa); through (tubular hollow dislocation nuclei) diffusion in the fields of high gradients of local stresses; dynamic microrecrystallization; high rate sensitivity in conditions of

amorphization and quasi-viscous mechanism of their destruction; reduction of the period of change of strength properties of nickel surface by ≈ 8 times [2].

Self-organization of strongly nonequilibrium processes is expressed in the change of direction of the flow of point defects and dislocations in region III of Fig. 2 (arrows) [15]. There are cooperative processes occurring as in the case of intense plastic deformation of metals [15]. The surface layer is prepared for destruction and separation from the surface, which is expressed in the change in the direction of the defect flux outward rather than deep into the surface [15]. One of the summands in expression (5) for entropy changes its sign to positive because the direction of energy flow changes [15]. Thus, the least action principle is a broader position, since it describes equilibrium and nonequilibrium processes than the position on the minimum [19] or maximum entropy production [20] for describing nonequilibrium processes.

The identified basic fundamental regularities of formation and kinetics of deformation defects at nano- micro-, meso-, and macroscale levels of plastic deformation of the surface layer of nickel and metals are described in [14, 16, 17].

Conclusion. The paper proposes a mathematical expression for the Lagrangian, which is used to describe the action of structure formation kinetics. The latter defines a new approach to the creation and evolution of new materials, as well as the main mechanisms of deformation during hardening and destruction of metal surfaces under external influences (rolling, triboloading, etc.).

The proposed approach and the established invariants are fundamental for both physical and mathematical and technical sciences. The latter determines their practical application. A system or substance under external influence performs minimum actions (J·s) to obtain a result when forming nanocrystalline structural states or creating new materials. The same is observed in the destruction of materials by formation of backbone crack, selective fracture, ets. In other words, the popular saying “where it’s thin, it’s torn” is realized. It is natural to assume the existence of other invariants in various fields of natural sciences. It is necessary to use the principle of least action to discover them.

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