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

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DISABILITY AS AN INDICATOR OF PUBLIC HEALTH AND AS A FACTOR IN THE COMPETITIVENESS OF THE REGION (ON THE EXAMPLE OF THE NORTHERN REGIONS)

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Abstract. *The article examines the concept of "competitiveness". Based on the analysis of indicators of disability in the regions of the North, it was determined that disability as a social phenomenon is inherent in all northern regions. The main economic aspect of disability is the termination of work when disability is established at working age, which causes serious economic damage to the state and is a determining factor in the competitiveness of the region.*

Keywords: *disability, competitiveness, northern regions, older generation, migration outflow, social benefits.*

Introduction

Today disability is viewed as a complex social phenomenon, where the quality of life is the main indicator of the well-being of society [1].

In the countries of the world, more than a billion people (15% of the population) live with some form of disability, of which almost 200 million experience serious difficulties in functioning. Recently, the disability of the population has been increasing due to demographic aging and a concomitant increase in the prevalence of chronic diseases. As of 01.10.2020, the number of disabled people in the Russian Federation amounted to 11,027,720 people, of which 395,883 people. falls on the regions of the North zone, which is 3.6%.

Around the world, people with disabilities show lower health outcomes, lower educational attainment, lower economic activity and higher poverty rates. [2].

Hence, the competitiveness of any economic entity (region) can be considered as its potential to compete, and competitive advantage - as the presence of certain characteristics of the entity that are most attractive in comparison with other op-

ponents (in this case, the indicator of public health).

Research of the content of the concept of "competitiveness"

The health of the population is the basis for determining the competitiveness of the region and is the main factor in the successful implementation of its socio-economic development.

Let us consider how the concept of "competitiveness" is interpreted by foreign and domestic researchers. Increasing the competitiveness of a firm in modern conditions M. Porter reduced it to an extremely meaningful formulation: "To be different", i.e. find an alternative solution to the problem that favorably distinguishes this economic entity from other similar entities in the market and thereby reduce the level of competition [3].

In their theory, he is echoed by the researchers J. Robinson and E. Chamberlin, who believed that competitiveness is the ability to bypass the struggle by developing new markets for differentiated products. [4].

In the works of J. Schumpeter and P. Romer, the competitiveness of an enterprise is also "determined by the ability to create new technologies, new markets and ideas." [5].

All the above mentioned interpretations in their basis point out the most important innovative role of competitiveness, based on intellectual leadership and excluding struggle.

In Russia, the concept of "competitiveness" has been studied relatively recently. Economists identify the main features that reveal the essence of the category of "competitiveness":

- competitiveness is manifested in the market (goods, works, services) [6];
- applies to both the object and the subject of market relations [6];
- has a certain competitive environment (quantitative assessment of economic objects, with the help of which the level of competitiveness is determined) [7];
- the basis for determining competitiveness is the identical key indicators of a competitor, which determine the social effect (the ability to meet human needs) [8];
- has a common legislative, legal, regulatory, scientific and methodological base and information space [9];

In this work, the basis for determining the competitiveness of a region, we will choose an identical key indicator - disability, where the health factor of the population will act as a competitive advantage and a favorable opportunity for socio-economic development in the competitive struggle.

Analysis of disability indicators in the regions of the North

At 01.10. In 2020, the share of the number of disabled people in the regions of the North in the total number of disabled people in the Russian Federation

was 3.6%. The largest number of people with disabilities was observed in the Republic of Karelia - 59,572 people, which amounted to 9.6% of the population of this region, followed by Arkhangelsk Oblast - 84,250 people. (7.7%) and the Komi Republic - 60,885 people. (7.3%). The next in the ranked order is the Nenets Autonomous Okrug - 2,916 people. (6.7%) and the Republic of Sakha - 53,025 people. (5.5%).

The lowest number of disabilities was noted in Yamalo-Nenets (2.5%), Khanty-Mansiysk (3.2%) and Chukotka (3.3%) Autonomous Okrugs, Magadan (3.6%) and Murmansk Oblasts (3.8%)) (fig. 1).

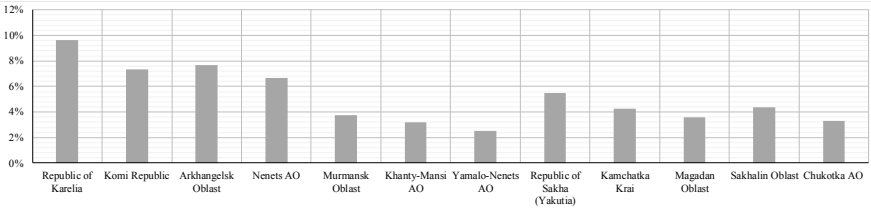

Figure 1 – *Share of the number of disabled people in the total population of the regions of the North*

An analysis of disability indicators by age groups in the regions of the North as of 01.10.2020 shows that the leading position, as in the Russian Federation, is occupied by citizens from 60 years old, whose number has reached 229,458 people. (57.97%). Representatives of the older generation significantly predominate in the Republic of Karelia (71.24%), followed by Arkhangelsk Oblast (68.36%), Nenets Autonomous Okrug (60.53%), Komi Republic (59.23%), Murmansk Oblast (58.80%), Kamchatka Krai (56.55%) and Sakhalin Oblast (55.20%). Among the disabled in these regions, this age group was more than 50%.

Chukotka (34.64%), Yamalo-Nenets (45.22%) Autonomous Okrugs, the Republic of Sakha (47.69%), Khanty-Mansi Autonomous Okrug (48.48%) and Magadan Oblast (49.42%). However, I would like to note that in these regions the number of citizens over 60 years old is constantly growing and, starting from 01.01.2019, representatives of the older generation increased from 1.03% (Chukotka Autonomous Okrug) to 4.62% (Khanty-Mansi Autonomous Okrug). In general, over this period in these regions, this age group increased by 12.8% (tab. 1).

It should be noted that a large contribution to the aging and disability of the population of the northern regions is made by the migration outflow from the North zone, which leads to a significant excess of the all-Russian rate of increase in the percentage of the population over working age [10].

Table 1.

Number of people with disabilities by age groups, as of 01.10. 2020 year, in the context of regions of the North, people

Territory	disabled	18-30	31-40	41-50	51-60	over 60							
	People	% of RF	% of population	People	%	People	%	People	%	People	%	People	%
Russian Federation	11 027 720	100	-	483 652	4.39	793 710	7.20	1 058 466	9.60	1 804 229	16.36	6 887 663	62.46
Regions of the North:	395 883	3.6	-	21 870	5.52	33 179	8.38	40 537	10.24	70 839	17.89	229 458	57.97
Regions of the North, age structure	100	-	-	-	6	-	8	-	10	-	18	-	58
Republic of Karelia	59 572	0.5	9.6	1 998	3.35	3 272	5.49	4 436	7.45	7 427	12.47	42 439	71.24
Komi Republic	60 885	0.6	7.3	2 751	4.52	5 160	8.47	6 481	10.64	10 431	17.13	36 062	59.23
Arkhangelsk Oblast	84 253	0.8	7.7	2 903	3.45	5 127	6.09	7 016	8.33	11 615	13.79	57 592	68.36
Nenets AO	2 916	0.0	6.7	136	4.66	212	7.27	311	10.67	492	16.87	1 765	60.53
Murmansk Oblast	28 247	0.3	3.8	1 512	5.35	2 447	8.66	3 288	11.64	4.39	15.55	16 608	58.80
Khanty-Mansi Autonomous Okrug	52 978	0.5	3.2	3 915	7.39	5 849	11.04	6 783	12.80	10 745	20.28	25 686	48.48
Yamalo-Nenets AO	13 771	0.1	2.5	1 269	9.22	1 471	10.68	1 774	12.88	3 030	22.00	6 227	45.22
The Republic of Sakha (Yakutia)	53 025	0.5	5.5	4 124	7.78	5 575	10.51	6 961	13.13	11 079	20.89	25 286	47.69
Kamchatka Krai	13 323	0.1	4.2	822	6.17	1 201	9.01	1 557	11.69	2 209	16.58	7 534	56.55
Magadan Oblast	5 040	0.0	3.6	324	6.43	584	11.59	694	13.77	947	18.79	2 491	49.42
Sakhalin Oblast	21 454	0.2	4.4	1 367	6.37	2 152	10.03	2 823	13.16	3 270	15.24	11 842	55.20
Chukotka AO	1 628	0.0	3.3	174	10.69	223	13.70	286	17.57	381	23.40	564	34.64

Source: Federal Register of Persons with Disabilities.URL: https://sfri.ru

A less significant group is made up of disabled people from 51-60 years old - 70 839 people (17.89%), the number of disabled people from 41-50 years old - 40 537 people, or 10.24%. (tab. 1). [11]. However, it should be noted that in a number of regions there is a rejuvenation of disability with a smaller proportion of citizens over 60 years old among the northern regions. Here, the largest share of disabled citizens aged 18-30 years was observed in the Chukotka (10.69%), Yamalo-Nenets (9.22%) and Khanty-Mansiysk (7.39%) Autonomous Okrugs, as well as the Republic of Sakha (7.78%). While in Karelia (3.35%) and Arkhangelsk Oblast (3.45%), on the contrary, their number is much lower.

According to the groups of disability, the maximum number of inhabitants of the north has group II, then disabled of group III and disabled of group I.

Conclusions and offers

Disability as a social phenomenon is inherent in all northern regions. Disability is the most important indicator of human health, and the health of the population is a determining factor in the competitiveness of a region, since it contributes to a decrease in the quantitative characteristics of resources for labor activity. Hence, it is most often viewed in the context of negative transformations in the composition of the population.

The main economic aspect of disability is the termination of work when disability is established at working age, which causes serious economic damage to the state. This is due to the fact that the state is forced to bear large costs for various types of social benefits, such as social security for people with disabilities (pensions, employment, vocational training, etc.) and measures for their social protection, including various programs aimed at the rehabilitation and habilitation of the disabled citizens, guaranteed by the state.

The reasons that contribute to the growth of disability, researchers include:

- deterioration of the ecological situation;
- changes in the age structure of the population towards its aging;
- unfavorable working conditions by industry and by region;
- an increase in the number of chronic diseases;
- the growth of household and transport injuries;
- lifestyle [12].

Eliminating these reasons will help reduce the growth in the number of disabled people and increase the competitiveness of the regions.

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MASS OPEN ONLINE COURSE AS AN ELEMENT OF BENCHMARKING IN EDUCATIONAL ACTIVITIES

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Abstract. *The article considers such an element of a marketing management tool as benchmarking in relation to educational institutions. The relevance of this issue is undeniable, since the use of this element in educational activities, of course, should lead to an effective organization of educational activities, attract students, including foreign ones, and contribute to improving the competitiveness of an educational institution. The article focuses on such an element as a mass open online course, examines the positive and negative aspects of its use, and analyzes online educational platforms.*

Keywords: *benchmarking, benchmarking in educational activities, a massive open online course.*

Introduction

Benchmarking is an innovative element of a marketing management tool that contributes to improving the competitiveness of an organization [1]. Despite some differences in the interpretation of benchmarking, its purpose is to try to identify the experience of the best practices of such organizations and implement this experience in their activities. Educational institutions are no exception and also use the element of benchmarking in their activities. This is especially true for universities that have international educational programs, as it is based on the desire to attract foreign students and present these programs on the international market.

Purpose of the study – to establish the importance of benchmarking in the activities of educational institutions, in particular, higher education institutions, as well as to evaluate and analyze online educational platforms and identify their role in improving the competitiveness of an educational institution, promoting the brand of an educational institution.

Materials and methods

The study and analysis of the literature sources allows us to conclude that today there are different definitions and interpretations of benchmarking by theo-

rists and practitioners. Some authors consider benchmarking a simple comparative analysis, while others, for example, the chairman of the international organization "Global Benchmarking Network" R. Mann, consider " ... benchmarking is much more than the usual reference comparison. Benchmarking focuses on "learning from the experience of others" and is defined as "identifying, adapting, and implementing methods that produce better results" [2, p. 791]. A. G. Ketz, Managing Partner of KPI International Management Consultants, noted in the results of his research that " ... benchmarking is the process of separating, defining and using the best practical examples and knowledge» [2, p.793].

Results and discussion

As already mentioned, the use of benchmarking elements in the activity is of great importance for educational institutions. If we interpret this concept in this area, then benchmarking is an effective process of organizing educational activities aimed at success. In this regard, it is worth noting the important role of mass open online courses in the modern educational environment. A massive open online course (MOOC) is a form of distance education, a model for providing educational content to anyone who wants to take the course. In addition, the online course can promote the brand of the university, increase the competitiveness of the educational institution by creating and using scientific and technical innovations. The first MOOC was launched in 2008, but this form of training became particularly popular in 2012, when projects that are now widely known, such as Udacity, Udemy, and Coursera, began to attract the first investments. To date, the work on the creation of MOOCs is carried out within the framework of international cooperation of educational institutions with the world's leading universities.

The purpose of the MOOC is to promote the "opening up" of education, to enable more students from different countries to get higher education. The MOOC development concept is based on the idea that the desire to learn should be realized without any economic, demographic or geographical restrictions, knowledge should be freely transferred from person to person, which is especially important in connection with the appearance of the COVID-19 virus in China at the end of 2019, which spread around the world in 2020.

The main distinguishing features of MOOCs are:

1) scale (a large number of people can participate in the training);

2) open access (anyone has the opportunity to participate in an online educational course).

According to a study published by East-West Digital News, people choose online education most often because of a lack of time at a basic level of education. In addition, 23% of businessmen and self-employed and 19% of managers of all respondents note the great popularity of online training. 86% of the participants expressed their positive attitude to online courses [3].

It is necessary to analyze the positive and negative aspects of MOOCs. The analysis is presented in table 1.

Table 1. *Positive and negative aspects of using MOOCs*

	Positive aspects of MOOCs	**Negative aspects of MOOCs**
From the point of view of an educational institution	1. Attracting new entrants 2. The ability to conduct training for a very large number of people 3. Reducing the financial costs of teaching 4. Improving the interaction of regional universities with leading Russian universities 5. Generating revenue for an educational institution by increasing the number of paid students and paid online courses 6. Ability to collect data on student success 7. Improving the effectiveness of the educational process and its individualization 8. Filling the shortage of teachers in narrow-profile disciplines	A small percentage of students completing the course compared to the number of enrolled students.
From the student's point of view	1. Save time 2. The possibility of obtaining a certificate of completion of the course 3. The opportunity to take the course for free 4. Availability of open access to course materials 5. Variety of topics	1. Lack of live communication with the teacher 2. The presence of a language barrier in some courses 3. Limited time for some courses

The analysis of online educational platforms allowed us to identify the most well-known online platforms in recent years, such as Udacity, Coursera, and hf. Among Russian educational platforms, the Lectorium can be cited as an example. This is a resource that provides an opportunity not only to create and post MOOCs, but also contains about 4,000 video lectures in its media library. This resource has more than 20 partners, about 150,000 visitors per month.

According to the study, according to data for 2020 from the online platforms Universality, Open Education, Coursera, Universarium, Uniweb, Lectorium, the leaders in the number of courses posted are: Open Education (31%), Coursera (23%), Universarium (19%). The results of the study are shown in Figure 1

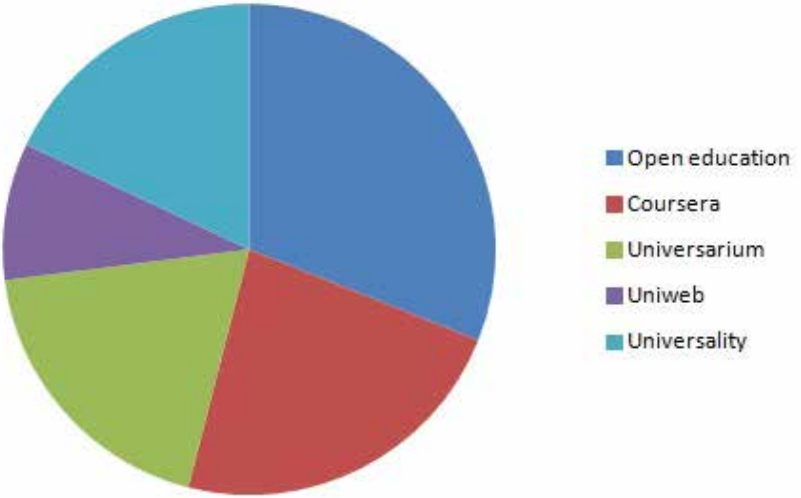

Figure 1. *Comparison of the number of courses posted on domestic platforms in 2020*

One of the main reasons for the success of the Open Education project is that this project brought together the best Russian universities, giving them their own ready-made platform and a constant flow of students.

Conclusion

The use of benchmarking in the educational environment, in fact, the search for best practices, standards, undoubtedly leads to a more effective process of organizing educational activities, studying, finding and achieving the best educational results. It is worth noting the vastness and relevance of this issue at the present time. The article focuses on the introduction of mass open online courses in educational activities, along with traditional forms of education. The creation of MOOCs, of course, not only contributes to the "opening" of education, but also is one of the best approaches that ultimately lead to an increase in the competitiveness of an educational institution, the popularization of educational programs, including on the international market, and the attraction of foreign students.

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CONDITIONS FOR THE DEVELOPMENT OF INNOVATIVE ACTIVITIES OF ORGANIZATIONS OF PRIMARY GENERAL EDUCATION (BASED ON THE MATERIAL OF THE REPUBLIC OF INGUSHETIA)

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Annotation. *The conditions for the development of innovative activities of general education organizations are proposed on the basis of the Republic of Ingushetia. They include: 1) improving the efficiency of management of innovation activities of such organizations, 2) the development of creative activity of subjects of innovation in these organizations.*

The characteristics of these conditions are fulfilled. The distinctive features of the innovative management structure, the management functions of general education organizations are named. The mechanisms of these functions, planning, control system, expertise, monitoring are characterized. Methods and forms of such activities have been determined. The creative individuality of the teacher, his professional identity, development components, sources, mechanisms are described in detail.

Keywords: *Conditions, innovation activity, primary general education, the Republic of Ingushetia, management, creative activity, mechanisms, planning,*

expert observation, monitoring, methods, the creative form of the teacher's personality, professional identity, sources.

The conditions for the development of innovative activities of organizations of primary general education in the Republic of Ingushetia include: 1) increasing the efficiency of managing the innovative activities of such organizations, 2) developing the creative activity of subjects of innovation in these organizations. Let us characterize these conditions.

The first condition implies progressive changes in all components of the control system: its functions, organizational mechanisms and methods, relations between the control and controlled systems, etc. In this context, the idea of value-semantic coordination of actions of control subjects (control and controlled systems) is productive. It is realized through 1) the value-based nature of management, which is based on the key universal values: creativity, activity, hard work; 2) the integrating nature of management, manifested in constructive relations between the subjects of innovation, 3) the motivating nature of management, which is based on material and moral incentives, 4) the implementation of tolerance in management, which consists in pluralism of opinions. The implementation of this idea meets the principles of co-creation, teamwork, project mode of operation of target groups, and management support.

At the same time, the managerial functions of organizations of primary general education include the exchange of information that ensures the coordination of actions of the subjects of the innovation process and the external environment. This requires the creation of electronic data banks in the areas of innovation activities of primary general education organizations, the development of an electronic document management system and high-quality exchange of information between educational organizations and other subjects of the national-regional educational environment.

The development of horizontal and vertical communication ties through a common information system at the intraschool and municipal levels of management will help improve the quality of management analysis, the analytical basis for organizing innovation in primary general education.

Planning is based on the target program method. On its basis, a comprehensive analysis of the state and trends of innovation activities of primary general education organizations is carried out, its modeling, programming, forecasting, algorithmization, determination of the necessary innovative resources, selection of methods and means.

The mechanism for ensuring the implementation of these functions should be the Program for the Development of Innovative Activities of Primary General Education Organizations [1] - a document that accumulates the goal, objectives,

trends, directions of innovative transformations of the system, and their predicted results.

An effective control system meets the requirements of 1) developing criteria and indicators, 2) focusing on results, 3) their availability, objectivity, specificity, ethnicity. The control function in the system of primary general education is traditionally implemented through inspection, within the framework of which the problem of preventing deviations of the results of the educational organization from the established norms is solved, regulation.

In contrast to the traditional inspection activities at the regional and municipal levels, burdened by the lack of general requirements and approaches to its implementation, innovative activities in the primary general education system develops new progressive assessment and control mechanisms. This ensures the reliability, objectivity and transparency of the assessment procedures.

Expertise plays a significant role in the management of innovative activities of educational institutions of primary general education - expert conclusions based on close methodological ideas about the essence of such activities, making an assessment of its level. The goal-setting of the examination of the innovative activity of primary general education organizations is manifested in the identification and assessment of the level of their innovative activity, the determination of its potential capabilities.

Openness and collegiality in the implementation of inspections of innovative activities and discussion of its results make it possible to objectively evaluate it in relation to a specific educational organization: to get acquainted with advanced experience, to see its achievements, to identify problems. If they are available, the functions of the district methodological service include providing assistance to teachers and schools. However, giving the results of the examination of the innovative activity of an educational organization to the public, it is necessary to observe the guarantees of confidentiality of information obtained in the course of diagnostics. This requires the correct wording of the expertise.

The products of the expertise of the innovative activity of the organization of primary general education can be: innovative portfolios of the school, methodological recommendations, plans and programs, motivation of teachers to develop and implement innovations in the educational process. Expertise imparts to management activity the specificity of collective, research, state-public activity, reflection.

Monitoring is one of the elements of expertise. It aims to test the quantitative and qualitative indicators of innovation. Moreover, in the process of monitoring, the dynamics of innovative activities of organizations of primary general education is studied. Such dynamics can be positive (there is a tendency to increase the creativity and creative activity of subjects of educational activity), inert (there are

no positive characteristics of the dynamics of innovation activity), stable (there are stable indicators of innovation activity).

In the process of monitoring empirical methods are used: survey (questionnaire, interview, conversation), testing, psychological and pedagogical observation, etc.

Organizational forms of innovation management in an elementary general school include a meeting, a management seminar, a management living room (presentation of the achievements of the management team of a specific educational organization, exchange of ideas and findings), a district expert council, district methodological associations of teachers, etc.

We believe that the introduction of innovations taking into account these methods and forms will lead to the creation of innovation-oriented organizational structures: creative and research groups, associations of educators-innovators, organizational committees for the development and implementation of innovations.

Returning to the conditions for the development of innovative activities of organizations of primary general education in the Republic of Ingushetia, let us dwell on the second condition highlighted above: the development of the creative activity of the subjects of innovation in these organizations. Such activity presupposes the development of the teacher's creative individuality, i.e. building a self-improvement program for them, defining individual paths for their professional growth. A creative teacher not only realizes himself, but qualitatively transforms himself, rethinks his professional expectations, looks for opportunities for the development of professionally significant qualities, develops a personal pedagogical concept.

The creative individuality of the teacher has been exhaustively studied by F.N. Gonobolin, V.I. Zagvyazinsky, A.A. Kan-Kalikom, V.I. Kolesnikova, V.V. Kraevsky, Yu.L. Lvova, N.E. Mazhar, N. D. Nikandrov, I.P. Podlasym, M.M. Potashnikov, I.P. Rachenko, V.D. Semenov, V.A. Slastenin, A.I. Shcherbakov and others. From the scientific publications of these authors it follows that the development of creative individuality in innovative activities is ensured by stable professional interests, a system of professional and personal self-education, the need to harmonize oneself, personal and professional reflection.

The formation of the teacher's creative individuality is carried out in the system of pre-university, university professional training, independent practical activity. An important factor in this matter is pedagogical self-awareness. Its functions according to V.A. Slastenin include reflective-regulating, constituting, constructing [2]. The first consists in the subjective imprinting of professionally significant methods and standards of activity, the development, on this basis, of our own indicative and regulatory system of actions. The constitutive function is the development of personal criteria and norms of professional activity. The design function

takes the ability to design and implement innovative activities outside the framework of normative activities.

At the same time, VA Slastenin distinguishes several types of self-awareness: operational, communicative, intraindividual [Ibid]. The first type is characterized by an orientation towards the awareness of professional competencies, methodological and technological preparedness. The communicative type is determined by the importance of solving problems and difficulties of a relational nature: solving conflict situations, problems of mutual understanding and establishing positive contact. For teachers of the intraindividual type, localization of the main difficulties in professional activity is characteristic, the qualification of most professional difficulties as derivatives of personal, individual problems.

Professional self-awareness is determined by the content and structure of human activity, acquires its properties and characteristics: structuredness - amorphousness, staticity - dynamism, uniformity - diversity. Human self-awareness is determined by activity. In this regard, for the dynamism and flexibility of the teacher's creative self-awareness, it is important to have two components: 1) the inclusion of active communication, creativity in the sphere of life, 2) the implementation of their own innovative ideas. At the same time, the development of the teacher's creative individuality is viewed as a process of integrating external professional training and internal, personal formation of a person.

The components of the development of the teacher's creative individuality in innovative activities according to A.I. Bondarevskaya [3] are: value-motivational, cognitive-content, constructive-practical, emotional-volitional, reflective. The criteria for the teacher's creative individuality are: 1) self-organization of qualitative changes in personality and activity, 2) self-renewal, changing the way of work, 3) setting and solving pedagogical, psychological, subject tasks in relation to oneself and one's activity, 4) perception of external social manifestations as prerequisites for their development.

The mechanisms of the teacher's creative individuality include: actualization, self-determination, implementation, activity, regulation, construction, identification, assessment, education [5].

The source of the development of the teacher's creative individuality is the contradiction between the expectations of the social environment and the level of professional and personal development. The internal conditions for the successful development of the creative individuality of the teacher in innovative education are: the teacher's readiness for innovative activities, competence, pedagogical skills. External conditions are divided into normative and regulatory, prospective-target, need-stimulating, communicative and informational.

To implement the above conditions for the development of the creative individuality of the teacher in innovative education, full-scale work of the administra-

tion of the educational organization is necessary to create a developing environment in it, involve teachers in innovative activities, turn methodological work into scientific and methodological, activate intrapersonal factors of professional growth and maximize creative potential teacher.

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VALUE ORIENTATIONS OF OLDER PRESCHOOL CHILDREN WITH MENTAL RETARDATION

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Abstract. *Analysis of the state of the problem of the development of value orientations in older preschool children with mental retardation showed that it was not well developed, which allowed us to consider it more deeply. The senior preschool age is determined as a sensitive period for the formation of value orientations in children. The article attempts to compare the results of a comparative study of the value orientations of older preschoolers with disabilities (mental retardation) and preschoolers who do not have developmental disabilities. The specific values of the data showing the development of value orientations in children of five to seven years are given.*

Keywords: *preschool children, values, value orientations, disabilities, mental retardation.*

Introduction

The current situation of the modern educational system is characterized by the orientation of teaching and upbringing to the development of an integral, versatile developed personality. If we talk about the state order, the Federal State Standard of Preschool Education is aimed at solving the following tasks: combining education and upbringing into a holistic educational process based on spiritual, moral and sociocultural values and rules and norms of behavior adopted in society in the interests of a person, family, society; the formation of a general culture of the personality of children, including the values of a healthy lifestyle, the development of

their social, moral, aesthetic, intellectual, physical qualities; ensuring the variability and diversity of the content of Programs and organizational forms of preschool education, the possibility of forming Programs of various orientations, taking into account the educational needs, abilities and health status of children [2].

Currently, the studies have revealed the genesis, conditions, methods and means of forming value orientations both in adults and in preschool children. There are separate works in which an attempt is made to study and form value orientations in preschool children (P.P. Blonskiy, K.N. Wentzel, P.F. Kapterev, N. I. Pirogov, K.D. Ushinsky and other). At the same time, many aspects of this area of scientific and applied research have been insufficiently studied: the peculiarities of the formation and formation of value orientations in children with disabilities are not fully presented, the possibilities of influencing this process of mental health delay in older preschool children have not been revealed, pedagogical means and methods of various value orientations in the development and diagnosis of children with mental retardation in preschool age. This is largely due to the fact that among scientists there is an opinion that the process of forming value orientations is based on a person's achievement of a certain level of intellectual development, which is discovered much later than preschool age. At the same time, in the works of L.P. Knyazeva, T.I. Erofeeva, R.R. Nakokhova, O.B. Shirokikh, indirectly, and in the study of N.V. Kosmacheva directly confirms the possibility of forming value orientations in older preschool children. Researchers note that the effectiveness of mastering and assimilating such orientations is associated with what pedagogical tools and methods are used by teachers and to what extent they correspond to the laws of moral development of children at the stage of preschool childhood.

Rapid changes in society lead to large-scale changes in human development. And, as a result, the value orientations of the individual change, which begin to form in preschool age (L.Ya. Bozhovich), which in the future determines the life strategies of a person (M. Rokich).

The category «value» is the subject of philosophy, psychology, pedagogy. From a philosophical standpoint, values reflect an ethical view of the objects of the surrounding world, characterize their positive or negative meaning for a person from the standpoint of good-evil, morality-immorality, usefulness-harm. Psychology studies value orientations as a structural element of personality, explores their hierarchy and mechanisms of value self-determination. Pedagogical science deals with the issues of actualization of the process of personal value self-determination. From her position, value orientations reflect the totality of a person's relations, reflect his worldview and influence the choice of behavioral strategies.

The study of value orientations is devoted to a lot of research conducted in various directions. For this work, two of them seem to be important: identifying the features of modern life that affect the formation of values and studying the

value orientations of children. An analysis of works devoted to the study of social conditions affecting the values of children showed that such features are value uncertainty, value relativism, value nihilism, the carriers of which, to one degree or another, affect the transmission of values to the younger generation [3].

Purpose of the study

Another area of research that is important for us is the study of value orientations in children themselves. Studies show that a new generation of children is experiencing distortions of values, their shift to the material side and extreme polarization, when one child «coexists» with values opposite in sign [4]. At the same time, we found that value orientations in children with special health abilities, on which there are practically no scientific works, are an unexplored area. Therefore, the purpose of this work is to study value orientations in preschool children with disabilities (mental retardation).

The study was carried out on the basis of the municipal budgetary preschool educational institution «Combined Kindergarten N 33» in the city of Achinsk, Krasnoyarsk Territory.

Materials and methods

The sample of subjects consisted of 48 children aged five to seven years.

The study was conducted on two samples: in the first sample there were 24 children, the state of intellectual development, who were qualified by the psychological, medical and pedagogical commission as "mental retardation." These children attended groups of a combined, compensatory orientation.

The second sample included children who did not belong to the category of disabilities (24 people). The age of children in both groups is from 5 to 7 years old, they have normal intellectual development, sound hearing and vision.

The study was carried out according to the method of studying the value orientations of children by SM Valyavko, EV Averyanova [1]. This technique is based on the fact that the child's desires reflect the most significant and essential objects of reality and spheres of activity. This makes it possible to judge value orientations based on the desires expressed by the child.

Results and discussion

The criteria for studying the development of value orientations in children aged five to seven were: health, play, cognitive, hedonism, communication, spiritual values.

The results of the study are presented in Figures 1, 2.

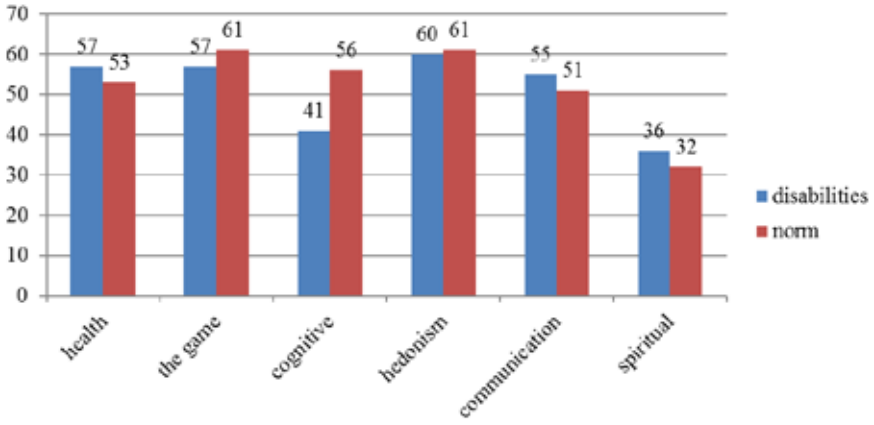

Figure 1. *Data of a comparative analysis of the value orientations of 5-year-old preschoolers with disabilities and preschoolers without health disorders. Horizontally - values, vertically - the number of subjects focused on these values*

As can be seen from Figure 1, the value of «hedonism» associated with receiving various pleasures (60 and 61%, respectively), and the value of «the game» (57% and 61%, respectively) are in the lead among 5-year-old children of both groups.

The data indicate that in comparison with normally developing peers for children with intellectual disabilities, the value of «health» (58% and 53%, respectively) and the value of communication (55% and 51%, respectively) are of great personal importance. Cognitive values were in third place (41 and 56%, respectively). There was a difference in cognitive values, the preference of which is higher in children than in the norm by 15%. Spiritual values have the smallest weight in both groups of subjects (32 and 36%, respectively).

However, a comparative analysis of the data obtained on samples of children with special health and normative abilities showed that the differences are not statistically significant. Thus, we can conclude that for the studied groups of 5-year-old children, regardless of their health status, a focus on entertainment and enjoyment is characteristic (children of both groups first of all chose photographs with the image of sweets and a disk with cartoons), the desire for game types activities, communication.

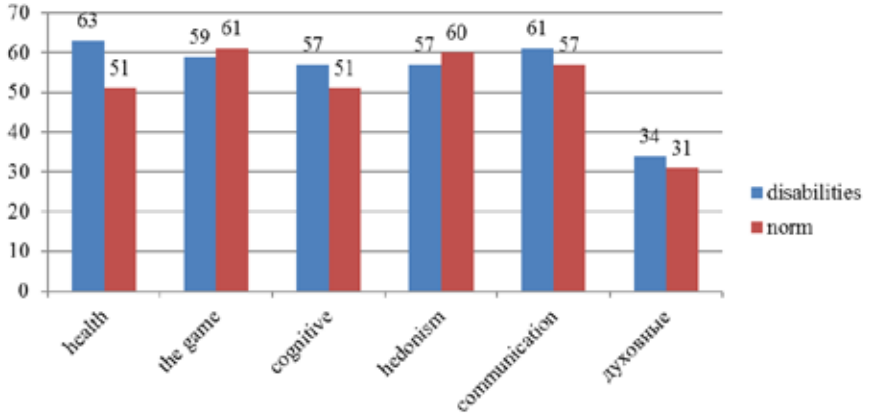

Figure 2. *Data of a comparative analysis of the value orientations of 7-year-old preschoolers with disabilities and preschoolers without health disorders. Horizontally - values, vertically - the number of subjects focused on these values*

As can be seen from Figure 2, in children of 7 years old, in comparison with normally developing peers for children with mental retardation, the value of «health» (63% and 51%, respectively), the value of «communication» (61% and 57% respectively). In second place are the values «the game» (59 and 51%, respectively), «hedonism» (57 and 60%, respectively) and «communication» (61 and 57%, respectively). In third place, gaining the smallest share in both groups, «spiritual» values (34 and 31%, respectively).

A comparative analysis of the formation of value orientations in older preschool children with mental retardation is shown in Table 1.

Table 1 - *Comparative analysis of the formation of value orientations in children 5 and 7 years old with mental retardation*

	5 years	**7 years**	**rank, 5 years (X, dx)**	**rank, 7 years (Y, $d_{y)}$**	**$(d_x - d_y)^2$**
health	57	63	4	6	1
the game	57	59	4	3	4
cognitive	41	60	2	4	4
hedonism	57	57	4	2	9
communication	55	61	3	5	4
spiritual	36	34	1	1	0

Having ranked the formation of value orientations, according to Spearman's rank correlation, it can be seen from Table 1 that children with mental retardation at the age of 5 are significantly more likely to choose the values: «health», «the game», «hedonism» (rank 4), and by the age of 7 values: «health» (rank 6), «communication» (rank 5) and «cognitive» values (rank 4).

Thus, in the course of the study of identifying the level of formation of value orientations in five to seven years with mental retardation, he showed that by the age of 7, the rank of values significantly increased: «health» (from 4th to 6th rank), «cognitive» values (from 2 by 4th rank), «communication» (from 3rd to 5th rank), and the proportion of «spiritual» values and «the game» (from 4th to 3rd rank) decreased. The specific weight of the «hedonism» value by points remained at the same priority level.

Thus, in the course of the study of identifying the level of formation of value orientations in five to seven years with mental retardation, he showed that by the age of 7, the rank of values significantly increased: «health» (from 4th to 6th rank), «cognitive» values (from 2 by 4th rank), «communication» (from 3rd to 5th rank), and the proportion of «spiritual» values and « the game» (from 4th to 3rd rank) decreased. The specific weight of the «hedonism» value by points remained at the same priority level.

	5 years	**7 years**	**rank, 5 years (X, dx)**	**rank, 7 years (Y, d_y)**	**$(d_x - d_y)^2$**
health	53	51	3	2	0.25
the game	61	61	5	5	0
cognitive	56	51	4	2	2.25
hedonism	61	61	5	5	0
communication	51	57	2	4	4
spiritual	32	31	1	1	0

Having ranked the formation of value orientations, according to Spearman's rank correlation, it can be seen from Table 2 that children with a norm of intellectual development at the age of 5 are significantly more likely to choose values: «the game», «hedonism» (rank 5), and by the age of 7 the values: «the game» (6th rank), «hedonism» (5th rank) and «communication» (4th rank).

Thus, in the course of the study of identifying the level of formation of value orientations in five to seven years with a norm of intellectual development, he showed that the share of the value of «health» was higher at 5 years old, and by the age of 7, it slightly decreased, and the share of the value «communication», on the contrary, increased. The rank of values «the game» and «hedonism» remained at the same priority level.

Comparing the results of the development of value orientations, obtained on samples of children with special health abilities and norms, he showed that the value of health prevails in children with mental retardation. Also, based on the results obtained, it can be concluded that for the studied groups of children of 7 years old, the desire for play activities, enjoyment, the desire to communicate with peers and gain knowledge is characteristic.

A comparative analysis of the formation of value orientations in children of 5 years old: with the norm of development and with mental retardation is reflected in Table 3.

Table 3 - *Comparative analysis of the formation of value orientations in children of 5 years old with a norm of intellectual development and with mental retardation*

	5 years, developmental norm	**5 years, impaired mental function**	**rank, 5 years, developmental norm (X, dx)**	**rank, 5 years, impaired mental function (Y, d_y)**	**$(d_x - d_y)^2$**
health	53	57	3	4	4
the game	61	57	5	4	0.25
cognitive	56	41	4	2	4
hedonism	61	57	5	4	0.25
communication	51	55	2	3	1
spiritual	32	36	1	1	0

Having ranked the formation of value orientations, according to Spearman's rank correlation, it can be seen from Table 3 that children, both with the norm of intellectual development and with mental retardation at the age of 5, significantly more often choose the values: «the game», «hedonism» (5 rank - norm, 4 - mental retardation), but for children with mental retardation at the age of 5, the value «health» is important (rank 4).

Thus, during the study of identifying the level of formation of value orientations in children of senior preschool age (5 years), he showed that the proportion of «cognitive» values for children with a norm is higher than for children with mental retardation (4 and 2 ranks, respectively). According to the ranking matrix, the value of «communication» for children with mental retardation at 5 years of age is more important than for peers with normal intellectual development (3 and 2 ranks, respectively). The rank of values «the game» and «hedonism» in children with the norm is higher than in preschoolers 5 years old with mental retardation (5 and 4 ranks, respectively).

A comparative analysis of the formation of value orientations in children of 7 years old: with the norm of development and with delayed mental development is reflected in Table 3.

Table 4 - *Comparative analysis of the formation of value orientations in children of 7 years old with a norm of intellectual development and with mental retardation*

	7 years, developmental norm	**7 years, impaired mental function**	**rank, 7 years, developmental norm (X, dx)**	**rank, 7 years, impaired mental function (Y, $d_{y)}$**	**$(d_x - d_y)^2$**
health	51	63	2	6	12.25
the game	61	59	5	3	6.25
cognitive	51	60	2	4	2.25
hedonism	61	57	5	2	12.25
communication	57	61	4	5	1
spiritual	31	34	1	1	0

Having ranked the formation of value orientations, according to Spearman's rank correlation, it can be seen from Table 4 that children with a norm of intellectual development at the age of 7 are significantly more likely to choose the values: «the game», «hedonism» (rank 5), and their peers with mental retardation less often to 7 years (5 and 3.2 ranks, respectively). For children with mental retardation at the age of 7, according to the matrix of ranks, the values «health», «cognitive» values and «communication» are most important than for peers with a norm of intellectual development (the value of «health» - 6 and 2 ranks, respectively, «cognitive» values of 4 and 2 ranks, respectively), the value of «communication» (5 and 4 ranks, respectively).

Thus, in the course of the study of identifying the level of formation of value orientations in seven years with a norm of intellectual development, he showed that the proportion of the value of «health» at 7 years is higher in children with mental retardation (12.25 correlation coefficient of ranks), and for children at 7 years with a norm of intellectual development, the rank of value «hedonism» (12.25 correlation coefficient of ranks) is significantly higher in accordance with the data of the rank matrix in children of 7 years of age with mental retardation. The «game» value rank among 7-year-old preschoolers with a norm is higher than among peers with mental retardation (6.25 rank correlation coefficient), and the «communication» value rank among 7-year-old preschoolers with mental retardation, on the contrary, is higher than among peers with mental retardation norm (1 rank correlation coefficient).

Conclusion

Thus, having carried out a comparative analysis of the problem of the formation of value orientations in children aged five to seven years with mental retardation, we can single out it as a very global one, since its formation affects not only the formation of the personality of preschoolers, but also determines the success of education in primary school.

Thus, we come to the conclusion that preschool age is a sensitive period for the formation of value orientations in older preschool children, and from the level of its development we can talk about the success of the initial readiness and systematic education in primary school.

In this connection, there is a need to study the formation of value orientations in older preschool children and aspects that influence the formation of values in children with disabilities.

Recommendations

1. It is necessary to modify the methods for studying value orientations in preschool children in order to conduct a valid study of values in older preschool children with mental retardation.

2. In connection with the revealed comparative data on the formation of value orientations of children with a norm and with mental retardation, it is necessary to adjust the content section of the adapted educational program of preschool education for children with mental retardation in the educational field of «spiritual and moral development».

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FEATURES OF THE SEVERODVINSK MURALS AND THE HISTORY OF THEIR ORIGIN

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Purpose of the work *– to describe all the paintings in a single resource.*

Research methods and objects: *Severodvinsk murals, classification of Severodvinsk murals and their history.*

Results: *study of the origin with icon painting, as well as book miniature; story about compositional techniques, themes and manner.*

Abstract. *The goal of the article is to describe all the paintings in a single resource (many scattered sources) and highlight the most important thing. In addition, tell about the peculiarities of the Severodvinsk murals and the history of their origin with icon painting, as well as book miniatures; about compositional techniques, themes and manner.*

Keywords: *Severodvinsk painting, folk art, Boretskaya, Rakulskaya, Permogorodskaya, Toymskaya, Puchugskaya, Uftyugskaya.*

Introduction

Russian folk paintings are known all over the world. The murals were passed on from a family of craftsmen to a family. The followers, opening artels, passed on the skill of the folk fine applied art of painting.

The most impressive among them are "Severodvinsk paintings". The term denotes the general name of folk Russian wood painting dating from the late 18th century in villages and towns along the Northern Dvina River (fig. 1). In the Vologda and Arkhangelsk Oblasts in the North-West of Russia, craftsmen created wooden household items and decorated them with northern paintings.

Each painting has a unique character and style. Geographically, they are located in the Northern Dvina, Permogor, Upper Uftyuga, Rakulka and Barok. V. Vasilenko pointed out stylistic differences; an expedition of the Historical Museum carried out work on typification in various areas in the North of the Dvina.

Fig 1. *On the map, the main villages along the Sev. Dvina*

Outwardly different, the Northern paintings are similar in theme, composition, and pen drawing. Scientifically, painting began to be studied from the end of the 50s, the organizer of the expedition was the Zagorsky Museum, which sent an expedition to the Northern Dvina. The most reliable sources are described in the works of Kruglova and Arbat. They established classifications of three types of painting: Rakul, Permogorsk, Severodvinsk (Boretskaya - the richest, Puchugskaya - openwork). Severodvinsk painting is subdivided into directions: Puchugskaya, Boretskaya, Rakulskaya, Permogorskaya, Uftyuzhskaya, Toymskaya.

In the 16th century, the Northern Dvina was a major cultural, trade and transport junction, and the neighboring towns along the riverbed were its centers (fig. 1). All-Russian culture was spread by the cities of the north of Belozersk and Kargopol, as well as monasteries. Architectural monuments wear the same style from the 16th to the 17th centuries, which formed the basis for peasant paintings in the north.

The painting was formed in the 18th -19th century in a natural way, under the influence of the posad culture in the 18th century. Products are created in the same style, which served as the basis for all peasant paintings and further developed the peasant culture of the north [1].

Products are varied: chests, spinning wheels, boxes, tues, household utensils and many other household items (fig. 2). The predominant theme was scenes of folk life and festivities in symbiosis with natural motives (fig. 2).

Fig 2. *Severodvinsk spinning wheels and a painting element*

Let's take a closer look at each of the directions, structuring them, highlighting the unifying factors, masters, as well as the features of each painting of the North:

Boretskaya painting

Fig 3. *The tree of Life*

Fig 4. *Composition of Boretz Painting*

Fig 5. *Spinning wheels of the Amosovs*

Description of the painting: Boretskaya painting is recognized as the most elegant and richest. The most famous products are Boretsky spinning wheels (fig. 5). They consist of three compositional parts. A typical composition consists of a window located at the top of a spinning wheel, a tree of life in the middle and below - young lovers on a sleigh or a charioteer (fig. 4). The plots are taken from folklore, from folk songs. The most famous masters in this direction are the Amosov family. Their works have survived to this day (fig. 5).

Characteristic elements: shamrock, branch with berries, tulip, tree, birds, horses, geometric ornament. The early works traced the school of northern icon

painting in Novgorod, the roots go deep into ancient Russian art. Bork's art includes the moments of the census, book design, popular prints, northern writing of icon painting (clothes embroidered with pearls, hats, outerwear, bright coloring of painting, horseman). It is the composition of the spinning wheels that is compared with the iconostasis. The icon painting is inspired by the presence of some signs, while the painting itself is original. Instead of saints, birds and rays of the sun are depicted. The windows show a unicorn and a lion.

Color spectrum: In addition to traditional green, yellow and red, wood painting is supplemented with a gold color, making it festive and elegant. The background usually remains white. The images are distinguished by the grace of lines and the whiteness of the background, the floral pattern stands out in color, gilding with gold leaf created a festive look and an elegant, expressive mood.

Compositional features and themes: The characteristic features of the painting of the spinning wheel are the patterns on its stem. The shamrock extends on a straight stem along the entire leg, ending with a rosette with a very lush tulip. In the uppermost compositional circle, a bird or a beautiful flower could also be placed. The legs themselves had a certain configuration: they were cut out in the form of 4 or 5 circles, connected by wavy transitions. The compositional subjects reflect the everyday scenes of the peasants of the north. Characterized by a rider on a horse (from one to two), plant motifs - red bushes with buds and curls, petal rosettes, solar symbols. On the visible side of the spinning wheel is the wedding scene of the departure of the bride and groom, princess or merchant family. Red clothes with gold belts, with gold trim with pearls. Tulip-shaped flowers are characteristic of the paintings of the chests of the 17th and 18th centuries, all the characters are dressed in festive boyar outfits - the influence of Novgorod schools. New compositions and a trace of old Russian themes constantly appear, each master introduces his own small character of painting, having fallen in love with depicting birds more and more elegant, colorful and with richly decorated tails. The symbol "Tree of Life" depicting birds is the favorite of the folk painting masters of the north. The symbol of the power of nature, happiness and human well-being is depicted by a solid, strong and at the same time graceful tree with roots - the "Tree of Life" (fig. 3). This part of the spinning wheel is therefore called STAVO WITH WOOD. A favorite image - a village sleigh, transport, relevant at any time of the year and in any weather, for any holiday and fair, for a wedding - this object is present in all characteristic scenes.

Materials and tools: wood base, gouache, tempera, ink, brushes, feather, varnish, sandpaper and primer.

Permogorsk painting

Fig 6. *Products with household compositions*

Figure 7. *Permogorsk spinning wheel*

Description of the painting: The main center is Arkhangelsk Oblast - several villages of Permogorye. This painting is called solemn. As with all northern paintings, the most famous works of the masters are the spinning wheels. Spinning wheels are painted according to certain patterns. Famous craftsmen are the Khripunov brothers. There is a certain character in their manner: a cold color for the father, the main red color for the older brother, and bright colors in the works of the younger brother. O. Kruglova clarifies: "she was inspired by the fact that (the older brother) studied like his father, as well as the craftsmen - E. Yarygin" [6]. Yarygin's style is distinguished by a detailed elaboration of plot patterns. The master Alexander Misharin of the 19th and 20th centuries succeeded in this. His skill is characterized by a well-padded, free hand, naive art, slightly spontaneous. The master studied with his father. V. Yurkin was famous in Permogorye, who adorned the decoration and doors in the huts. Some of his works have survived to this day, as O. Kruglova writes about in her books [6].

Color spectrum: Typical color scheme: red patterns are depicted on a white background, green and yellow colors are only complementary.

Be sure to apply black contouring, feather or hair.

Compositional solutions and features: As is typical for northern paintings, the painting of spinning wheels is subordinated to the scheme: in the central composition, among the plant shoots, a bird was placed and depicted in a medallion, in the lower part there is a traditional scene of horseback riding, a wedding scene, and gatherings (Fig. 7). Everything underfoot is decorated with rich and delicate, fabulous, curls and floral elements.

Spinning blades are distinguished by their narrowness. They are cut in the form of several circles, mainly 4 or 5. Horses are laconic, without details - popular naive is characteristic here, unlike Toyma and Bork. The special character is emphasized by openwork herbal red curls.

Signs and influence of the Ustyug school are also noticed. The master writes curls with black, red and white teeth, fills the entire plane of the plot. The image is not limited only to scenes with a bird and horses, there are also many other thematic everyday and holiday compositions (fig. 6).

Arbat in his book mentions a spinning wheel, on which there is a scene at a table with tea - but not a couple, newlyweds and a father (a man with a beard). An example of a custom composition (according to the researcher). They also depicted the craftsmen and forest subjects - for example, deforestation [2].

Materials and tools: wood base, gouache, tempera, ink, brushes, feather, varnish, sandpaper and primer.

Puchug painting

Figure 8. *Puchug spinning wheel*

Fig 9. *Composition of the charioteer in armak*

Fig. 10 *Kuznetsovskaya spinning wheel*

Description of the painting: The characteristic spinning wheels amaze with their splendor and intricate ornamentation: stylization of plant elements, borders, frames, corners.

Puchug openwork - rich painting, originated in the Northern Dvina in the village of Puchuga near the village of Borok. To this day, paintings on spinning wheels have survived, the graphic drawing on which is striking in its openwork. The famous craftsmen who left their mark are the Kuznetsovs, their spinning wheels have been preserved in the museum to this day (fig. 10).

Typical compositional solutions and features: The spinning wheels are made in the traditions of the north, the blade was divided into three parts (fig. 8). As in all northern paintings, scenes of festivities, weddings, everyday scenes, and folk festivals are characteristic. The spinning wheels of the Puchuga are very similar to the Boretskys, but there are also differences: a driver on a spinning wheel, a carrier, wears a black hat in a peasant sheepskin coat, and there are lapels on the hat - characteristic features of the painted composition. Horses with a beautiful posture, painted in gold and green, are harnessed to a covered golden cart, and the characteristic figure of a man in a village army jacket (fig. 9). The back side is decorated with a skating scene, everything is framed by a trefoil and several plant elements, surrounded by geometric triangles. The shamrock is especially different - it has a thin part of the leaf, at the top turning into a round berry. Also, a distinctive feature is the painting on the spinning wheel's leg: the stem is decorated with curly leaves from the base to the very top of the rosette. A six-pointed star, an ancient symbol, was located on the legs of the spinning wheels. Scenes of peasants' labor are typical for painting: spinning peasants, feeding animals, birds, hunting, caring for animals, working in the field, sawing wood. Also wine drinking, rest. In addition, the compositions could be accompanied by inscriptions - both with moralizing and with sayings.

Color spectrum: The painting was carried out on a white background, the main color is red with elements: green leaves, white droplets and dots, let's say blue.

Materials and tools: wood base, gouache, tempera, ink, brushes, feather, varnish, sandpaper and primer.

Rakul painting

Fig 11. *Rakul composition with a bird*

Fig. 12 *household utensils*

Description of rakul painting: Not far from Permogorye in the Arkhangelsk Oblast on the Rakulka River (flows into the Northern Dvina) there is the village of Ulyanovskaya - the progenitor of the Rakul painting. The Rakul painting is characterized by a large ornament, due to decorative leaves, bushes, birds. Famous masters of the 19th century - the Old Believer family of Vityazevs, who painted utensils: spinning wheels, baskets, boxes, - passing on the skill to their descendants, from family to family (fig. 12).

Characteristic features of the composition: The pattern of paints is similar to enamel inserts, the northern scheme is used for painting the spinning wheel, the division into 3 sectors inherent in these paintings. The first section consists of a branch with large leaves, a bird takes the place in the middle, and a branch takes the last lower part (fig.11). The shrub leaves are dyed in several colors (2 or 3 colors), creating a sense of colorful variety and richness. The basis of the painting is floral ornamental elements, decorative leaves, combined into bunches, branches and bushes. The birds were executed in black and outlined in black, green and red colors were also present (fig.11). In the manner of painting - unusual patterns, on a red background the box is girdled with scallops. In the ornamental motifs there are circles in the center, roosters flaunt on the side parts. All elements are graphic, made with a contour, all elements of the product are made in the same style.

The main element in spinning wheels is a curved stem, with large rounded drops of different colors running on both sides. The background color of the spinning wheel is yellow, in ornamental frames on a white background there are graphic images of birds consonant with a rooster.

Color spectrum: The color scheme is made up of ocher-gold, red colors and additional: blue, white, green, brick-red. There is a characteristic black outline of northern paintings, it is also used to apply other details: antennae, veins and curls. The background has a yellow-gold flavor.

Ulyanovsk spinning wheels are solved very boldly, brightly, using local colors: red, white and green. The shape is unique, as is the painting - a wide blade with four heads, the leg is made of semicircles, tapering towards the bottom of the spinning wheel base.

Materials and tools: wood base, gouache, tempera, ink, brushes, feather, varnish, sandpaper and primer.

Toym painting

Fig 13. *Tree of life with birds*

Fig 14. *Toym spinning wheel*

Description of the painting: In the villages of the North near Toyma in the 19th century, folk Toymskaya painting of home decoration and walls prevailed. The painting is called lush. The most famous products are spinning wheels (fig. 14). Old Russian patterns prevail, based on stylized red herbs, frames, corners. The most famous icon painter, the master of this Oblast - Tretyakov Sr. and his brother, also noted his uncle. They created carved and painted spinning wheels - elegant, neat, in the icon-painting style. They tried to make each painting unique, not repeating the previous one. They depicted details by hand, without using a stencil. The master E. Menshikov is famous in the village of Abakumovskoye. Like Tretyakov, he is a native of the icon-painting school - all glorious masters who left their unique products to their descendants [3].

Typical composition: The cavity was made from one piece of wood, from a single piece with a root. The cavity was wide, divided by the master into three sections, similar to the canons of icon painting. At the very bottom, there was an image of a wedding ride on horses.

Male lonely image: with a primitive cart with a window. Behind them they could portray a bride. In the middle, she painted with a patterned ornament of the "tree of life", with birds - as if from fairy tales (fig. 13). The upper part with windows on the sides and stylized images of flowers on the windowsill. In the center, between the windows, a tulip-shaped flower, or a tree, or birds was depicted.

Color spectrum: Products were painted with red and gold flowers on a snow-white background, yellow, blue, brown, a little green, or a gold background predominated.

Materials and tools: wood base, gouache, tempera, ink, brushes, feather, varnish, sandpaper and primer.

Uftyuzhskaya

Fig 15. *Typical composition*

Fig 16. *Uftyug spinning wheel*

Description of the painting: Another of the brightest crafts of the North is the Uftyug painting. From the 18th to the 20th century, the inhabitants of the North created birch bark, wooden products, decorating them with carvings and paintings.

Mastery was born in Uftyug, in Arkhangelsk Oblast. Due to its remoteness, the village was a center of religion and trade. The old Russian art of icon painting and miniature had a strong influence on the masters. Household items developed into painting: tues, which were painted by the master, were used in the household. The products were signed both for sale and for gifts to friends and relatives. Famous masters - A. Kuvakin, who worked with slightly noticeable strokes and pastel shades. F. Bestuzhev adhered to the graphic outline and compositional dynamics. The Novinsky family passed on the craftsmanship of the mid-20th century. [5]. The works of the described masters, especially the spinning wheels (fig. 16), adorn museums in Russia.

Typical compositions and features: The scenes of the compositions are a peasant life intertwined with nature. On products: spinning wheels, platbands, boxes - vegetation, birds (swans, chickens, doves, peacocks, mythical birds) are depicted (fig. 15) in nature under trees. This painting is characterized by a geometric ornament, a pattern, a circle - a solar symbol. The six-leaved flower in this painting is a symbol of fertility. The rosette symbol is the princess of all plants. Tulip is a symbol of beauty and youth. Krin is a symbol of the transformation of spring.

Color spectrum: The technology is consistent: first, light paint was applied, then dark, then the outline and other subtle details were drawn. The color palette consists of pink, terracotta and blue, blue, as well as bright green and white. The structure of the product was emphasized by a light background.

Materials and tools: wood base, gouache, tempera, ink, brushes, feather, varnish, sandpaper and primer.

Conclusion: In Northern paintings, everything is subordinated to the shape of the object - both decor and painting are individually selected based on this rule. Each product became a work of folk art. Old Russian art influenced the development of painting in the north, monumental painting, book miniatures, icon painting, ornamentation of books can be traced in them. The Narodnik masters transferred book motives and miniature techniques to painting. The principle and manner of depicting clothes, colors and characters in the drawing are laconic and simplicity. Techniques in composition are typical for icon painting and book miniatures (combination of composition and narrative scenes of different times). Dyes and techniques are taken from the miniatures of Ancient Rus. We primed the product, painted with a contour, ink, then filled everything with color. The paints were diluted with egg yolk, and later they switched to dyes. Although it is borrowed from the influence of books, the nature of the painting is different. In the Northern paintings, plant motifs are visible among the components - a wriggling shoot with located sharp shamrocks and tulip-shaped flowers. Typical and popular compositions: sleigh rides, triplets, weddings and festive gatherings, the Sirin bird or fish was placed in the center. The symbiosis of nature and man is inherently present in every plot.

In the paintings of the North, story compositions were created in which everyday scenes, hunting scenes are common, everything has a symbolic meaning, especially when painting spinning wheels. In addition to a happy prosperous life, wedding skating, scenes of peasant labor - scenes of a fight between two warriors, a figure of horsemen, a hunting scene (fig. 17). As an example, a hunting scene: the figure of a hunter-groom, a bird-bride. Confirmed by folklore research: before the wedding ceremony of lamentation, in words the bride compares herself to a bird, and the groom acts as a hunter [4].

Fig 17. *Characteristic compositions*

Images of a unicorn, lion, horse, deer, bird gamayun, sirin, alkonost, peacock, swan, duck, chicken, herbs, flowers (tulips), bushes, berries, geometric signs and

circles of the sun are frequent (fig. 17). A separate symbol is the tree of life - a symbol of the power of nature, the well-being of mankind and happiness. The color palette consists of shades of red against a contrasting white background. The paintings are inherent in carpet compositions; in earlier samples they resemble arabesques. Shades of green and yellow sound like additional shades in the painting. A characteristic feature is the outline, made in black paint and with a fine goose feather or fine hair. Many northern artists painted household items and came from icon painting schools, participated in painting church walls and facades. The murals are both traditionally pagan and have Christian content. All these are the unifying motives of the Northern painting, which over the years becomes more relevant and interesting to study. Shows its relevance in the modern interior, household items find their place, thereby preserving the traditions of the craft. Northern folk painting is a bright and distinctive art. Each master of the North in painting brought some of his own specific character and style, worthy examples of art will always be relevant.

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INFLUENCE OF BURN TOXEMIA ON CORRELATIONS BETWEEN HEART RATE AND BLOOD PARAMETERS DEPENDING ON AGE

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Abstract. *The ongoing traditional intensive therapy turned out to be insufficiently effective in terms of correcting metabolic and functional disorders observed in the first 10 days of burn toxemia in the examined patients, which was expressed in the preservation of the increase in the mesor of the circadian rhythm of the HR detected on the first day. A negative correlation was found between erythrocytes, hemoglobin, and blood hematocrit with the mesor of the circadian rhythm of the HR in infancy, in senior school age and at the age of 19-40 years. Corrective antiarrhythmic drug therapy, aimed at maintaining a lower HR characteristic of the elderly, turned out to be effective. The absence of significant correlations between HR and white blood components indicates a fairly effective anti-inflammatory therapy in most of the studied patients.*

Keywords: *burn toxemia, blood, age, heart rate.*

Relevance. It is known that acute burn toxemia lasts from 2-4 to 10-15 days. Diagnosed with toxic myocarditis - tachycardia, arrhythmia, deafness of heart sounds, expansion of the boundaries of the heart, decreased myocardial contractility and a drop in BP. There is toxic hepatitis, pneumonia, exudative pleurisy, atelectasis, bronchitis, pulmonary edema. Hemoconcentration is replaced by anemia - Ht, the number of erythrocytes decrease, hyperleukocytosis up to 30x 10^9/l, a shift of the leukocyte formula to the left [1-4].

Due to the lack of information on the differentiated assessment of the severity of the condition, the peculiarities of the influence of changes in the homeostasis system depending on the characteristics of the organism at different age periods, we considered it necessary to study the monitoring data of HR, traditional clinical and biochemical parameters of blood, to determine the relationship increasing the effectiveness of treatment, optimizing the prognosis.

Purpose. To study and assess the age-related characteristics of the effect of

burn toxemia on the correlations of heart rate and blood parameters depending on age.

Material and research methods. The results of monitoring the heart rate (HR) of patients admitted to the Department of Cambustiology of the Republican Scientific Center of Emergency Medicine due to burn injury were studied. After recovery from shock, routine anti-inflammatory, antibacterial, infusion therapy, correction of protein and water-electrolyte balance disorders, early surgical, delayed necrectomy, additional parenteral nutrition, syndromic, symptomatic therapy were performed. Changes in the HR circadian rhythm were studied by hourly continuous recording of hemodynamic parameters in 107 patients with severe thermal burns in six age groups - group 1 - 31 patients aged 6 months - 3 years, group 2 - 25 patients aged 3.1-7 years, group 3 25 patients - 7.1-18 years old, 4 - 12 patients 19-40 years old, 5 - 7 patients 41-60 years old, group 6 - 7 patients 61-78 years old. The division into groups was dictated by the well-known characteristics of each age group, described in detail in the literature. Hemodynamic parameters in each pediatric group were differentiatedly studied in three subgroups, depending on the severity of the burn injury, taking into account the duration of intensive care in the ICU. Children were in the ICU from 4 to 10 days - 1 subgroup, 2 subgroup from 11 to 20 days, 3 subgroup from 21 to 50 days.

Table 1.

Characteristics of patients admitted with thermal burns

Sub-groups	Groups	Age	Burn area of 2-3A degrees in%	3 B degree	IF, units	In ICU, days
1	Group 1	19.3±6.2 month	32.7±9.8	0.1±0.03	33.4±10.1	6.8±1.8
2		14.2±4.6 month.	24.8±7.4	9±2.8	48.4±11.28	12.8±1.3
3		10.1±2. month.	26.7±2.2	6±2.7	71.3±8.4	26.3±2.4
1	Group 2	4.7±0.8	37.3±14.7	3.1±4.4	42.5±15.7	8.1±1.3
2		4.0±0.1	47.9±17.1	18.1±12.2	85.1±28.7	13.1±1.9
3		4.4±0.6	59.2±12.2	36.7±13.3	127.5±33.3	27.3±3.2
1	Group 3	11.4±3.2	41±11	6.6±6	57±11	7.3±1.1
2		15±2	55.1±14.4	4.8±3.5	86.3±15.7	12.7±1.1
3		9.7±1.5	25.8±11.4	22.5±6.6	95.8±19.1	28.8±4.8
	Group 4	27.3±5.6	59.4±13.5	21.3±13.3	119.4±38.4	22.4±14.6
	Group 5	50.7±7.1	54.3±16.5	11.9±8.9	92.5±20.8	13.3±2.4
	Group 6	71.3±7.0	40.8±5.8	21.7±6.7	86.7±12.8	18.8±9.5

As shown in tab. 1, the main factors affecting the severity of the condition of children with thermal burns of infancy were age (the younger the child, the more severe the condition), the area of damage to the skin surface of grade 3B, and the IF index.

The average age of children with severe burns in the age group from 3.1 to 7 years (group 2) ranged from 3.9 to 5 years (tab. 1). The area of the 2-3A degree burn in subgroup 1 was 37.3 ± 14.7%, in subgroup 2 - 47.9 ± 17.1%, in subgroup 3 - 59.2 ± 12.2%. A statistically significant difference was found in the area of grade 3B burns in subgroups 1 and 3, which in the most severe subgroup of children exceeded grade 3B burns than in group 1 by 11 times ($p < 0.05$) and was 6 times greater than in subgroup 2. In accordance with the severity of the condition, the duration of intensive therapy in ICU conditions in subgroup 2 was more than in the first by 62% ($p < 0.05$), in subgroup 3 more than three times longer ($p < 0.05$) than in the first. The main determinants of the duration of inpatient treatment in groups 1, 2 and 3 were such indicators as the size of the burn area of grade 3B, the Frank index, and the duration of intensive care in the ICU. Thus, age, IF index, and the area of grade 3B thermal damage served as objective indicators of the severity of thermal burns and made it possible to predict the duration of intensive care in the ICU and inpatient treatment of pediatric patients.

As can be seen from Table 1, the age groups of adult patients were significantly different and the mean values were 27.3 ± 5.6 years in group 1, 50.7 ± 7.1 years in the second, and 71.3 ± 7.0 years old in the third. The total area and area of deep skin lesions did not differ significantly. The highest index of IF was revealed in group 1, which determined the longest duration of intensive therapy in ICU conditions in group 4.

Results and discussion.

The mesor of the circadian rhythm HR on the first day in children under 3 years old in subgroup 1 did not differ from the norm, however, in subgroup 3, a significant increase in heart rate was found by 12% ($p < 0.05$) on day 1 and by 12% ($p < 0.05$) for 2 days. In the older group of school age in the 3rd subgroup, an increase in the mesor of the circadian rhythm HR in 1 - 8 days by an average of 8% ($p < 0.05$) was revealed. In the adult groups of those burnt on the first day, a tendency to an increase in heart rate relative to the age norm was revealed. Higher indicators of the mesor of the circadian rhythm HR were found in group 4 on days 2-6 compared to indicators in group 5 by 19%, 16%, 9%, 7%, 6% ($p < 0.05$, respectively). Also, HR indicators lower than group 4 were noted in patients of group 6 on days 1 - 8 by 14%, 12%, 12%, 20%, 14%, 12%, 17%, 18%, respectively, which characterized the effectiveness of corrective medication therapy aimed at maintaining a lower HR characteristic of older age.

Table 2

HR dynamics during toxemia, depending on age

	Group 1			Group 2			Group 3			Group 4	Group 5	Group 6
days	Subgroup 1	Subgroup 2	Subgroup 3	Subgroup 1	Subgroup 2	Subgroup 3	Subgroup 1	Subgroup 2	Subgroup 3			
1	133 ±7.3	142 ±19.9	149 ±6.3*	133 ±7.6	129 ±5	135 ±4	106 ±3	94±3	115 ±3*	102 ±3	99 ±6.6	87 ±4≈
2	130 ±7.8	140 ±9.9	152 ±10.6*	129 ±7.9	123 ±2	126 ±2	107±2	114±5	122 ±3*	103 ±1	86 ±1.8≈	90 ±2≈
3	136 ±5.0	137 ±6.2	130 ±12.9	124 ±10.8	118 ±1	127 ±2	107 ±2	111 ±4	123±3*	101.1 ±0.8	86.6 ±1.9≈	88.6 ±1≈
4	139.3 ±5	138.8 ±5	139.7 ±12	126.6 ±6	122 ±3	129 ±2	110 ±2	116 ±3	121±2*	107.1 ±1.6	97.8 ±2≈	87.3 ±2≈
5	138.8 ±4	137.6 ±3	136.7 ±10	126.3 ±6	124 ±2	129 ±2	111 ±2	116 ±3	127±2*	106.1 ±1.5	98.7 ±2.3≈	91.8 ±3≈
6	139.8 ±3	139.5 ±5	137.3 ±6	131.4 ±5	122 ±2	131 ±2	112 ±2	109 ±2	128±3*	106 ±1.4	100.1 ±2≈	92.7 ±2≈
7	140.7 ±4	138.9 ±7	137.3 ±6	130.2 ±5	127 ±4	130 ±2	117 ±2	110 ±2	128±2*	111 ±2.3	97.3 ±1.9	92 ±2.5≈
8	139.6 ±2	138 ±6.9	141.8 ±5	132.3 ±9	126 ±3	133 ±2	117 ±4	110 ±3	130 ±2*	111 ±2.1	96.8 ±3.6	91.5 ±1≈
9	139.2 ±2	135.8 ±5	135.8 ±6	131 ±5.5	128 ±3	131 ±2	130 ±5	120 ±4	121 ±3	112.3 ±2	95.7 ±2.1	96.5 ±3
10		136.2 ±6	136.8 ±7		130 ±2	133 ±2		112 ±4	128 ±3	110 ±2	93 ±3	93.4 ±3

*-the difference is significant relative to the indicator in 1 subgroup

≈-the difference is significant relative to the indicator in group 4

As shown in fig. 1, the negative effect of anemia on heart function (an increase in the tendency to compensatory tachycardia due to hemic hypoxia) was found in subgroup 1 of group 1, 1, 2, 3 subgroups of group 3, in group 4 and a slight trend in group 6. The revealed negative correlation between the red part of the blood (erythrocytes, hemoglobins and hematocrit with the index of the mesor of the circadian rhythm HR), regardless of the severity of burn injury in infancy, in senior school age and at the age of 19-40 years, testified to the negative effect of burn toxic anemia on cardiac function, causing tachycardia, which was not only compensatory in nature, but characterized the unfavorable state of myocardial trophism, myocarditis in conditions of severe intoxication, impaired capillary perfusion in combination with inflammatory changes in the heart muscle.

Correlations between HR and the red part of the blood by age

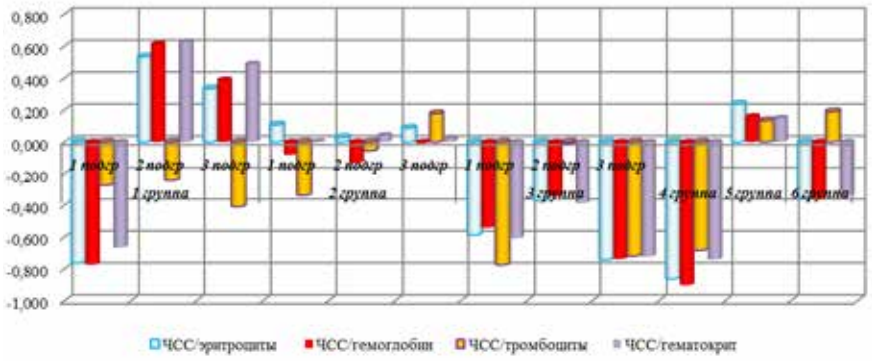

Fig.1

The revealed correlations indicate that the ongoing traditional intensive therapy was not effective enough in terms of correcting metabolic and functional disorders observed in the first 10 days of burn toxemia in the examined patients.

Correlation of HR with the constituent ingredients of leukocytes

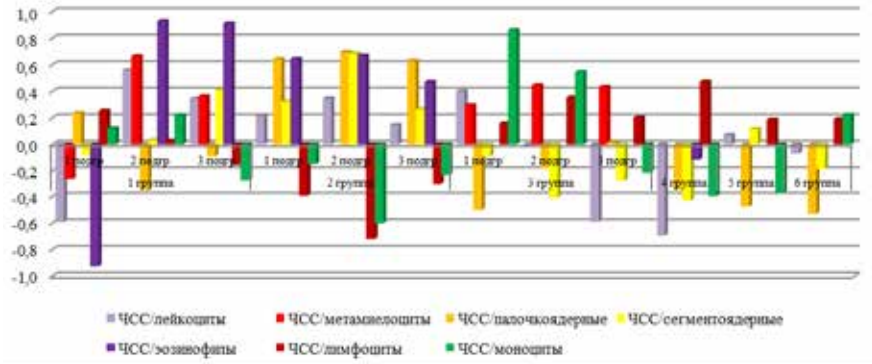

Fig.2

The absence of significant correlations between HR and white blood components indicates a fairly effective anti-inflammatory therapy (fig. 2) in most of the studied patients. However, a strong negative correlation between HR and eosinophils was revealed in children of subgroup 1 of group 1 and a direct correlation in 2,3 subgroups of group 1, moderate in all children of group 2, which can be understood as an age-related feature of the participation of cellular immunity and

a more active participation of eosinophils in the systemic inflammatory response in children of early and preschool age in compensatory reactions during toxemia of burn injury. The direct correlation between HR and the number of monocytes in peripheral blood in children of the 1st subgroup of the 3rd group characterizes the insufficient effectiveness of anti-inflammatory correction, which was manifested by the tendency to increase the heart rate in response to the inflammatory response (growth of monocytes).

Direct strong correlation between HR and the level of glucose, total protein, albumin in the blood (fig. 3) in 1,2,3 subgroups of group 2, in 1 and 3 subgroups of group 3, subgroup 5, apparently, reflect an increase in the workload on of the heart in conditions of an increase in the concentration of the studied parameters, which may be characteristic of the loss of the water component of the blood volume. Confirmation of this assumption is the tendency to increase the heart rate with the growth of urea in children of groups 2 and 3. In group 6, the feedback of HR and total protein in the blood is associated with the negative effect of hypoproteinemia on cardiac function (fig. 3).

Correlations between HR and biochemical parameters

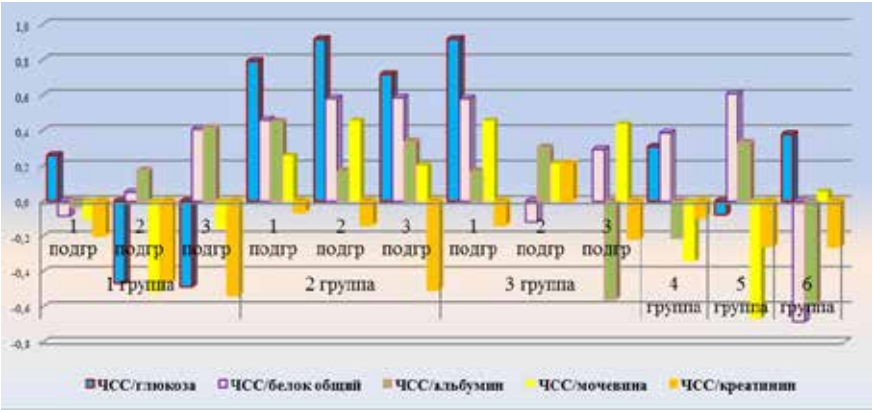

Fig.3

Significant were (fig. 4) the negative effect of plasma sodium growth on cardiac function in subgroup 1 of group 1 and in group 4, an increase in plasma potassium concentration in 2, 3 subgroups of group 2, 2 subgroup of group 3, as well as an increase in ALT in 6 group. The different directions of the influence of electrolytes on myocardial function can be explained by various changes in homeostasis during the period of burn toxemia, which created different conditions for heart function even under conditions of effective control of blood biochemical

parameters, when in some cases the increase in heart rate was of a compensatory nature, in others it turned out a direct reaction to changes in the concentration of substances in the blood, synapses, increasing the sensitivity of adrenergic receptors, thirdly, the manifestation of early signs of acute heart failure (for example, with an increase in ALT) in elderly patients.

Correlation of HR with electrolytes, blood enzymes

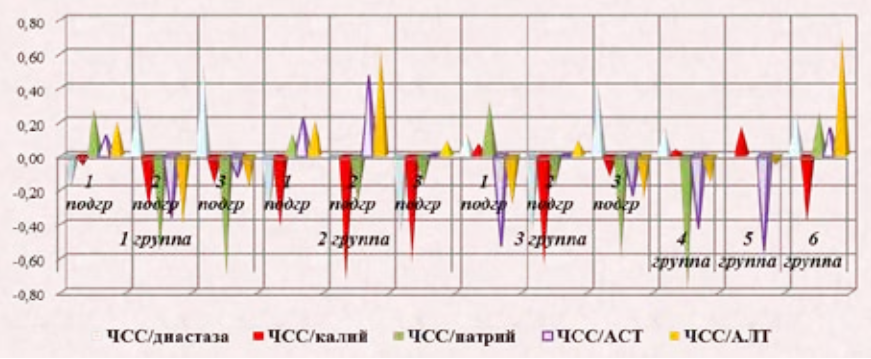

Fig.4

As shown in fig. 5, in children of the 1st subgroup of infancy, a direct relationship was found between the increase in PI on HR, and in the 2nd and 3rd subgroups (more severe burns), the opposite was found. The latter can be thought of as a positive effect of PI growth on heart function. Direct rather strong correlation between PI and HR is associated with the influence of water deficiency in subgroup 1 of group 1, limitation of infusion therapy due to the predominance of enteral administration, and better general condition of patients. With more severe burns of infants (subgroups 2,3), a tendency to decrease the protein-forming function of the liver (decrease in PI) contributed to the development of tachycardial syndrome in children.

A direct strong correlation between PI and HR in group 5 is due to the negative effect of hypercoagulation on cardiac function, causing a tendency to tachycardia, with the resulting oxygen debt in the myocardium, a decrease in blood flow velocity, a tendency to hypercoagulation and thrombus formation. A tendency to tachycardia under conditions of hypercoagulation was also found in subgroup 2 of group 2, in subgroup 2 of group 3, and in groups 4 and 6 (fig. 5).

Correlation between HR and the parameters of the hemocoagulation system

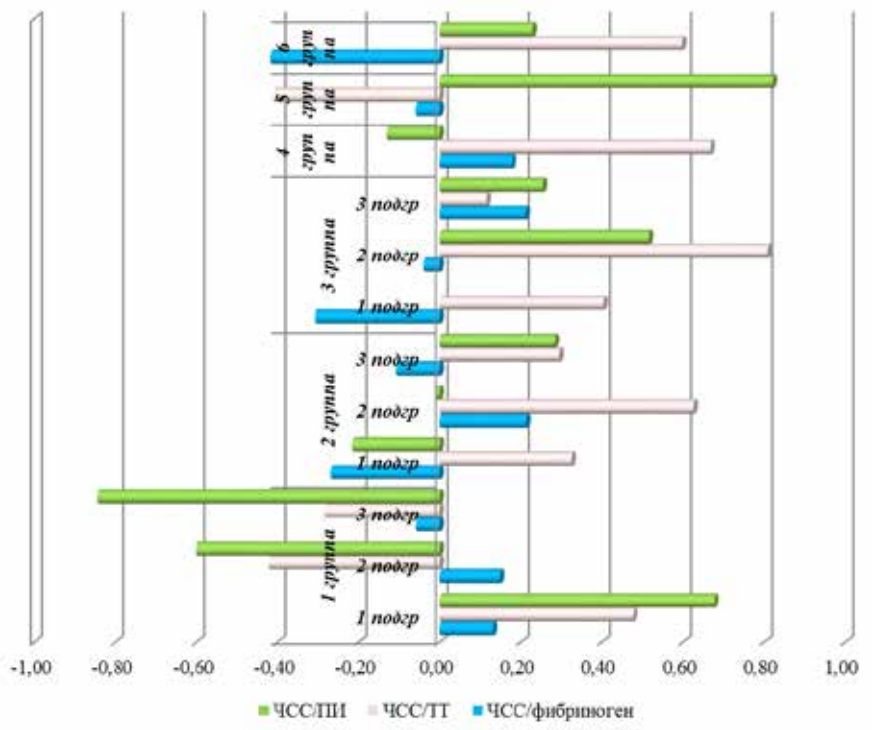

Fig.5

Conclusion. The ongoing traditional intensive therapy turned out to be insufficiently effective in terms of correcting metabolic and functional disorders observed in the first 10 days of burn toxemia in the examined patients, which was expressed in the first 10 days of toxemia in the preservation of the HR circadian rhythm mesor increase detected on the first day. A negative correlation was found between erythrocytes, hemoglobins, and hematocrit with the HR mesor of the circadian rhythm regardless of the severity of burn injury in infancy, in senior school age and at the age of 19-40 years. Corrective antiarrhythmic drug therapy, aimed at maintaining the lower HR characteristic of older age, turned out to be effective. The absence of significant correlations between HR and white blood components indicates a fairly effective anti-inflammatory therapy in most of the studied patients.

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CORRELATION RELATIONSHIPS BETWEEN MYOCARDIAL OXYGEN DEMAND AND BLOOD PARAMETERS DURING BURN TOXEMIA, DEPENDING ON AGE

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Abstract. *A statistically significant difference in the mesor of the circadian rhythm MVP was revealed only between subgroup 3 of group 1 and indicators of patients in group 6 in 1 (by 22%), 2 (19%), 7 (13%), 8 (22%), 10 (17%) day. With a comparatively larger burn surface and deeper damage to the skin, a less pronounced stress increase in myocardial oxygen demand was found in group 6. Decrease in MVP, subject to an increase in erythrocyte, hemoglobin and blood hematocrit in subgroups 1 and 3 of group 1, in all patients in groups 2,3,4. While the feedback MVP and dynamics of the red part of the blood in 5.6 groups disappeared. An increase in MVP was revealed under the condition of an increase in leukocytosis, that is, an inflammatory reaction in patients aged 41-60 years. In the first 10 days of the toxemia period, laboratory signs of acute pancreatitis, liver failure with a predominance of cytolytic syndrome were revealed. In senior*

school age, the lack of anticoagulant therapy was revealed (it was performed in all patients with thermal burns), as well as an undesirable tendency to an increase in TT in subgroup 1 of group 1, children in groups 2 and 3, in groups 4 and 6 of patients.

Keywords: *myocardial oxygen demand, blood, burn toxemia, age.*

Relevance. Despite the short period of time that elapsed from the onset of skin and respiratory tract burns to the death of the victims, changes in the heart were constantly observed. Very often the heart muscle even looked altered macroscopically. So, almost always there was a sharp plethora of the heart, the presence of small hemorrhages under the epicardium, in some cases - turbid swelling of the myocardium. Histological changes were expressed primarily in vascular disorders. Even in persons who died a few minutes later due to severe burns, carbon monoxide poisoning and suffocation with smoke, as a rule, hyperemia of the heart vessels, stasis in the arterioles, minor hemorrhages in the thickness of the myocardium and under the epicardium were observed. Focal fragmentation can also take place before the onset of agony, and apparently occurs due to dystrophic changes in muscle fibers [1-4]. During the period of shock and toxemia in severe burn injury, there is a decrease in the pumping function of the myocardium and deterioration of peripheral circulation with a significant increase in myocardial oxygen demand [5]. However, due to insufficient information on changes in myocardial oxygen demand depending on age, we tried to evaluate and study the impact of laboratory test changes on MVP.

Purpose of the work. To assess the correlations between myocardial oxygen demand and blood parameters during toxemia, depending on age.

Material and research methods. The studies were carried out in the following age groups: group 1 - 6 months - 3 years, group 2 - 3.1-7 years old, group 3 - 7.1-18 years old, group 4 - 18.1-40 years old, group 5 - 41- 60 years old, group 6 - 61-85 years old.

As shown in Table 1, there were 63 male patients, 28 female patients. Age, anthropometric differences were significant in the absence of significant differences in age groups in the total area of the burn, deep damage of grade 3B and the duration of inpatient treatment. A significant predominance of IF in groups 4 and 5 was found, due to the aggravation of the condition by concomitant factors, such as combined trauma, carbon monoxide poisoning, concomitant ischemic heart disease, burns of the upper respiratory tract.

The research data were processed by the method of variation statistics using the Excel program by calculating the arithmetic mean values (M) and mean errors (m). To assess the significance of the differences between the two values, the para-

metric Student's test (t) was used. The interrelation of the dynamics of the studied indicators was determined by the method of paired correlations. In this case, the critical level of significance was taken equal to 0.05. Intensive therapy from the moment of admission was aimed at removing burn shock, adequate anesthesia and intravenous administration of crystalloids, volemic solutions under the control of hemodynamics, volume of urine output, correction of deviations in homeostasis indicators.

Table 1

Groups	men	women	age	Height, cm	Weight, kg	total burn area,%	area of 3B degree burn,%	IF, units	days in hospital
1	15	7.0	18.1±7.5 months	77.2 ±5.1	10.7 ±1.4	33.6 ±10.1	9.0 ±6.5	42.1 ±16.6	22.2 ±9.6
2	11	9	4.8±1.0* years	106.2 ±9.3*	21.6 ±10.8	50.8 ±14.9	25.8 ±11.6	88.7 ±36.8	46.3 ±18.4
3	14	4	12.1±3.0* years	147.5 ±14.5*	38.2 ±10.8*	50.7 ±12.7	11.7 ±6.5	76.3 ±19.1	34.3 ±18.2
4	13	2	27.1 ±4.8* years	173.5 ±6.3*	70.7 ±7.3*	58.2 ±14.1	20.2 ±12.0	112.3 ±35.6*	48.0 ±19.6
5	5	3	49.4 ±7.2* years	164.6 ±5.9*	72.0 ±12.8*	53.8 ±15.0	13.3 ±8.1	90.0 ±25.0*	26.5 ±13.4
6	5	3	70.1 ±6.4* years	169.0 ±10.0*	73.5 ±6.8*	35.7 ±10.6	20.5 ±7.8	77.3 ±30.2	41.6 ±19.3

*-deviation is significant relative to the indicator in group 1

Results and discussion.

As shown in table 2, a statistically significant difference in the mesor of the circadian rhythm MVP was found only between subgroup 3 of group 1 and indicators of patients in group 6 in 1 (by 22%), 2 (19%), 7 (13%), 8 (22%), 10 (17%) days.

Table 2.

Changes in the mesor of the circadian rhythm of myocardial oxygen demand during burn toxemia, depending on age

	Group 1			Group 2			Age group 3			19-40 years	41-60 years	61-78 years
	6 month-3 years			3.1-7 years			7.1-18 years					
Days	Subgroup 1	Subgroup 2	Subgroup 3	Subgroup 1	Subgroup 2	Subgroup 3	Subgroup 1	Subgroup 2	Subgroup 3	Group 4	Group 5	Group 6
1	135 ±17	145 ±23	140 ±18	117 ±6	126 ±4	137 ±9	121 ±4	111 ±6	133 ±8	119 ±4	124 ±11	108 ±6*
2	135 ±17	139 ±15	142 ±18	116 ±2	124 ±4	132 ±3	125 ±2	114 ±5	136 ±5	119 ±3	1062	114 ±3*
3	133 ±11	137 ±13	122 ±11	112 ±2	124 ±2	138 ±4	125 ±2	113 ±4	142 ±4	121 ±3	106 ±3	112 ±5
4	135 ±12	138 ±8	137 ±18	114 ±2	122 ±3	138 ±3	127 ±4	120 ±4	140 ±2	132 ±2	122 ±3	111 ±4
5	139 ±9	139 ±12	134 ±15	116 ±2	126 ±3	141 ±3	126 ±3	129 ±3	144 ±4	130 ±3	125 ±4	113 ±6
6	143 ±12	142 ±14	131 ±9	122 ±3	124 ±4	141 ±3	128 ±2	132 ±8	148 ±4	133 ±3	127 ±5	111 ±4
7	146 ±12	142 ±15	131 ±6	119 ±5	130 ±5	133 ±2	134 ±3	130 ±4	143 ±3	142 ±4	121 ±3	114 ±5*
8	146 ±10	137 ±10	141 ±12	124 ±2	126 ±3	139 ±3	143 ±6	130 ±5	147 ±3	141 ±5	118 ±4	109 ±4*
9	148 ±6	135 ±7	137 ±19	124 ±3	129 ±4	144 ±3	173 ±10	147 ±7	143 ±4	141 ±4	117 ±2	117 ±7
10		137 ±11	138 ±12		129 ±3	146 ±3		134 ±7	154 ±4	137 ±4	112 ±2	115 ±7*

*-significant difference from the indicator in the 3rd subgroup of the 1st group.

The revealed difference is most likely due to the age-related anatomical and functional differences of the indicated age groups, when with a relatively larger burn surface and deeper skin damage in group 6 (grade 3B 20.5 ± 7.8%, IF 77.3 ± 30.2 units) less pronounced stress increase in myocardial oxygen demand (108 ± 6%), which was due to less significant adaptive deviations in myocardial func-

tion and myocardial oxygen demand in conditions of age-related mitochondrial insufficiency (the indication for antiarrhythmic therapy with beta-blockers was the severity of deviation from the age norm of the heart rate).

Correlations between myocardial oxygen demand and the red part of the blood

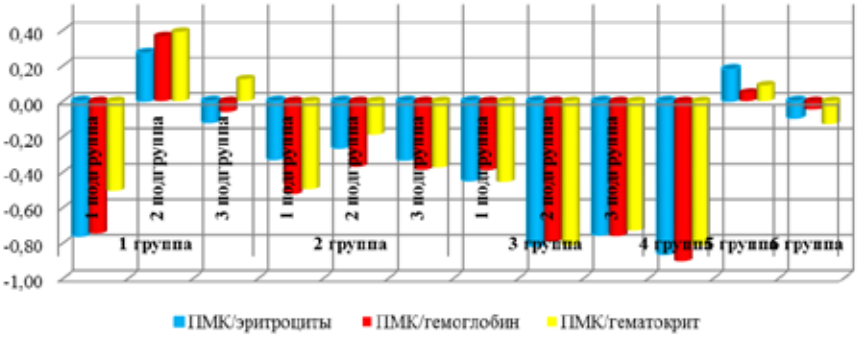

Fig.1

A negative correlation between changes in blood and MVP indicates a decrease in MVP, provided that the parameters of erythrocytes, hemoglobin and blood hematocrit increase in subgroups 1 and 3 of group 1, in all patients of groups 2,3,4. While the feedback between MVP and the dynamics of the red part of blood in 5.6 groups disappears, which can be explained by the age-related characteristics of the reaction of myocardial metabolism to stress at the age of over 61, when an increase in hemoglobin, HMT, and erythrocyte count does not decrease MVP, which is associated with limited functional adaptive capabilities of the cellular structures of the heart muscle in old age (fig. 1). Violation of the positive effect on the myocardial function of the growth of the parameters of the red part of the blood in infants of 2.3 subgroups of group 1 is possibly associated with the severity of the effect of general intoxication on tissue metabolism with burns with an area of 33.6 ± 10.1%, 3 B degree 9.0 ± 6.5%, IF -42.1 ± 16.6 units (tab. 1).

A reliably significant effect on MVP of the number of leukocytes in peripheral blood in group 4 was found, which indicates an increase in myocardial oxygen demand in conditions of an increase in leukocytosis, an inflammatory reaction in patients aged 41-60 years.

Correlation between myocardial oxygen demand and leukocytes

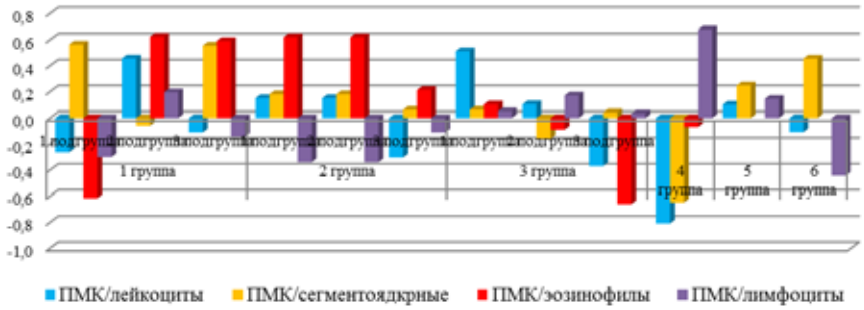

Fig.2

That is, there is a high probability of developing myocardial ischemia with ineffective anti-inflammatory therapy in this group (fig. 2). An unfavorable effect of eosinophilia on the MVP index was found in children of 2,3 subgroups in infancy, in 1,2,3 subgroups in preschool age, which characterizes a moderate likelihood of myocardial ischemia in an inflammatory reaction with predominant eosinophilia in children.

Correlation of MVP and blood biochemical parameters

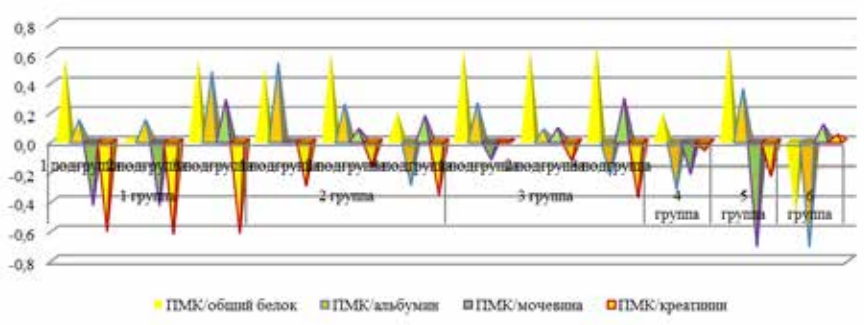

Fig.3

In the first 10 days of burn toxemia, there was some negative effect of the growth of total protein in the blood in subgroups 1 and 3 of group 1, children of groups 2 and 3, adult patients of group 4.5, when an increase in the concentration of total protein in the blood can increase myocardial oxygen demand, which leads to an increase in the likelihood of myocardial ischemia in children with burn toxemia (fig. 3). Taking into account the fact that the decrease in blood urea is more often

due to the alimentary factor, one can understand the high probability of an increase in MVP and the development of coronary insufficiency in toxemia in persons over 61 years of age. A negative effect on the metabolism of the myocardium of the energy-deficient state in elderly patients during the period of toxemia was stated.

Correlation of blood enzymes and myocardial oxygen demand

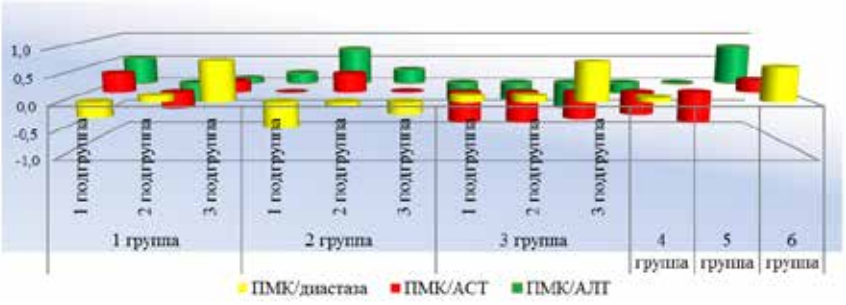

Fig.4

The increase in MVP is due to an increase in blood diastase in subgroup 3 of group 1, subgroup 3 of group 3, group 6 of severe burn patients in the first 10 days of toxemia. A direct correlation between ALT and MVP was also found in subgroup 2 of group 2, group 5, when acute cytolytic syndrome directly increases myocardial oxygen demand. Thus, in the first 10 days of the toxemia period, there are signs of acute pancreatitis, liver failure with a predominance of cytolytic syndrome, which in order to improve the efficiency of timely correction of homeostasis disorders determines the expediency of more effective membranotropic, hepatotropic therapy, the introduction of inhibitors of proteolytic blood enzymes (fig. 4).

Correlation of blood electrolytes and myocardial oxygen demand

Fig.5

All patients underwent timely correction of deviations of blood electrolytes under the control of laboratory parameters. It is possible that the revealed insignificant correlations between MVP and plasma potassium and sodium indices were an indicator of the effectiveness of the correction performed (fig. 5).

Correlation of hemocoagulation parameters and myocardial oxygen demand

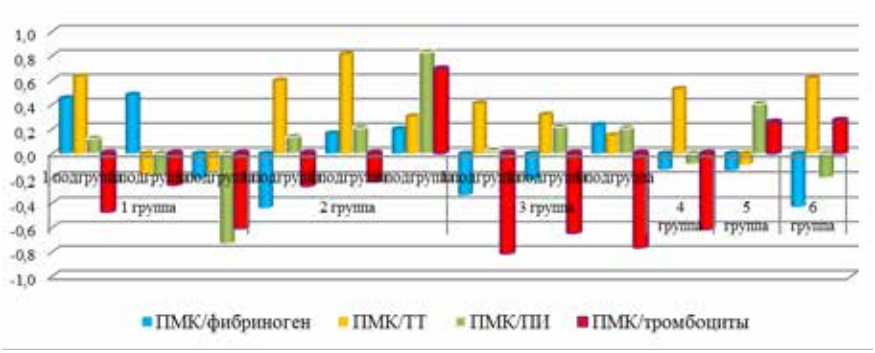

Fig.6

A direct reliably significant effect of PI, platelet count on MVP was found only in subgroup 3 of group 3, that is, a tendency to hypercoagulability in the second phase of blood coagulation can cause myocardial ischemia in severe burns in older school children with an area of 50.7 ± 12.7%, 3B degree 11.7 ± 6.5%. IF 76.3 ± 19.1 units. That is, in this subgroup, a lack of anticoagulant therapy was revealed (it was performed in all patients with thermal burns), as well as an undesirable tendency to an increase in TT in subgroup 1 of group 1, children in groups 2 and 3, in groups 4 and 6 when an increase in the propensity to hypercoagulation (increase indicator TT) has the likelihood of causing myocardial hypoxia.

Conclusion. A statistically significant difference in the mesor of the circadian rhythm MVP was revealed only between subgroup 3 of group 1 and indicators of patients in group 6 in 1 (by 22%), 2 (19%), 7 (13%), 8 (22%), 10 (17%) day. With a comparatively larger burn surface and deeper damage to the skin, a less pronounced stress increase in myocardial oxygen demand was found in group 6. A decrease in MVP was found under the condition of an increase in the parameters of erythrocytes, hemoglobin and blood hematocrit in subgroups 1 and 3 of group 1, in all patients of groups 2,3,4. While the feedback MVP and dynamics of the red part of the blood in 5.6 groups disappeared. An increase in MVP was revealed under the condition of an increase in leukocytosis, that is, an inflammatory reaction in patients aged 41-60 years. In the first 10 days of the toxemia period, labo-

ratory signs of acute pancreatitis, liver failure with a predominance of cytolytic syndrome were revealed. In senior school age, the lack of anticoagulant therapy was revealed (it was performed in all patients with thermal burns), as well as an undesirable tendency to an increase in TT in subgroup 1 of group 1, children in groups 2 and 3, in groups 4 and 6 of patients.

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CREATION OF STARTING MATERIAL FOR SELECTION OF SOFT WHEAT BY MEANS FUNGICIDES

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Abstract. *The effectiveness of the use of fungicides as inducers of biological variability and the creation of a new source material for the selection of spring bread wheat was studied. It has been shown that the disinfectants have both inhibitory and stimulating effects on the development of seedlings. It was found that under the influence of fungicides, the range of variability in morphological characteristics increased several times in conditionally mutant populations as compared with test objects (control). A different reaction of varieties to the action of fungicides was revealed, due to the differences in their genotypes. The "Serebristaya" variety showed a greater lability of indicators in response to the action of fungicides than the "Pavlogradka" variety. Cytological analysis did not reveal chromosome damage and their behavior during mitosis. New morphological types of plants have been identified by plant height; shape, density and color of the spike, the branching of the spike; the appearance of signs of other varieties of wheat. Infrared spectral analysis showed that the accumulation of fungicides was maximum for caryopses with a dormancy period of one and two years after treatment, significantly lower for the root system, while their content in leaves and stems was minimal. The dependence of the residual amount of active substances on the storage period of seeds after treatment, as well as on the concentration (dose) of the fungicide, was revealed.*

Keywords: *wheat, fungicide, cultivar, population, variability, chromosome, selection.*

Introduction

The central place in the sustainable growth of crop productivity belongs to selection, creation and use of new varieties and hybrids of grain crops as an innovative resource of the country's agro-industrial complex [4 - 6, 14]. The most important for global food security is the future productivity of soft wheat [18].

However, in recent years, the genetic base of the main domesticated crops, including wheat, has been narrowing as a result of the use of the same donors of high productivity, disease resistance and grain quality in breeding [9-11]. A decrease in the genetic diversity of wheat varieties during breeding can lead to genetic erosion in the gene pool of Russian wheat and the loss of a significant number of genes or alleles of productivity and resistance to biotic and abiotic stresses [11, 13]. The genetic similarity of varieties bred within the framework of regional breeding programs is much higher than the recommended one, which leads to massive damage to crops by pathogens in vast territories (epiphytotics) due to uniform susceptibility to them [5]. Genetic varietal uniformity of wheat, which until recently was a problem in individual regions, has acquired global proportions. In this regard, research is being carried out all over the world with the aim of expanding the genetic base of wheat at the expense of various sources of its variability [19]. In the breeding process, a special place is occupied by the improvement of economically valuable traits of existing varieties and the breeding of new ones using induced mutagenesis [6]. Currently, work on induced mutagenesis is being carried out in almost all countries of the world. With the skillful use of experimental mutagenesis, it is possible to change the plant beyond recognition and create a variety of breeding material in a fairly short time [7]. For example, the Green Revolution, which made it possible to double the yields of rice and wheat in developing countries, was largely based on the use of induced mutants [12]. However, intensive cross-breeding and selection programs carried out over the past decade and aimed mainly at increasing plant productivity have led to a decrease in the level of genetic diversity of cultivated plants in all their properties. Within a culture, plants become genetically more and more uniform, therefore, crops as a whole are vulnerable to the influence of biotic and abiotic environmental factors [5, 9, 13]. Insufficient adaptability of highly productive varieties is due to a decrease in the level of their resistance to unfavorable environmental factors. The pursuit of the harvest has led to an increase in the vulnerability of plants to stress [11].

To prevent such damage to agriculture, it is necessary to maintain the level of available genetic diversity of the initial material for breeding programs and conduct large-scale research in order to increase the level of genetic variability of the main crops due to different sources of its variability [5, 8, 19]. The induction of genetic diversity using chemical compounds contributes to the creation of new hybrids and varieties on a heterogeneous genetic basis with increased productivity

and resistance to biotic and abiotic stressors. The implementation of such programs can lead to the creation of more productive and environmentally sustainable agro-cenoses [5]. It has now been established that, in addition to chemical mutagens, fungicides can be quite effective mutagenic factors for creating the starting material of grain crops [1-4, 6-8, 12].

The relevance of research was determined by three main problems that have emerged by now in the world community:

1). *The threat to the food security of all mankind due to the massive destruction of crops by pathogens over large areas, causing enormous damage to the harvest of grain crops.*

In recent years, along with traditional diseases (brown rust, septoria, dust smut, etc.), the threat of stem rust epiphytoties has increased, the loss of grain from which can reach 50% and more. Periodically recurring disease epiphytotics are one of the main reasons for the instability of the wheat yield. This situation is caused by the lack of resistant varieties that can contain the massive damage to crops by stem rust [13]. Along with this, there was a threat of penetration into Russia from the countries of the Middle East through Central Asia of a new race of stem rust Ug 99, capable of destroying up to 100% of the crop. The emergence and spread of this race has caused great concern in the world scientific community. The Borlaug Global Wheat Rust Initiative was created to tackle rust diseases that threaten the food security of the entire planet (www.globalrust.org). The creation of wheat varieties resistant to rust diseases is the most effective way to protect the crop [13].

2). *Genetic uniformity of wheat varieties, which is the main reason for massive damage to crops by pathogens.*

The method of induced mutagenesis plays a huge role in increasing genetic diversity and improving economically valuable traits of existing varieties and breeding new ones [9]. However, there is an opinion that chemical mutagens used for this purpose have largely exhausted their capabilities [15], therefore, a wide search for new inducers of variability is being carried out. It has now been established that pesticides, including fungicides [6 - 8, 16, 17], can be such mutagenic factors for the creation of the initial material for grain crops.

3). *The ecological situation undergoing anthropogenic stress as a result of human economic activity.*

Chemical compounds used by humans need to be screened for mutagenic, cytotoxic and other damaging activities for organisms, as well as to monitor their environmental pollution. For this, it is necessary to study their effect on cellular structures, on the possibility of causing undesirable changes (mutations) in genotypes, the ability to accumulate in cells, tissues and other structures of organisms, to be included in food chains and the general ecological cycle [1]. On the other hand, the mutagenic activity of pesticides can be used to increase the genetic di-

versity of cultivated plants, in the gene pools of which the erosion of gene complexes and individual loci of adaptability to aggressive environmental factors has recently been observed [2–4].

Purpose of the study

To study the effects of fungicides on the biological traits and properties of wheat plants, including:

- influence on the cellular structures of wheat plants, morphology and behavior of chromosomes in the cell cycle (mitosis);

- to establish the change in the level of intrapopulation variability in experimental wheat populations, which can be used in the selection of biotypes with new properties;

- to determine the residual amount of active components of fungicides in vegetative organs and seeds of wheat in order to determine the food, feed and environmental safety of the use of chemical compounds in grain production, as well as - varietal specificity in the cumulative capacity of these substances.

- to create a source material for practical breeding in order to search for donors of economically valuable traits for obtaining new varieties of wheat with a complex of traits of increased productivity and adaptive properties.

Material and methods

In 2017–2019, pre-sowing treatment of wheat seeds of varieties Serebristaya and Pavlogradka with fungicides of a new generation was carried out: AltSil: (active ingredient - tebuconazole); Alcazar: (active ingredients - difenoconazole + cyproconazole); Comfort: (carbendazim); Terrasil: (tebuconazole). Each of the fungicides was used in two concentrations: at a dose recommended for grain production (n) and a doubled dose (2n) to enhance the morphogenesis process and assess the damaging effect on the cellular and organismic systems of wheat plants [2–4].

Germination of seeds was carried out in rolls, observing the methods and requirements of GOST for seed organizations. A total of 36 variants of the experiment were laid, 60 seeds in each roll (fig. 1). The test objects were seedlings of the Pavlogradka and Serebristaya spring soft wheat varieties, the seeds of which were not exposed to fungicides.

Fig. 1. *Laying seeds for germination in rolls*

Results and discussion

During the period of joint work from 2013 to 2021 a scientific project "Study of the effects of chemical compounds on soft wheat plants" is being carried out, developed on the basis of an agreement on scientific cooperation between the Pedagogical and Agrarian Universities of the city of Omsk and included in the list of innovative projects of universities.

In order to identify the presence or absence of chromosomal aberrations in the mitotic phases of mutants obtained by us under the influence of fungicides, we studied the meristematic zones of division of the primary root of wheat seedlings in 2017-19. A cytological study of conditional mutants and their initial forms showed that no morphological abnormalities of chromosomes and their behavior were found in all phases of mitosis [2]. In laboratory conditions, a morphophysiological study of wheat seedlings, the effect of dressing agents on the sowing quality of seeds, depending on the dose of the reagent and the dormancy period of seeds after treatment, was carried out. A multidirectional effect of various disinfectants and their consumption rates on the morphometric parameters of seedlings was established: fungicides AltSil and Alkasar inhibited the development of sprouts of the Pavlogradka variety (fig. 2), reducing the average values of the trait by 15.4-23.5%, while stimulating the development of the main root (fig. 3, 4).

Fig. 2. *Left photo: unequal effect of the influence of fungicides AltSil and Alkazar and their concentrations on the development of seedlings (in the center of the row - Pavlogradka variety, control)*

Right photo: Comfort stimulated the development of seedlings (to the left of the control, it is in the center); Terrasil inhibited their development at both doses (to the right of the control).

Fig. 3. *Variety Pavlogradka (control). The third day after soaking the seeds*

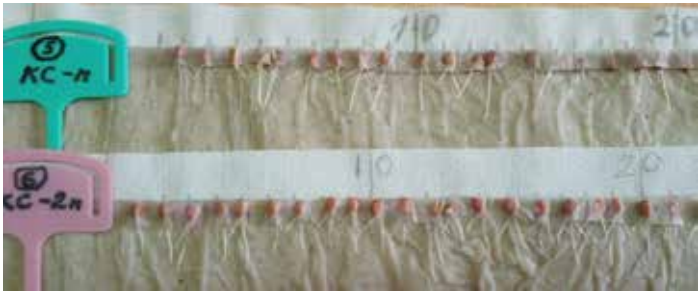

Fig. 4. *Seeds of the Pavlogradka variety after treatment with the Comfort fungicide: stimulating effect on the growth of primary roots in both concentrations*

Similar tendencies manifested themselves in all other variants of the experiment. In all of the studied wheat samples (36 variants of the experiment), an increase in the range of phenotypic variability was observed with the appearance of several new classes of distribution of the values of the traits "sprout length" "and the length of the central root" of plants.

It was found that under the action of fungicides the range of variability along the sprout length increased several times in conditionally mutant populations (Cv = 34 - 43%) of the Serebristaya variety, while in the control it remained at a low level (Cv = 6.5%). The intrapopulation variability also significantly increased in the mutants of the Pavlogradka variety (Cv: 24-37%) as compared to the control (Cv = 7.2%). However, the range of variability in them had a narrower range than in the mutants of the Serebristaya variety (fig. 6). The variability of root length in both cultivars showed greater stability under the influence of all fungicides than the sprout length. According to this trait, the mutants of the Serebristaya variety (Cv = 20.4-34.2%) had greater variability, in the control - 8.0%; in the Pavlogradka variety - 14.5-18.7 and 10.0%, respectively.

It has been established that dressing agents have a different effect on the growth and development of plants for different varieties of wheat. The Pavlogradka cultivar is more sensitive to the action of the Terrasil fungicide than the Silvery wheat cultivar. In the case of Comfort, a similar trend can be noted (fig. 5, 6). Under the effect of Comfort on the Pavlogradka variety, this fungicide in both doses caused the splitting of the first leaf of the seedlings, which may indicate an inhibitory effect on the formation of leaf mesophyll.

Fig. 5. *Seed sprouts of Pavlogradka variety - control (without treatment)*

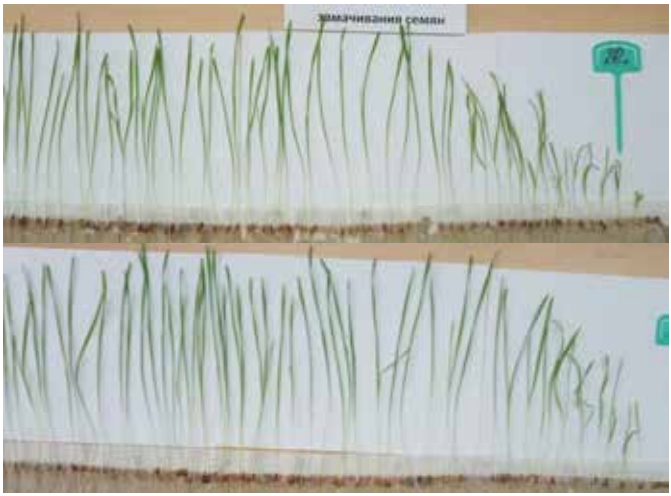

Fig. 6. *Development of Pavlogradka seedlings under the influence of Comfort: at dose n - top row; 2n - bottom row*
(unfinished student's attempt at constructing a variation series in nature)

Plants of generations M-1, M-2 and M-3 were grown under field conditions on the experimental field of the Omsk Agrarian University with selection in M-2 and M-3 of the most valuable biotypes for further use in practical breeding and genetic research. Were identified morphological types of plants on the following grounds: plant height; shape, density and color of the ear, branching of the ear; the appearance of signs of other varieties of wheat. In the next generation (M-3), caryopses from the main spike of the selected plants were sown in families in the first breeding nursery (SP-1); phenological observations were carried out over them during the growing seasons of 2018-19. A structural analysis of these plants was carried out according to quantitative characteristics of productivity according to the generally accepted method, a statistical analysis of the data was carried out, the results of research in scientific articles and conference proceedings were summarized [3, 4, 16, 17].

Infrared (IR) spectral analysis was carried out to determine the residual amount of active ingredients of the fungicides used in different parts of wheat plants. IR absorption spectra were recorded on an FT-801 FT-IR spectrometer (Simeks, Russia) in the range of 500-4000 cm^{-1} using a disturbed total internal reflection (DTIR) attachment. For each sample (leaves, roots, wheat seeds), 3 measurements were carried out, after which the results were averaged. The ZaIR 3.5 software was used to identify compounds and process spectral images.

It was shown that when analyzing wheat samples treated with fungicides (carbendazim, tebuconazole, difenoconazole + cyproconazole), absorption bands characteristic of the functional groups of benzimidazoles and triazoles are observed in the IR spectra. It was revealed that the accumulation of fungicides was maximum for caryopses treated with fungicides with a dormant period of one and two years after treatment, significantly lower for the root system, while their content in leaves and stems was minimal. The dependence of the residual amount of active substances on the storage period of seeds after treatment, as well as on the concentration (dose) of the fungicide, was revealed.

Conclusions

1.The multidirectional effect of various disinfectants and their consumption rates on the morphometric parameters of seedlings was established: fungicides AltSil and Alkasar inhibited the development of seedlings of the Pavlogradka variety, reducing the average values of the trait by 15.4-23.5%, but stimulated the development of the main root. The lag in the development of seedlings of the Serebristaya variety was more significant (by 18.5-30.2%) than in the plants of the Pavlogradka variety. The development of the root of the Serebristaya variety was inhibited by both fungicides; its growth lag averaged 10-16 mm.

2. The effect of the fungicides used on the level of population variability was revealed: the coefficients of variability of the sprouts of mutant lines of the Pav-

lograd ka cultivar in comparison with the control (Cv = 10.1%) increased to 21.2%, and the lines of the Serebristaya cultivar (Cv = 10.3%) - up to 25.6%.

The coefficients of variability of the root length of mutant lines of Pavlogradka cv. In comparison with the control (Cv = 11.4%) increased to 13.2%, and the lines of Serebristaya cv. (Cv = 7.9% - 13.5%) with a single dose of fungicides. At a double dose, these parameters changed in different directions, both in the direction of decreasing and in the direction of increasing the coefficients of variability. The values of the coefficients of variability of the traits of the Serebristaya variety varied in a wider range than that of the Pavlogradka variety.

3. Cytological analysis did not reveal damage to chromosomes and their behavior in mitosis.

4. The morphological types of plants have been identified according to the following features: plant height; shape, density and color of the ear, branching of the ear; the appearance of signs of other varieties of wheat.

5. It was found that the accumulation of fungicides was maximum for caryopses treated with fungicides with a dormancy period of one and two years after treatment, significantly lower for the root system, while their content in leaves and stems is minimal. The dependence of the residual amount of active substances on the storage period of seeds after treatment, as well as on the concentration (dose) of the fungicide, was revealed.

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CHEMICAL COMPOSITION ANALYSIS OF THE *MISCANTHUS* LEAVES AND STEMS

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Abstract. *A comparative analysis of the chemical composition of the stems of a herbaceous plant and a whole plant indicates that the values of such indicators as the mass fraction of protein, crude fat, ash, and acid-insoluble lignin are higher in the whole Miscanthus plant; therefore, for further research aimed to develop scientific and technological foundations for processing and use of Miscanthus biomass in the fuel and energy, cellulose, microbiological, and other industries, it is recommended to use whole Miscanthus plants, including the leaves and stems.*

Keywords: *Miscanthus, crude protein, fat, ash, fiber, cellulose, lignin, stems, leaves.*

Introduction

Miscanthus or silvergrass is a genus of perennial herbaceous plants of the *Poaceae* family. Currently, the areas for the cultivation of herbaceous plants are constantly growing. This phenomenon can be explained by high growth rates and the prospects for its application in the national economy. All over the world, including

the Russian Federation, the opportunities of using this plant in the chemical and energy industries are being studied [27, 37, 43].

Miscanthus is a very valuable raw material due to its ability to accumulate a large amount of solar energy. The main advantage of this plant is its high yield. This plant can grow actively on nutrient-depleted soils while still preserving its good quality and high lignin content [11, 138].

The fuel problems that have arisen at present can be solved by using renewable energy sources, among which *Miscanthus* is a promising raw material for use as biofuel and for the production of bioethanol on its basis. Large-scale cultivation of crops for bioenergy requires the study and introduction of new technologies for obtaining planting material.

In addition to biofuel production, plants of the *Miscanthus* genus can be used to obtain biologically active substances from them. *Miscanthus* extracts include fatty acids, sterols, and other aromatic compounds. The main structures of phenolic compounds and sterols of the bark and core of *Miscanthus giganteus* include vanillic acid, para-coumaric acid, vanillin, para-hydroxybenzaldehyde, syringaldehyde, campesterol, stigmasterol, β-sitosterol, stigmasta-3,5-dien-7-one, stigmast-4-en-3-one, stigmast-6-en-3,5-diol, 7-hydroxy-β-sitosterol, and 7-oxo-β-siterol [1, 53, 114].

According to the research of T.N. Goryachkovskaya and K.G. Starostina, lignocellulosic biomass, obtained from *Miscanthus* plants, contains approximately 70% polysaccharides, consisting of hexose (cellulose) and pentose (hemicellulose) residues. Upon complete hydrolysis of these polysaccharides, a mixture of hexoses (glucose, galactose, mannose) and pentoses (arabinose, xylose) is formed, which can later be used as substrates for bacterial cultivation [73].

Simple hydrocarbons, such as glucose and fructose, can be converted into products such as bioethyl alcohol, vitamins, enzymes, proteins, amino acids, lipids, organic acids, technical cellulose using bacteria and fungi.

It was found that the hydrolysates of the herbaceous plant *Miscanthus sinensis*, in addition to peptoses and hexoses, contain a large amount of high and low molecular weight organic acids, alcohols, ketones, humic acids, and minerals. The qualitative and quantitative content of the substances depends on the method of obtaining hydrolysates of *Miscanthus sinensis* [6, 139].

This study aimed to study the chemical composition of non-wood lignocellulosic raw materials – *Miscanthus*.

Materials and methods

Miscanthus sinensis, which grows in the Northwestern Federal District of the Russian Federation, was selected for this study:

– *Miscanthus sinensis* "Ferner Osten", harvested in 2019;

–*Miscanthus sinensis* "Strictus", harvested in 2019;

–*Miscanthus sinensis* "Zebrinus", harvested in 2019.

Mature plants were selected to analyze the chemical composition of the samples. Plants with a higher height and containing the maximum number of inflorescences were selected for analysis. The chemical composition of individual parts (leaves and stem of the plant) of *Miscanthus sinensis* and a whole herbaceous plant were studied in the experiment. As the leading indicators characterizing the chemical composition of cellulose-containing raw materials, we chose the mass fraction of crude protein, mass fraction of fiber, mass fraction of fat (crude fat), mass fraction of ash, lignin, and cellulose.

The content of crude protein, mass fraction of fiber, and crude fat was assessed in accordance with the requirements of GOST 32040-2012 "Fodder, mixed and animal feed raw stuff. Spectroscopy in near infra-red region method for determination of crude protein, crude fiber, crude fat, and moisture". The mass fraction of crude ash was determined following GOST 32933-2014 (ISO 5984: 2002) "Animal feeding stuffs - Determination of crude ash". The mass fraction of lignin was evaluated according to GOST 11960-79 "Fiber semi-products and raw materials of annuals for pulp and paper industry. Method for determination of content of lignin". GOST 16932-93 (ISO 638-78) "Pulps — Determination of dry matter content" was used to determine the mass fraction of cellulose. To study the chemical composition, all samples were cut with scissors to a size of 0.5-1.0 cm.

Results and discussion

The results of studying the chemical composition of whole *Miscanthus sinensis* samples are present in Table 1.

Table 1 – *The results of studying the chemical composition of whole Miscanthus sinensis samples*

Indicator	Indicator value of Miscanthus sample		
	***Miscanthus sinensis* "Ferner Osten"**	***Miscanthus sinensis* "Strictus"**	***Miscanthus sinensis* "Zebrinus"**
Moisture content, %	9,00±0,54	8,50±0,51	8,80±0,53
Mass fraction of crude protein, %	5,25±0,31	4,42±0,26	5,12±0,31
Mass fraction of fiber, %	10,35±0,62	11,31±0,68	12,88±0,77
Mass fraction of crude fat, %	0,95±0,05	1,23±0,07	1,02±0,06
Mass fraction of crude ash, %	4,20±0,25	3,21±0,19	4,68±0,28
Mass fraction of lignin, %	12,00±0,72	18,00±1,08	10,00±0,60
Mass fraction of cellulose, %	62,00±3,72	57,00±3,42	64,00±3,84

Analysis of the results presented in Table 1 indicates that the moisture content of all three studied *Miscanthus* samples is no more than 9.0%, which does not contradict the literature data. It was shown that *Miscanthus sinensis* is not distinguished by a high content of lipid and protein compounds. The content of crude protein in *Miscanthus sinensis* “Ferner Osten” was 5.25% and in *Miscanthus sinensis* “Strictus” – 4.42%. A record amount of fiber (12.88%) was noted in the *Miscanthus sinensis* “Zebrinus”. *Miscanthus sinensis* “Strictus” contains 11.31% fiber. The smallest mass fraction of fiber was observed in the sample of *Miscanthus sinensis* “Ferner Osten”. It has been found that the herb is rich in cellulose. The maximum cellulose content (64.0%) was found in the *Miscanthus sinensis* “Zebrinus”, and the minimum – in the *Miscanthus sinensis* “Strictus” (57.0%). *Miscanthus sinensis* “Strictus” contains a record amount of lignin (18.0%), *Miscanthus sinensis* “Zebrinus” contains 1.8 times less lignin (10 %).

The results of studying the chemical composition of the leaf part of the *Miscanthus* samples are presented in Figure 1.

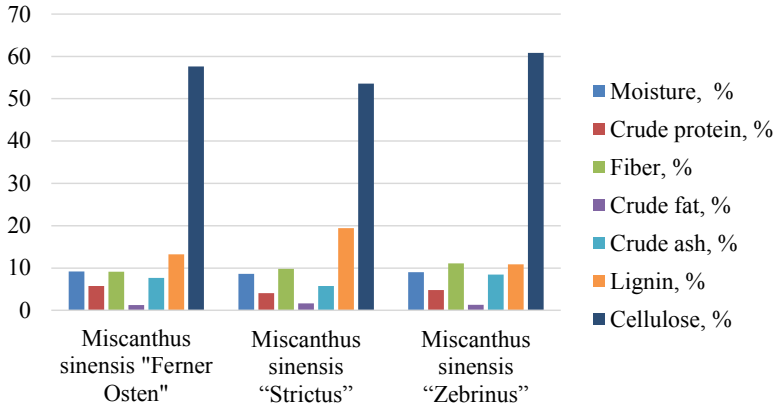

Figure 1 – *The results of studying the chemical composition of the leaf part of the Miscanthus sinensis samples*

Figure 1 shows that the leaf part of *Miscanthus sinensis* is characterized by an increased content of acid-insoluble lignin, ash, and fiber. So, for example, the leaf part of *Miscanthus sinensis* “Strictus” contains 19.44% of lignin, the leaf part of the *Miscanthus sinensis* “Zebrinus” – 10.88% of lignin. The mass fraction of acid-insoluble lignin of the leaf part of the *Miscanthus sinensis* “Ferner Osten” was 13.21%. The mass fraction of fiber in the leaf part of the *Miscanthus sinensis* “Zebrinus” reaches 11.07%, which is 1.23% higher than the fiber content in the

leaf part of the *Miscanthus sinensis* "Strictus" and 2% higher than the fiber content in the leaf part of the *Miscanthus sinensis* "Ferner Osten".

Comparative analysis of the chemical analysis results of the whole *Miscanthus sinensis* and its leaf part shows that the leaf part contains more acid-insoluble lignin and lipid fraction than the whole plant. Thus, the lignin content in the leaf part of the *Miscanthus sinensis* "Ferner Osten" is 13.21%, which is 1.1 times more than the lignin content in the whole plant. The lignin content in the leaf part of the *Miscanthus sinensis* "Strictus" is 1.09 times higher than the lignin content in the whole plant. The mass fraction of lignin in the leaf part of the *Miscanthus sinensis* "Zebrinus" exceeds 1.08 times the content of lignin in the whole plant. The crude fat content of the leaf part of the *Miscanthus sinensis* "Ferner Osten" is 1.33 times higher than the crude fat content of the whole plant. The content of the lipid fraction in the leaf part of the *Miscanthus sinensis* "Strictus" is 1.66%, which is 1.34 times more than the lipid content in the whole plant. Reduced content of fiber and cellulose in the leaf part of the samples was noted in comparison with the whole plant samples. So, for example, in the leaf part of the *Miscanthus sinensis* "Zebrinus", the mass fraction of cellulose is 60.81%, which is 3.19% lower than the cellulose content in the whole plant. In the leaf part of the *Miscanthus sinensis* "Zebrinus", the mass fraction of fiber is 11.07%, which is 1.15 times lower than the fiber content in the whole plant. A similar trend was noted for other samples under study.

Figure 2 shows the results of the chemical composition study of the *Miscanthus sinensis* stems.

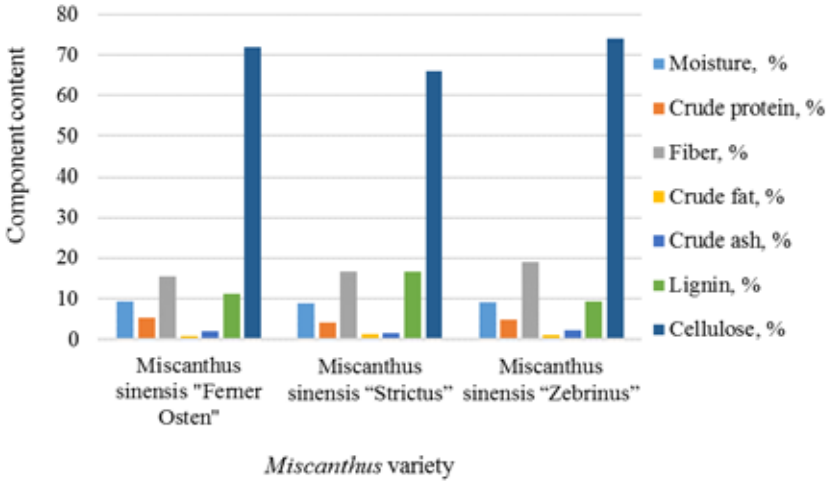

***Figure 2** – Chemical composition study of the Miscanthus sinensis stems*

The results presented in Figure 2 indicate that the *Miscanthus sinensis* stem is characterized by an increased content of acid-insoluble lignin, ash, fiber, and cellulose. For example, the *Miscanthus sinensis* "Zebrinus" stem contains 73.83% cellulose, 9.20% lignin, and 19.06% fiber. The mass fraction of acid-insoluble lignin in the *Miscanthus sinensis* "Ferner Osten" stem was 11.07%. The mass fraction of fiber in the *Miscanthus sinensis* "Ferner Osten" stem reaches 15.49%.

Comparative analysis of the chemical analysis results of the whole *Miscanthus sinensis* plant and its stem samples shows that the stems of the plant contain more cellulose and fiber than the whole plant. The cellulose content in the *Miscanthus sinensis* "Zebrinus" stem is 71.92%, which is 1.16 times more than the cellulose content in the whole plant. The fiber content in the *Miscanthus sinensis* "Zebrinus" stem exceeds the cellulose content in the whole plant by 1.49 times. The cellulose content in the *Miscanthus sinensis* "Strictus" stems is 65.89%, which is 1.15 times more than the cellulose content in the whole plant. The fiber content in the *Miscanthus sinensis* "Strictus" stems exceeds the content of this component in the whole plant by 1.46 times. The same tendency was noted for the *Miscanthus sinensis* "Zebrinus".

A comparative analysis of the chemical composition of the herbaceous plant stem and whole plant indicates that the values of such indicators as the mass fraction of protein, crude fat, ash, and acid-insoluble lignin are higher in the case of a whole plant.

Conclusion

Thus, it is recommended to use whole *Miscanthus* plants, including the leaves and stems, for further research to develop scientific and technological foundations for processing and using *Miscanthus* biomass in the fuel and energy, cellulose, microbiological, and other industries.

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DETECTION OF DIROFILARIA SP. MICROFILARIAE IN THE BLOOD OF DOGS IN KHABAROVSK

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Abstract. *The problem of dirofilariosis, including in the Russian Federation, is caused by the wide circulation of the pathogen in the natural environment, lack of proper measures to identify and dehelminthize infected animals of obligate definitive hosts (dogs, less frequently cats) and extermination measures against intermediate hosts of dirofilariae - Culicidae family mosquitoes Anopheles, Ochlerotatus, Aedes, Stegomyia, Culex, Culiseta and Coquillettidia genera (about 70 species of mosquitoes are capable of maintaining larval development of dirofilariae to the invasive stage). Until the middle of the last century, only a few dozen cases of dirofilariosis were diagnosed, and over the past 50 years their number has increased dramatically. In Russia, dirofilariasis is registered in the Primorsky, Khabarovsk, Krasnodar, Stavropol Territories, North Caucasian republics, Astrakhan, Volgograd, Rostov, Lipetsk and Voronezh regions.*

Keywords: *dirofilariasis, microfilariae, definitive hosts, mosquitoes.*

Introduction

At the present stage, dirofilariasis is becoming an acute problem, since it is the only helminthiasis in temperate climates with a transmissible route of transmission. Dirofilariosis is a biogelminthiasis whose pathogen is transmitted by blood-sucking mosquitoes. In modern conditions there is a tendency to increase the number of registered cases of Dirofilariosis caused by Dirofilaria repens among the residents permanently residing in the temperate zone of Western Europe and Russia. Since the end of the 1970s, the attention of specialists from different regions of Russia to this problem has increased noticeably.

The territory of the Far East is a moderate risk zone for dirofilariasis infection. In Khabarovsk single cases were recorded, but in recent years there has been a tendency for helminthiasis to spread. Creation of irrigation canals, climate change, decrease of frog populations due to catching of frogs by Chinese citizens for eating and medicine preparation, annual burning of peat bogs and forest belts in the

city outskirts lead to the shift of temperature regime; all that creates conditions for mass outbreak of Culex, Aedes, Anopheles mosquitoes and appearance of new outbreaks.

The formation of synanthropic foci and the preservation of the parasitic system of dirofilariae in the chain dog-mosquito-human and dog-mosquito-dog may be a factor in the increase in the number of dirofilariosis patients. In synanthropic foci, the extensiveness of invasion by dogs and the high number of the vector can have a considerable influence on the human infestation. It is known that in dogs dirofilariosis is caused by two pathogen species: Dirofilaria immitis and Dirofilaria repens, in people, as a rule, only Dirofilaria repens. Circulation of the pathogen in the natural environment and lack of appropriate measures to identify and deworm infected animals (dogs and cats) - obligate definitive hosts, contribute to increased transmission of dirofilariosis to humans [1].

Purpose of the study – to establish the study of the incidence of dirofilariasis among definitive hosts (dogs) in Khabarovsk city.

Blood of dogs was examined for the presence of microfilariae by the classical method: direct microscopy of a fresh drop of blood under low magnification (×10); the easiest, most convenient and fast diagnostic method (Fig. 1).

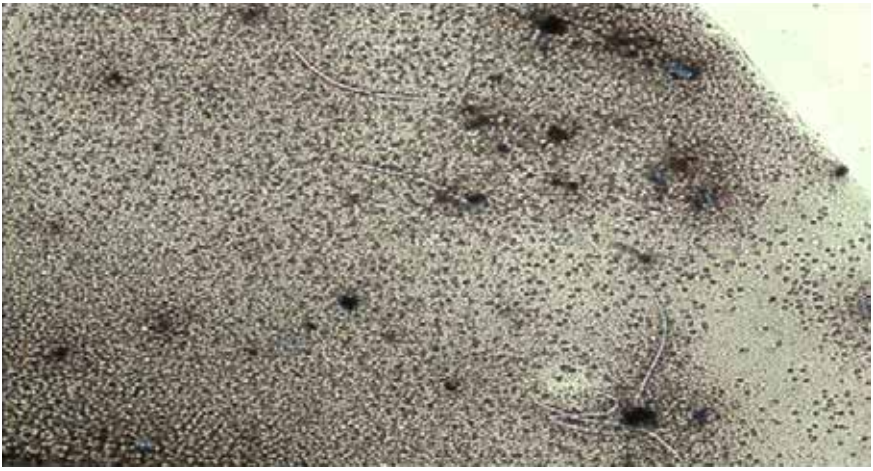

Fig. 1. *Microfilariae in canine blood (Photo by Ivanova I.B.)*

The research work was carried out by microscopy. A total of 659 dogs were examined by random sampling. There were 336 animals from veterinary clinics, 39 service dogs (from the kennel of the UVD, UVD on Transport, FKB IK-3 UFSIN of Russia for Khabarovsk Krai), and homeless dogs from four city districts - 284.

The results of the analysis of our studies showed a high contamination of dogs with dirofilarias in Khabarovsk city. Of the 659 dogs examined, 193 (29.3±1.7%) had microfilariae detected in their blood (Fig. 2).

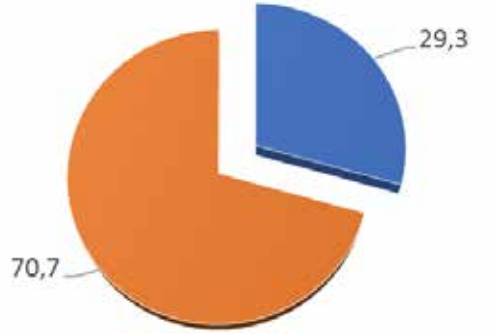

Figure 2. *Detection of microfilariae in surveyed dogs in the territory of Khabarovsk*

It is interesting to note that microfilariae in the blood remained mobile up to 3 days after being kept in a refrigerator at +8^{0}C. In the examination of 39 working dogs in 14 cases (35.9±7.6%) the dirofilariae were detected in the early stages of development. Examination of 336 animals from veterinary clinics revealed microfilariae in 87 of them, the rate of infestation was 25.9±2.3%. (Table 1).

Table 1.

Dirofilariosis infestation in dogs in Khabarovsk

Clinic	Total examined	Detected infestations (Abs. (Abs.)	(P,%), (m, ±)
From veterinary clinics	336	87	25,9±2,3
Service dogs	39	14	35,9±7,6
Stray dogs	284	92	32,4±2,7
Total	659	193	29,3±1,7

extensity of infestation

The rate of infestation of working dogs was 1.4 times higher than that of domestic dogs in Khabarovsk.

In the city of Khabarovsk (the capital of the Far Eastern Region), as well as in some regions of the Russian Federation, the problem of increasing number of stray dogs remains. In the course of examination of 284 stray dogs, dirofilariosis was verified in 92 cases. The rate of infestation was 32.4±2.7% (Table 1).

Conclusion

Wide circulation of the two species of dirofilariae among animals was established; the extensiveness of the infection was 29.3% throughout Khabarovsk. The infestation rate of dogs with dirofilarias in Khabarovsk city is 29.3%. The rate of stray dogs' infestation by dirofilarias was 1.2 times higher than in dogs with owners and kept in apartments; the rate of service dog's infestation was (35.9±7.6%) and was 1.4 times higher than in domestic dogs (25.9±2.3%).

Prevention of human and animal infestation with dirofilarias is based primarily on interruption of transmissible transmission of infestation and consists of several directions: extermination of mosquitoes, identification and deworming of infested domestic dogs, prevention of contact of mosquitoes with domestic animals and humans.

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VEGETATIVE HOMEOSTASIS IN RESIDENTS OF THE ARCTIC ZONE WITH DIFFERENT TYPES OF INTERHEMISPHERIC ASYMMETRY OF CEREBRAL ENERGY EXCHANGE

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Abstract.

Purpose of the study *- to reveal the relationship of autonomic homeostasis with interhemispheric asymmetry of the brain in young residents of the Arctic zone of the Russian Federation.* ***Materials and methods.*** *The study of cerebral energy processes and interhemispheric asymmetry was carried out by registering the DC-potential level of the brain and calculating the interhemispheric gradient (Td-Ts) on a 5-channel hardware-software diagnostic complex "NeuroKM" in 63 young people of working age (30-34 years old), born and permanently residing in the Arctic zone. The study of autonomic homeostasis included the study of the frequency parameters of heart rate variability at rest and during exercise - a passive orthostatic test using the VNS-spectrum diagnostic complex (Neurosoft LLC). Statistical data processing was carried out using the SPSS Statistics 26 software.* ***Research results.*** *In northerners with different types of hemispheric dominance of cerebral energy processes, the sex characteristics of autonomic homeostasis were revealed. At rest, in both study groups, the activity of the parasympathetic division of the autonomic nervous system in the regulation of the heart rhythm predominates. In "left hemispheric" men and "right hemispheric" women, there is an insufficient reactivity of the parasympathetic division of the autonomic nervous system in response to the orthostatic test and an increase in sympathetic activity. In men with right hemispheric asymmetry and women with left hemispheric dominance, a more pronounced vagal activity with normal parasympathetic reactivity in response to load and preservation of the reserve of parasympathetic regulation is observed.* ***Conclusion.*** *Thus, the most optimal vegetative homeostasis is observed in men with right hemispheric dominance and women with left hemispheric asymmetry of cerebral energy exchange.*

Keywords: *Arctic, able-bodied population, hemispheric asymmetry, DC-potential level, vegetative homeostasis.*

Introduction

The cerebral hemispheres are two symmetrical, but functionally unequal organs, the role of which is to ensure certain functions and interhemispheric interactions [2, 11, 14]. Adaptation to the harsh climatic conditions of the Arctic occurs with the stress of all body systems [7, 8, 9, 10, 12], including the autonomic and central nervous system with changes in neuroenergy metabolism [3, 4], and interhemispheric asymmetry [5, 6].

Relatively recently, a provision has appeared on the dynamic properties of interhemispheric asymmetry due to the interaction between the cortex and the autonomic nervous system. The literature contains information on the right-sided dominance of sympathetic influences in humans [17], as well as on the representation of the sympathetic and parasympathetic nervous systems in the insular cortex of each hemisphere [15]. It has been suggested that the sympathetic and parasympathetic fibers coming from the ventromedial nucleus of the thalamus intersect in such a way that most of the sympathetic fibers are directed to the right insular cortex, and parasympathetic fibers to the left [16]. Consequently, stimulation of the temporal and frontal cortex of the right or left hemisphere leads to the activation of the sympathetic or parasympathetic system [17; 18]. The natural circadian rhythm of the tone of the sympathetic and parasympathetic nervous systems can also affect the dynamic asymmetry [13].

Thus, the interactions between the cerebral cortex and the autonomic nervous system remain poorly understood. All of the above predetermined the conduct of this work, the purpose of which is to identify the features of vegetative homeostasis in residents of the Arctic zone of the Russian Federation (30-34 years old) with different types of hemispheric dominance of cerebral energy processes.

Materials and methods

The basis of this work was the study of cerebral energy processes and heart rate variability in young people of working age (30-34 years old), born and living in the territory of the Arctic zone of the Russian Federation (men -30 people, women-33). Registration and analysis of the DC-potential level (DCL) were carried out using the 5-channel hardware-software diagnostic complex "Neuro-KM" ("ASTEK", Russia), the analysis of heart rate variability - using the diagnostic complex VNS-spectrum (LLC "Neurosoft") at the same time of the day, with the maximum physical and mental rest of the subjects with the permission of the Ethics Committee of the Institute of Biomedical Research NArFU (protocol № 1 dated January 14, 2019). Functional images of the brain and autonomic indicators were obtained during the same experimental session. All subjects were right-

handed. Each participant signed an informed consent form for the examination in accordance with the Declaration of Helsinki, which regulates scientific research.

DCL registration was carried out with non-polarizable silver chloride electrodes applied at five points of the scalp corresponding to the Fz, Cz, Oz, Td and Ts regions according to the international scheme 10-20. The reference electrode was placed on the left wrist. DCL recording was carried out 5-6 minutes after the application of the electrodes. DCL distribution analysis was performed by mapping monopolar constant potential (CP) values and calculating the interhemispheric gradient (Td-Ts). After recording the DCL of the brain, the autonomic regulation of the circulatory system was assessed by the parameters of heart rate variability (HRV) using the VNS-spectrum software and hardware diagnostic complex (Neurosoft, Russia) [1] at rest and during a passive orthostatic test. The duration of the recording in the supine position was 5 minutes. Then, after adaptation of the subjects in a horizontal position for 10 minutes, the head end of the turntable was raised by 60°. After turning the table, the studied HRV parameters were recorded for 5 minutes.

Statistical processing was carried out using the SPSS Statistics26 software package. One-dimensional descriptive statistics were calculated for each of the indicators, and the distributions of features were assessed for normality. The results of nonparametric data processing methods were presented as a median, first and third quartiles (Me (Q1; Q3)). For all the results presented, the differences were considered significant at $p<0.05$. For comparison of groups, the nonparametric Mann-Whitney test was used.

Results and discussion

When assessing the DCL of the brain and calculating the interhemispheric gradient (Td-Ts), 4 study subgroups were formed: 16 males with right hemispheric dominance and 14 with left hemispheric dominance; 18 women with right hemispheric asymmetry and 15 with left hemispheric asymmetry.

Spectral analysis of heart rate variability indicators revealed the following features of autonomic homeostasis in men with different types of hemispheric asymmetry (tab. 1).

Table 1. *Indicators of the spectral structure of heart rate variability in men 30-34 years old with different types of hemispheric dominance, living in the Arctic zone*

Indicators		**Right hemispheric (n=16)**	**Left hemispheric (n=14)**
TP	Background	4248.00(2326.25;6810.25)	4566.50(2654.25; 9729.00)
	Orthotest	3529.50(2527.50; 5655.00)	5183.50(4461.00; 6049.75)

VLF	Background	1311.00(776.50; 1874.50)	1349.00(607.00; 2582.00)
	Orthotest	1544.50(805.50; 2283.25)	1862.00(1512.50; 3147.75)
LF	Background	1196.50(836.00; 3194.25)	1511.50(1151.50; 1959.25)
	Orthotest	1325.50(918.75; 2189.75)	1704.00(1172.00; 2949.50)
HF	Background	1391.00(489.75; 2330.75)	1266.50(775.00; 2369.00)
	Orthotest	648.00(265.00; 1448.25)	690.50(399.75; 1915.25)*
LF/HF	Background	1.15(0.73;1.73)	1.10(0.77;1.55)
	Orthotest	2.45(0.95;3.83)	1.70(1.23; 3.95)**
VLF%	Background	28.00(23.50; 38.25)	31.00(17.00; 46.50)
	Orthotest	35.00(25.75;59.50)	37.00(29.00;52.50)
LF%	Background	35.00(31.00;41.75)	36.00(21.25; 48.00)
	Orthotest	34.50(28.25;47.75)	37.50(28.50;43.50)
HF%	Background	32.00(23.75;40.00)	28.00(24.00;38.75)
	Orthotest	17.00(10.25;34.25)*	20.00(7.75;32.25)**

*Note: * marked statistically significant differences between baseline and orthotest HRV indicators in men of the same group (*p<0,05; ** p<0,01)*

Spectral analysis indices in men with right-hemispheric and left-hemispheric dominance of cerebral energy processes do not have statistically significant differences. The total spectrum power (TR) is within the age norm in both study subgroups. High-frequency fluctuations (HF) both in absolute values and in percentage terms in "right hemispheric" men are slightly higher than in the subgroup of "left hemispheric" men. The power of low frequency waves (LF) in absolute values within the age norm in men with right hemispheric asymmetry and at the upper limit of the norm - with left hemispheric asymmetry. As a percentage, LF was within normal limits in both study groups. Waves of very low frequency (VLF) both in absolute units and in percentage within the age norm in both groups, however, in men with right hemispheric asymmetry of cerebral energy exchange, this indicator has lower values. Spectral analysis data indicate the activity of the parasympathetic division of the ANS in the regulation of heart rhythm in both study subgroups with a more pronounced vagal effect in "right hemispheric" men. The coefficient of vagosympathetic influence LF/HF at rest is within the normal range and does not have statistically significant differences in the groups.

After performing the orthostatic test, the indicators of high-frequency oscillations (HF) significantly decreased in absolute values in the "left hemispheric" men (p=0.019) and in percentage terms in both subgroups (p=0.041 in the "right hemisphere", p=0.006 in the "left hemisphere"), which indicates a decrease in vagotonic activity in response to orthostatic load in males. In the group of "left hemispheric" men, there is an increase in the total power of the spectrum (TR) due to an increase in the low-frequency (LF) and very low-frequency (VLF) components of the spectrum and a decrease in the high-frequency (HF) due to sympathetic

neuro-reflex activity. In men with right-hemispheric activity of cerebral energy exchange, a decrease in the total power of the spectrum is observed against the background of a pronounced decrease in high-frequency oscillations (HF%) and moderate low-frequency (LF%) in the general structure of the spectrum, as well as an increase in the very low-frequency (VLF%) component, which is characteristic of the centralization of regulation heart rate during orthopedic testing. The coefficient of autonomic reactivity K30/15 has statistically significant differences in the subgroups of left and right hemispheric men (p=0.029). In the subgroup of "left-hemispheric" men, K30/15 is equal to 1.06 (1.02; 1.13) - significantly reduced, which indicates the pathological reactivity of the parasympathetic division of the ANS in response to orthostatic load. In "right hemispheric" men, the coefficient of autonomic reactivity K30/15 is within the normal range - 1.16 (1.05; 1.28); this subgroup of subjects showed a normal reactivity of the parasympathetic division with the resistance of the vagus nerve to a stressful situation. The LF/HF index after the orthostatic test, reflecting the adequacy of autonomic support, significantly increased in the group of "left hemispheric" men (p=0.006) and reflects an increase in the activity of the sympathetic part of the ANS in response to exercise. Whereas in men with right-hemispheric dominance of cerebral energy processes, this indicator at rest and after the orthostatic test did not have statistically significant differences, which indicates the preservation of the reserve of parasympathetic regulation in this study group.

When assessing the indicators of heart rate variability in women with different types of dominance of cerebral energy processes, the following features of autonomic regulation of the heart rate were revealed (tab. 2).

Table 2. *Indicators of the spectral structure of heart rate variability in women aged 30-34 years with different types of hemispheric dominance, living in the Arctic zone*

Indicators	Gender	Right hemispheric (n=18)	Left hemispheric (n=15)
TP	Background	5987.00(5027.75;9439.75)	9990.00(3296.00; 12742.00)
	Orthotest	5808.00(2733.50; 7613.25)	8779.00(3432.00; 11803.00)
VLF	Background	1809.00(1160.75; 2232.25)	2442.00(639.00; 4114.00)
	Orthotest	1749.00(1215.75; 2560.75)	2458.00(1015.00; 5293.00)
LF	Background	1173.50(1188.25; 2631.00)	2494.00(1172.50; 4757.00)
	Orthotest	1581.50(461.75; 3272.25)	2368.00(1133.00; 3175.00)
HF	Background	2545.00(834.00; 5477.75)	4597.00(1618.00; 6706.00)
	Orthotest	1410.50(431.75; 2728.00)	1692.00(930.00; 4678.00)
LF/HF	Background	0.84(0.43;1.10)	0.67(0.51;1.10)
	Orthotest	0.88(0.74;2.43)	1.20(0.71; 1.80)*

VLF%	Background	26.00(17.00; 41.50)	28.00(19.00; 33.00)
	Orthotest	37.00(24.00;52.25)	36.00(22.00;52.00)*
LF%	Background	28.50(23.00;34.50)	31.00(23.00; 42.00)
	Orthotest	28.50(20.75;42.00)	31.00(25.00;36.00)
HF%	Background	39.00(28.00;54.50)	45.00(35.00;50.00)
	Orthotest	29.00(16.25;41.50)	35.00(18.00;42.00)*

*Note: * marked statistically significant differences between baseline and orthotest HRV indicators in women of the same group (*p<0,05; ** p<0,01)*

The values of spectral analysis at rest do not have statistically significant differences in females with different types of hemispheric asymmetry of cerebral energy processes. In women, the values of the total spectrum power (TR) are higher than the normative values for this age group, and the highest indicators are observed in "left hemispheric" women due to the contribution to the total power of the spectrum of high-frequency oscillations (HF). High values of the total spectrum power may be associated with impaired adrenergic reception in women living in northern latitudes under the influence of female sex hormones. Thus, in women at rest, regardless of the type of hemispheric dominance of neurometabolism, the initial vagotonic tone is observed, and the parasympathetic section has a more pronounced effect on the heart rate in "left hemispheric" women.

When conducting a passive orthostatic test, the total power of the spectrum (TP) in females decreases mainly due to the high-frequency component of the rhythm (HF); low frequency oscillation (LF) remains unchanged. The contribution of the very low-frequency component (VLF) to the regulation of the heart rate increases. The K30/15 coefficient in the group of "right hemispheric" women is reduced by 1.17 (1.09; 1.39), which indicates the pathological reactivity of the parasympathetic division of the ANS in response to orthostatic load. In "left hemispheric" women, the K30/15 indicator is closest to the norm of 1.23 (1.10; 1.32), which indicates the normal reactivity of the parasympathetic section with the resistance of the vagus nerve to stress stimuli.

The indicator of autonomic support (LF/HF) in response to orthostatic load significantly increased in the subgroup of "left hemispheric" women (p=0.023) relative to rest, however, there were no significant differences in this indicator when assessing the orthostatic test between the groups. It should be noted that the value of Q3=2.43 in the subgroup of "right hemispheric" women is higher than that of "left hemispheric" women (Q3=1.80), therefore, autonomic support of heart rate regulation in women with right hemispheric asymmetry is due to a more pronounced activation of the sympathetic section ANS with preservation of the reserve of vagotonic regulation in response to stress in both groups.

Conclusion. Thus, the results of this study indicate the presence of gender

differences in vegetative homeostasis in individuals with different types of hemispheric asymmetry of cerebral energy processes. The most optimal autonomic homeostasis is observed in men with right hemispheric dominance and women with left hemispheric asymmetry of neurometabolism. At rest, in all subjects, regardless of the type of hemispheric domination of cerebral energy processes, the activity of the parasympathetic division of the autonomic nervous system in the regulation of the heart rhythm predominates, which is consistent with the provision on the adaptive-trophic protective action of the vagus nerves on the heart, and is one of the factors of individual stability. a healthy organism to the unfavorable climatic conditions of the Arctic zone. However, in "left hemispheric" men and "right hemispheric" women, there is an insufficient reactivity of the parasympathetic division of the autonomic nervous system in response to an orthopedic test and an increase in sympathetic neuro-reflex activity. In men with right hemispheric asymmetry and women with left hemispheric dominance, a more pronounced vagal activity with normal parasympathetic reactivity in response to load and preservation of the reserve of parasympathetic regulation is observed.

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OZONATION AS A METHOD FOR INDUSTRIAL WASTEWATERS PURIFICATION

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Abstract. *The article briefly provides information on the chemical properties of ozone and the use of ozone technologies to remove organic (aromatic compounds, oil products, dyes) and inorganic (cyanide ions, heavy metal ions) pollutants from wastewater. The prospects for the use of ozone in various combinations with other activators of the purification processes are noted.*

Keywords: *ozone, waste water, treatment*

Introduction

Ozonation is a widely used method of deep purification of water from a large number of organic and inorganic biologically difficultly oxidized compounds. Ozone can also be used to decolorize effluents, remove suspended solids and colloids, oxidize complex organo-mineral complexes, toxic ions, organic micro-contaminants, and as a disinfectant.

Among the areas of ozone use in wastewater treatment, the main ones are the local treatment of individual wastewaters from toxic substances; deep post-treatment after biological structures (reduction of odors, color COD, BOD); post-treatment after physical and chemical treatment (coagulation flotation); intensification of biological treatment; disinfection.

Ozone is one of the most powerful oxidizing agents. Its redox potentials in acidic and alkaline environments are

$O_3 + 2H_2O + 2e = O_2 + 2OH^-$ $\quad Eo = +1{,}246$ V

For comparison, the redox potentials (*Eo*) of commonly used oxidants are: +2.075 V for persulfate; +1.70 V for iodic acid and permanganate; +1.76 V for

hydrogen peroxide in an acidic environment; +1.63 V for hypochlorite; +1.359 V - for chlorine. Fluorine +2.87 V has a higher potential [1].

Ozone is also a powerful disinfectant. It destroys bacteria (*colibacteria*, *staphylococcus*, *salmonella*) and bacterial spores (*brevibacteiumspores*); destroys viruses (HBsAg, HAAg, PVI, HIV, influenza virus, hepatitis A virus); kills fungal parasites (*aspergillusversicolor, penicillium, aspergillusniger, fusariumoxysporumf.sp.melonogea, fusariumoxysporumf.sp. lycopersici, candida bacteria*); destroys unicellular parasites [2].

In the last 20 years, the fields of application of ozone have expanded greatly. The development of ozone technologies is facilitated by the unlimited raw material resource (air, oxygen) as well as the ecological purity of this reagent, since the final product of ozone decomposition is oxygen, and the ozonation products are not carcinogenic substances and do not pollute the environment, as is the case with oxidation, for example, with chlorine. During ozonation of aromatic pollutants, C_1-C_2- carboxylic acids are formed as products, which are actively utilized by microorganisms, as they enter the cycles of their metabolism.

The disadvantages of the ozonation process include, mainly, the high cost of ozone, the need to use corrosion-resistant materials for equipment, the toxicity of ozone (MPC in the air is 0.0001 mg/l) [3].

Being a strong oxidizing agent, ozone actively interacts with almost all components of wastewater, however, the rate and mechanism of the reaction depend on the nature of the reagent and the conditions of the reaction. The oxidizing properties of ozone in water can be manifested in direct oxidation reactions, and oxidation by radicals formed during the decomposition of ozone.

The diagram shows the mechanism of ozone decomposition in water [4]:

$H_2O \leftrightarrow H^+ + OH^-$

$O_3 + H_2O \rightarrow 2OH^{\bullet} + O_2$ $\quad k_2 = 1.1 \times 10^{-4}$ (l/mol.s)

$O_3 + OH^- \rightarrow O_2^{\cdot -} + HO_2^{\cdot}$ $\quad k_3 = 70$ (l/mol.s)

$O_3 + OH^{\bullet} \rightarrow O_2 + HO_2^{\cdot} \rightarrow O_2^{\cdot -} + H^+$

$O_3 + HO_2^{\cdot} \rightarrow 2O_2 + OH^{\bullet}$ $\quad k_5 = 1.6 \times 10^9$ (l/mol.s)

$2HO_2^{\cdot} \rightarrow O_2 + H_2O_2$

The rate of decomposition of ozone in water depends on the pH of the medium. The rate constant of ozone decomposition increases by two orders of magnitude from $2.3 \times 10^4 s^-$ to $1.6 \times 10^6 s^-$ when the pH of the medium changes from 1 to 8.[3,6,7] With an increase in pH, the concentration of reactive radicals ($OH^{\bullet}$, $HO_2^{\cdot}$, $O_2^{\cdot -}$) increases, the rate of oxidative destruction of organic pollutants increases significantly. However, it should be borne in mind that the products of reactions involving molecular ozone and radicals can differ significantly. This makes it necessary to discriminate between radical and molecular reactions, as well as to determine the conditions corresponding to a particular mechanism.

Temperature and ozone consumption are also important parameters that should be considered when optimizing the water treatment process. Taking into account that the solubility of ozone in water decreases with increasing temperature, it is advisable to carry out ozonation at a low temperature (20-50°C) [4].

Removal of aromatic compounds

Ozone effectively oxidizes phenols and aromatic hydrocarbons. Table 1 shows data indicating the dynamics of the removal of phenol and cresols from alkaline aqueous solutions depending on the ozone consumption.

Table 1. *The content of phenol and o-, m-cresol, depending on the consumption of ozone. Initial concentration of phenols 100 mg/l, (pH=12) [5]*

Phenol		**o-Cresol**		**m-Cresol**	
Ozone consumption, mg/l	**Phenol content, mg/l**	**Ozone consumption, mg/l**	**Content of o-Cresol, mg/l**	**Ozone consumption, mg/l**	**Content of m-Cresol, mg/l**
0	96	0	99	0	99
54	47	49	46	57	41
110	12	100	11	110	2,7
180	0,4	150	1,7	150	0,4
220	0,2	200	0,0	200	
260	0,1	240	0,1	260	

Ozonation of phenols in an alkaline medium leads to their deep and rapid oxidation, which is associated with the predominance of radical processes under these conditions. $OH^{\bullet}$ radicals do not react selectively with aromatic compounds, causing a variety of reactions - hydroxylation, decarboxylation, depolymerization, etc.

The rate constants of reactions of organic compounds with the participation of $OH^{\bullet}$ radicals are in the range of 10^6 - 10^9 l/mol×s, which is much higher than the corresponding rate constants of reactions for molecular ozone [6]. For comparison, Table 2 shows the rate constants of reactions in an acidic medium of molecular ozone with compounds that are the main components of PPI wastewater [6, 7].

One of the main problems of PPI wastewater treatment is the presence of organochlorine compounds formed at the stage of pulp bleaching. Chlorine can be present both in the aromatic nucleus and in the side chain of the phenylpropane unit of lignin. The presence of chlorine, an electron-withdrawing substituent in the aromatic structure of lignin and its degradation products, increases the stability of the aromatic ring in ozone oxidation reactions.

Table 2. *Rate constants of reactions of molecular ozone with phenols and intermediate products of ozonation [6, 7].*

Compound	k, l/mol×s.	Compound	k, l/mol×s.
Lignosulfonate Na	3×10^5	2.3-dichlorophenol	$< 2.0\times10^3$
Phenol	3.0×10^3	2.4-dichlorophenol	$< 1.5\times10^3$
Guaiacol	$>5.1\times10^5$	2.4.5-trichlorophenol	$< 3.0\times10^3$
Veratrol	1.5×10^4	Muconic acid	1.6×10^4
Veratric alcohol	3.0r	Maleic acid	1×10^3
Veratric aldehyde	4.0×10^3	Formic acid	< 3
Veratric acid	5.6×10^3	Glyoxalic acid	0.2
2-chlorophenol	1.1×10^3	Oxalic acid	$< 4\times10^{-2}$
4-chlorophenol	6.0×10^2	Acetic acid	3.0×10^{-5}

Polyaromatic hydrocarbons (PAHs) are relatively poorly soluble in water. The solubility of PAHs in water increases in the presence of benzene, oil and oil products, detergents, etc. The more of these substances are in the effluent, the more toxic and carcinogenic PAHs can be dissolved in water. Under the action of ozone, PAHs are easily oxidized with the formation of quinones or dicarboxylic acids, which is preceded by the breaking of the double bond of the phenanthrene type. Side chain oxidation and more complex intramolecular oxidation are also possible [8].

Substitution, oxidation and addition reactions more readily enter less stable hydrocarbons. Therefore, acenes or hydrocarbons containing acene structures are more reactive than phenes (phenanthrene type structures) with the same number of rings, or hydrocarbons containing phenic structures [8]. The ozone reaction rate increases in the series benzene→naphthalene→anthracene [6].

Removal of oil products

Ozonation is the most effective way to remove oil products from wastewater. The use of ozone does not lead to the formation of toxic products. The process includes a direct reaction of molecular ozone and reactions involving the resulting $OH^{\bullet}$ - radicals.

When ozonizing water containing oil products at a concentration of 1 mg/l, which is about 10 times higher than their odor threshold, complete deodorization of water was observed as a result of 3-5 minutes treatment with a dose of ozone of 3 mg/l [9]. In the case of increased concentrations of oil products in water, it is necessary to increase the dose of ozone, which is not always economically feasible, therefore, ozonation must be used in combination with other methods, for example, chemical clarification, filtration, and adsorption. This allows you to bring the efficiency of water purification up to 99%.

Removing dyes

Ozone is successfully used for the destruction of dyes. Since dyes are unsaturated compounds, they are easily oxidized by ozone. Ozonation is an effective method of wastewater treatment in the textile industry, especially in combination with biological treatment [10].

It is shown that ozonation in an alkaline medium (pH 13) with preliminary and subsequent sedimentation is the most effective for the treatment of wastewater generated during dyeing of fabric with vat, cold and direct dyes. For wastewater generated by sulfur dyeing, the greatest bleaching effect is achieved when it is settled and subsequently ozonized in an acidic environment. Studies have shown that, depending on the type of dye used, the duration of ozonation of wastewater in the textile industry should be 3–15 min at an oxidant dose of 30–60 mg/l [10].

Removal of inorganic contaminants

Ozone is also successfully used to neutralize inorganic pollutants, for example, cyanides [11]. The amount of cyanide in the wastewater of electroplating workshops varies within a wide range from 2 - 30 mg/l to 150 - 300 mg/l. Ozonation in an alkaline medium with the participation of OH radicals under conditions of ozone decomposition (pH 10-11) leads to the formation of less toxic cyanates, which are then oxidized by ozone to CO_2 and H_2O:

$CN^- + O_3 \rightarrow CNO^- + O_2$

$2CNO^- + 3O_3 + 2OH^- \rightarrow 2(CO_3)^{2-} + N_2 + 3O_2 + H_2O$.

The ozone consumption per 1 mg of cyanide ions corresponds to the stoichiometric ratio of the reaction and is practically 2.0-2.1 mg/l.

During ozonation, simple cyanides are oxidized faster, more difficult - complex metal-bound ($[Fe(CN)_6]^{4-}$, $[Ag(CN)_2]^-$). Complex cyanides exhibit different activities: copper and nickel cyanides are the easiest to oxidize, since their ions catalyze the reaction. The oxidation rates of complex cyanides of silver and cadmium are approximately the same as those of simple cyanides. Zinc cyanide interacts worse with ozone. The decomposition of very stable complexes of iron or gold under normal conditions is insignificant [12].

With the help of ozone, one can also purify water from iron ions and remove manganese ions [11, 13]. Oxidation by ozone of Fe^{2+} and Mn^{2+} ions in an alkaline medium proceeds with the formation of insoluble oxides and hydroxides Fe^{3+} and Mn^{4+}.

Conclusion

Despite the fact that the electrosynthesis of ozone was discovered more than 130 years ago, only in the last few decades has tangible technical progress been made towards the practical use of ozone. The use of the latest advances in ozone synthesis technology has dramatically improved the efficiency and reliability of ozone generators.

An obstacle to the widespread use of ozonation in various industries was the significant energy consumption for ozone synthesis. However, at present, in our country and abroad, new generation ozonizers are produced with high efficiency of ozone synthesis and low energy consumption. Improving the designs of ozonizers, the use of new dielectric materials (enamel, aluminum oxide, ceramics), a decrease in the thickness of the dielectric barrier, a decrease in the size of the discharge gap, an increase in the frequency of the supply voltage, the use of oxygen instead of air as a working gas, make it possible to obtain high concentrations of ozone with low energy consumption. This enables widespread use of ozone technologies.

In addition, the use of modern advanced oxidation process, combining ozone with hydrogen peroxide, transition metal salts, titanium oxide, UV and ultrasonic irradiation, electrochemical processes, can significantly increase the efficiency of oxidation at lower ozone consumption.

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THE MECHANISM OF FORMATION OF STATIC ELECTRICITY FROM THE ATMOSPHERE OF OUR PLANET

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Abstract. *The article is devoted to the mechanism of the formation of static electricity, the mechanism of the formation of mobile electrons and the mechanism of the formation of thermoelectric currents between the material body and the air environment, where the gap uniting the environment of the interatomic space of the material body and the environment of the interatomic space of the air shell of our planet is located. This natural phenomenon is based on a varied force of interaction, different work and different power between different material bodies having different chemical and physical properties, having different densities and different volumes that come into contact with the atmosphere of our planet. This discovery allows a deeper understanding of the mechanism of the formation of static voltage, the mechanism of the formation of mobile electrons and the mechanism of the formation of thermoelectric currents in the air, consisting of various gases surrounding our planet.*

Keywords: *the mechanism of the formation of static electricity, the mechanism of the formation of mobile electrons, the mechanism of the formation of thermoelectric currents.*

Humanity has always been interested in natural phenomena that have taken place on our planet. At that time, thinkers and scientists of antiquity could not give unambiguous answers to many of the mysteries of nature. For some reason, more modern scientists are now mainly remembered, but one must always remember about the thinkers and scientists of antiquity, of whom there were many, but they were already interested in questions that even modern scientists with a high level of accumulated knowledge cannot explain many natural phenomena, occurring in

our macrocosm and microcosm.

Consider the mechanism of the formation of static electricity, between various materials having different densities that are in the air environment of our planet, which has in its composition most of the nitrogen atoms and oxygen atoms.

It should be emphasized that the surface of any material body has different roughness. If we process all materials interacting with the atmosphere of our planet up to the 14th accuracy class with an allowable roughness of no more than 0.010 microns, then the height of this deviation will be very different from the diameter of the electron itself, which has a radius of $2.8179403267 \cdot 10^{-15}$ m.

Fig.1

Fig. 1 shows a material body 1, which interacts with the air environment 2. Between the material body and the air environment there is a gap 3 that unites the environment of the interatomic space of the material body and the environment of the interatomic space of the air shell. Due to the roughness of the surface of the material body 1 having depressions 4 and protrusions 5, there is a different interaction between oxygen atoms and nitrogen atoms that make up our atmosphere. The environment of the interatomic space of the material body 1 consisting, for example, of copper and the environment of the interatomic space of the atmosphere of our planet 2 have different densities. Between the atoms of the air shell located in the gap 3, with the help of the forces of interaction between the copper conductor and various atoms of the air, oxygen atoms 6 and nitrogen atoms 7 are separated into separate electrons. Electrons of nitrogen atoms and oxygen atoms have different densities and different strengths of interaction with the interatomic space of the conductor 1 consisting of copper.

Knowing the density of the atmosphere of our planet, you can easily determine the mass of the atmosphere located in one cubic meter.

$$m = p \cdot V = 1.2041 \text{ kg/m}^3 \cdot 1 \text{ m}^3 = 1.2041 \text{ kg}$$

where:

m -the mass of the atmosphere of our planet. kg

p - the density of the atmosphere of our planet at 20 ºC = 1.2041 kg/m^3

V- the volume of our planet's atmosphere = 1 m^3.

Further, you can easily determine the force of interaction of the air shell, which has a volume of one cubic meter, to the surface of our planet, which has the acceleration of gravity of bodies in space = 9.80665 m/s^2.

$$F = m \cdot g = 1.2041 \text{ kg} \cdot 9.80665 \text{ m/s}^2 = 11.808187265 \text{ H}$$

where:

F - the force of interaction of 1 m^3 of the atmosphere of our planet. H

g - free fall acceleration of bodies in space = 9.80665 m/s^2

m - the mass of our planet's atmosphere, kg

However, it should be noted that the force of interaction of the atmosphere of our planet located in one cubic meter includes many different gases with different densities, where most of all nitrogen atoms and oxygen atoms are contained in the atmosphere of our planet.

From known sources, we know that at normal temperature, humidity and atmospheric pressure, the density of the main gases in our atmosphere is:

P_1 - nitrogen density = 1.1233 kg/m^3

P_2 - oxygen density = 1.42987 kg/m^3

P_3 - other components of the composition of the atmosphere are 0.97 %.

Состав атмосферы

Газ		Содержание в сухом воздухе, %
N_2	Азот	78,08
O_2	Кислород	20,95
Ar	Аргон	0,93
CO_2	Углекислый газ	0,03
Ne	Неон	0,0018
He	Гелий	0,0005
Kr	Криптон	0,0001
H_2	Водород	0,00005
Xe	Ксенон	0,000009

It is possible to check the strength of the interaction of the atmosphere of our planet, which is located in one cubic meter, which includes different percentages of the main components consisting of nitrogen gas and oxygen gas, according to a

new law open and published in the scientific and practical journal "Higher School" № 6 for 2021.

The force of interaction of the investigated volume of a gas mixture consisting of many different atoms or molecules placed in one volume is equal to the sum of many products of the density of each atom or each molecule, the acceleration of free fall of bodies in space, the investigated volume of the mixture, and their percentage in a given volume.

Moreover, the sum of all the various investigated atoms or molecules of the investigated volume of the gas mixture should be one hundred percent.

$$F = (p_1 \cdot g \cdot V \cdot \%) + (p_2 \cdot g \cdot V \cdot \%) + (p_3 \cdot g \cdot V \cdot \%) =$$

$$= \left(\frac{\text{Кг}}{M^3} \cdot \frac{M^3}{} \cdot \frac{M}{c^2} \cdot \%\right) + \left(\frac{\text{Кг}}{M^3} \cdot \frac{M^3}{} \cdot \frac{M}{c^2} \cdot \%\right) + \left(\frac{\text{Кг}}{M^3} \cdot \frac{M^3}{} \cdot \frac{M}{c^2} \cdot \%\right) = H$$

where:

F - the force of interaction of the investigated volume of the gas mixture, H

P_1 - the density of the first atom entering the volume of the test gas, kg/m^3

P_2 - density of the second atom entering the volume of the studied gas, kg/m^3

P_3 - density of a molecule entering the volume of the gas under study, kg/m^3

g - acceleration of gravity of the medium where the gas is located, m/s^2

% - the percentage of atoms or molecules included in this volume of gas,

V- investigated volume of gas mixture, m^3.

For example, let us determine the force of interaction of the air shell of our planet at which we will proceed from the fact that the density of air on our planet at 20ºC, normal pressure and normal humidity will be 1.204 kg/m^3, which is located at sea level with the acceleration of gravity of bodies in space = 9.80665 m/s^2.

$$F = (p \cdot g \cdot V \cdot \%) = \left(\frac{\text{Кг}}{M^3} \cdot \frac{M^3}{} \cdot \frac{M}{c^2} \cdot \%\right) = H$$

F = 1.2041 kg/m^3 · 9.80665 m/s^2 · 1 m^3 · 100 % = 11.808187265 H

where:

F - the force of interaction of the volume of the air gas mixture. H

P - the density of the air gas mixture of our planet = 1.2041 kg/m^3

V- investigated volume of the gas mixture of our planet = 1m^3

g - acceleration of gravity of the medium where the gas is located = 9.80665 m/s^2

% - the content of atoms and molecules included in the volume of air = 100 %.

For example, according to the new law, we will determine the strength of the interaction between the nitrogen atoms of the same name that make up the atmosphere of our planet.

$$F = (p \cdot g \cdot V \cdot \%) = \left(\frac{кг}{м^3} \cdot \frac{м^3}{} \cdot \frac{м}{с^2} \cdot \% \right) = Н$$

F = 1.1233 kg/m^3 · 9.80665 m/s^2 · 1 m^3 · 78.08 % = 8.601144405056 H

where:

F - the force of interaction between electrons of the same nitrogen atoms. H

P_1 - nitrogen gas density at 25 ºC = 1.1233 kg/m^3

g - acceleration of free fall of the medium at a given height = 9.80665 m/s^2

% - percentage of nitrogen in the air = 78.08 %.

For example, according to the new law, we will determine the strength of the interaction between the oxygen atoms of the same name that make up the atmosphere of our planet.

$$F = (p \cdot g \cdot V \cdot \%) = \left(\frac{кг}{м^3} \cdot \frac{м^3}{} \cdot \frac{м}{с^2} \cdot \% \right) = Н$$

F = 1.42987 kg/m^3 · 9.80665 m/s^2 · 1 m^3 · 20.95 % = 2.93765815613725 H

where:

F - the force of interaction between the electrons of an oxygen atom. H

P_2 - oxygen gas density at 25 ºC = 1.42987 kg/m^3

g - acceleration of free fall of the medium at a given height = 9.80665 m/s^2

% - oxygen percentage in air = 20.95 %.

From the calculations performed, it follows that the force of interaction between atoms and molecules of the atmosphere of our planet = 11.80818 H. So if the air flow of the gaseous mixture moves one meter, then we get the work of the air flow. If this work is performed per unit of time, then we will get the power generated by the air flow of the gaseous mixture at a certain height from the sea level, since the movement of the air flows of the gaseous mixture at different heights is different.

However, we are interested in the strength of the interaction of the electrons of each nitrogen atom and the electrons of each oxygen atom with any material body, such as copper.

For example, according to the new law of the open and published in the scientific and practical journal "High school" № 3 for 2021, we will determine the strength of the interaction between the electrons of the nitrogen atom and the electrons of the oxygen atom that make up the atmosphere of our planet.

$$F = p \cdot (\lambda \cdot n_a) \cdot (\lambda \cdot n_к) = \frac{кг}{м^3} \cdot \left(\frac{м^2}{с} \cdot шт \right) \cdot \left(\frac{м^2}{с} \cdot шт \right) = Н$$

F = 1.2041 kg/m^3 · (0.000019 m^2/s · 5) · (0.000019 m^2/s · 6) = 1.30404 · 10^{-8} H

where:

F - force of interaction between nitrogen atoms and oxygen atoms, H

P - the density of the interatomic space of air at 20 ºC = 1.2041 kg/m^3

λ - thermal diffusivity of electrons in air at 20 ºC = 0.000019 m^2/s

n_a - the number of electrons in the outer row of the nitrogen atom = 5 pcs.

n_k - the number of electrons in the outer row of an oxygen atom = 6 pcs.

For example, according to the new law, we will determine the strength of the interaction between the electrons of the atom of the copper conductor and the electrons of the nitrogen atom that make up the atmosphere of our planet.

$$F = p \cdot (\lambda \cdot n_M) \cdot (\lambda \cdot n_a) = H$$

F = 1.2041 kg/m^3 · (0.0001125 m^2/s · 1) · (0.02775 m^2/s · 5) = 1.87952484 · 10^{-5} H

where:

F - force of interaction between copper and nitrogen atoms, H

P - the density of the interatomic space of air at 20 ºC = 1.2041 kg/m^3

λ - thermal diffusivity of copper electrons at 20 ºC = 0.0001125 m^2/s

λ - thermal diffusivity of nitrogen electrons at 20 ºC = 0.02775 m^2/s

n_m - the number of electrons in the outer row of a copper atom = 1 pcs.

n_a - the number of electrons in the outer row of the nitrogen atom = 5 pcs.

For example, according to the new law, we will determine the strength of the interaction between the electrons of the atom of the copper conductor and the electrons of the oxygen atom that make up the atmosphere of our planet.

$$F = p \cdot (\lambda \cdot n_M) \cdot (\lambda \cdot n_K) = H$$

F = 1.2041 kg/m^3 · (0.0001125 m^2/s · 1) · (0.02845 m^2/s · 6) = 2.31232353 · 10^{-5} H

where:

F - the force of interaction between copper and oxygen atoms, H

P - the density of the interatomic space of air at 20 ºC = 1.2041 kg/m^3

λ - thermal diffusivity of copper electrons at 20 ºC = 0.0001125 m^2/s

λ - thermal diffusivity of oxygen electrons at 20 ºC = 0.02845 m^2/s

n_m - the number of electrons in the outer row of a copper atom = 1 pcs.

n_k - the number of electrons in the outer row of an oxygen atom = 6 pcs.

From the calculations performed, it can be seen that the electrons of the copper atom have a greater force of interaction with the electrons of the oxygen atom than with the electrons of the nitrogen atom that is part of the atmosphere of our planet.

The force of interaction in the gap 3 between copper atoms and oxygen atoms creates a tension that leads to the separation of oxygen atoms into separate electrons, causing them to electrify and create electrical charges. If the movement of separated electrons released from oxygen atoms does not pass through the conductor, then this natural phenomenon can be called the mechanism of formation of static electricity.

The force of interaction in the gap 3 between the material body and the atoms of the air environment is a physical quantity that characterizes the action of bodies on each other and is a measure of this action, including:

- force of gravitational attraction and ionization,
- atomic, magnetic and electromagnetic forces,
- force of speed of movement and direction of movement,
- force of gravity, inertia, friction, elasticity and deformation,
- external, internal, contact or non-contact forces and so on...

Let us consider the mechanism of the formation of an electric current, between different materials having different densities in the atmosphere of our planet, which has in its composition the majority of nitrogen atoms and oxygen atoms.

If the movement of electrons released from oxygen atoms pass through a conductor, then this natural phenomenon can be called the mechanism of formation of mobile electrons and, depending on their number, these electrons do a certain job, which can be determined by the new Belashov's law.

A new law determining the strength of the interaction between mobile electrons and stationary atoms of a conductor, semiconductor or dielectric was discovered and published in the scientific and analytical journal "Actual problems of modern science" № 2 for 2021, which was formulated as follows:

The force of interaction between mobile electrons and stationary nuclear-free atoms of a conductor is equal to the product of the mass of a mobile electron by the speed of movement of mobile electrons along the conductor, by the acceleration of free fall of bodies in the space of moving mobile electrons by the number of mobile electrons, the diameter of the conductor, the length of the conductor and is inversely proportional to the diameter of the mobile electrons by thermal diffusivity of conductor electrons.

$$F = \frac{m \cdot v \cdot g \cdot n \cdot d_{п} \cdot L_{п}}{d_{э} \cdot \lambda} = \frac{кг}{} \cdot \frac{м}{с} \cdot \frac{м}{с^2} \cdot \frac{шт}{} \cdot \frac{м}{} \cdot \frac{м}{} \cdot \frac{}{м} \cdot \frac{с}{м^2} = Н$$

where:

F - force of interaction between mobile electrons and a conductor, H

v - the speed of electric charges moving along the conductor, m/s

g - acceleration of gravity of the medium where electrons move, m/s^2

λ - thermal diffusivity of conductor electrons at 25 ºC, m^2/s

d e - diameter of a mobile electron, m

n - the number of mobile electrons, pcs.

m - moving electron mass , kg

d_{p} - conductor diameter, m

L_{p} - conductor length, m

Let us consider the mechanism of formation of thermoelectric current, between various materials having different densities of the interatomic space of the conductor, which are in the air environment of our planet. For example, take two conductors, one of which is platinum and the other conductor is copper, which are connected in series.

For example, let us determine the strength of the interaction between the electrons of the third row copper atom having eighteen electrons and one electron of the fourth row copper atom at different temperatures.

$$F = p \cdot (\lambda \cdot n_{в}) \cdot (\lambda \cdot n_{н}) = H$$

$$F_{0\,^{\circ}C} = 8930\ kg/m^3 \cdot (0.00011250\ m^2/s \cdot 1) \cdot (0.00011250\ m^2/s \cdot 18) =$$
$$= 0.002034365625\ H$$

$$F_{500\,^{\circ}C} = 8930\ kg/m^3 \cdot (0.00009667\ m^2/s \cdot 1) \cdot (0.00009667\ m^2/s \cdot 18) =$$
$$= 0.001502129589786\ H$$

where:

F- the force of interaction between the electrons of a copper atom, H

p - the density of the medium of the interatomic space of copper = 8930 kg/m^3

λ - thermal diffusivity of copper at 0 ºC = 0.00011250 m^2/s

λ - thermal diffusivity of copper at 500 ºC = 0.00009667 m^2/s

n_v - the number of electrons of the third row of copper = 18 pcs.

n_n - the number of electrons of the fourth row of copper = 1 pcs.

Let us determine the power between electrons and copper atoms at 0 ºC and 500 ºC.

$$P_{0\,^{\circ}C} = 0.002034365625\ H \cdot 1\ m \cdot 1\ c = 0.002034365625\ W$$

$$P_{500\,^{\circ}C} = 0.001502129589786\ H \cdot 1\ m \cdot 1\ c = 0.001502129589786\ W$$

where:

$F_{0\,^{\circ}C}$ - the force of interaction between electrons of copper atoms at 0 ºC = = 0.002034365625 H

$F_{500\,^{\circ}C}$ - the force of interaction between electrons of copper atoms at 500 ºC = = 0.001502129589786 H

L - conductor length = 1 m

t – time = 1 s.

It should be emphasized that with an increase in the temperature of a conductor made of copper wire, its thermal diffusivity, the force of interaction with electrons of oxygen atoms and the power decreases.

For example, let us determine the strength of the interaction between the electrons of the platinum atom of the fifth row having seventeen electrons and one electron of the platinum atom of the sixth row at different temperatures.

$$F = p \cdot (\lambda \cdot n_{в}) \cdot (\lambda \cdot n_{н}) = H$$

$$F_{0\,^{\circ}C} = 21500\ kg/m^3 \cdot (0.00002472\ m^2/s \cdot 1) \cdot (0.00002472\ m^2/s \cdot 17) =$$

$$= 0.0002233491552 \text{ H}$$

$$F_{500\,^{\circ}C} = 21500 \text{ kg/m}^3 \cdot (0.00002561 \text{ m}^2/\text{s} \cdot 1) \cdot (0.00002561 \text{ m}^2/\text{s} \cdot 17) =$$
$$= 0.00023972125255 \text{ H}$$

where:

F- the force of interaction between the electrons of the platinum atom,H

p - density of the medium of the interatomic space of platinum = 21500 kg/m^3

λ - thermal diffusivity of platinum at 0 ºC = 0.00002472 m^2/s

λ - thermal diffusivity of platinum at 500 ºC = 0.00002561 m^2/s

n_v - number of electrons of the fifth row of platinum = 17 pcs.

n_n - the number of electrons in the sixth row of platinum = 1 pcs.

Let us determine the power between platinum atoms at 0 ºC and 500 ºC.

$$P_{0\,^{\circ}C} = 0.0002233491552 \text{ H} \cdot 1 \text{ m} \cdot 1 \text{ s} = 0.0002233491552 \text{ W}$$

$$P_{500\,^{\circ}C} = 0.00023972125255 \text{ H} \cdot 1 \text{ m} \cdot 1 \text{ s} = 0.00023972125255 \text{ W}$$

where:

$F_{0\,^{\circ}C}$ - the force of interaction between electrons of platinum atoms at 0 ºC = 0.0002233491552 H

$F_{500\,^{\circ}C}$ - force of interaction between electrons of platinum atoms at 500 ºC = 0.00023972125255 H

L - conductor length = 1 m

t – time = 1 s

It should be emphasized that with an increase in the temperature of a conductor made of platinum wire, its thermal diffusivity, the force of interaction with electrons of oxygen atoms and the power increases.

Let us determine the difference in power with increasing temperature between the cold and hot junction of a thermocouple consisting of a copper conductor and a platinum conductor at different temperatures.

$P_{0\,^{\circ}C} = 0.002034365625 \text{ W} – 0.0002233491552 \text{ W} = 0.0018110164698 \text{ W}$

$P_{500\,^{\circ}C} = 0.00150212958978 \text{ W} – 0.0002397212525 \text{ W} = 0.001262408337236 \text{ W}$

where:

$P_{0\,^{\circ}C}$ - the power between the electrons of the atoms of a copper conductor at 0 ºC = 0.002034365625 W

$P_{0\,^{\circ}C}$ - the power between electrons of platinum conductor atoms at 0 ºC = 0.0002233491552 W

$P_{500\,^{\circ}C}$ - the power between the electrons of the atoms of a copper conductor at 500 ºC = 0.001502129589786 W

$P_{500\,^{\circ}C}$ - the power between electrons of platinum conductor atoms at 500 ºC = 0.00023972125255 W.

After the calculations made, it can be concluded that when the temperature changes inside the copper and platinum conductor, a potential difference and a different number of electrons interacting with these conductors arise, where in old

electronic theories it is said about the positive charge and negative charge of the conductors.

It should be emphasized that in fact both conductors are charged with the same electrons released from oxygen atoms or nitrogen atoms of our atmosphere. It turns out that in one conductor the number of electrons released from the atmosphere of our planet associated with the conductor appears significantly more than in another conductor, which depends on many parameters and chemical properties of the interatomic space of one and the second conductor. This circumstance forces the power of electrons from a more saturated conductor, which has a large number of electrons associated with it, to flow into a less saturated conductor. Depending on the number of electrons, some of them maintain the potential to overcome the resistance of this conductor, and the other part of the electrons that overcome this resistance move along the conductor, while the electrons do a certain job. Moving electric charges in the medium having the acceleration of free fall of bodies in space always move around the conductor in a spiral.

In conclusion, we can say that our material world is very diverse and all the processes occurring in it from random circumstances that occur in time, in varying degrees, affect one another, therefore a new theory of multifaceted dependence is being put forward. In this world, everything is intertwined, and one phenomenon of nature is in varying degrees dependent on another. More active material bodies dominate over less active material bodies, therefore there can be no independent and constant constants, laws or physical quantities. For example, the new law of gravitation and cosmic interaction between two material bodies that are located in the space of the Solar system or another system is closely related to the new law of gravitation of one material body located in the space of the Solar system to the central star of the Sun. At the same time, the laws of gravitation and cosmic interaction are in constant dependence on the new law of the activity of a material body located in space and the new law of the acceleration of free fall of bodies in space. And the listed laws are closely related to the new law of energy between two material bodies that are in the space of the solar system and the new law of the energy of one material body located in the space of the solar system to the central star of the sun and many others...

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DUALITY OF CHAINS OF ALMOST AFFINE CODES

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Abstract. *Almost affine codes are generalization for widely used linear codes which can be used in ideal perfect secret sharing schemes. In [1] Simonis and Ashikhmin defined and studied some properties of almost affine codes. In the other hand quasi-uniform codes [2] are generalization of almost affine codes. In this paper we show that duality of chains of linear codes holds in the almost affine case as well and we make a conjecture about such property for quasi-uniform codes.*

Keywords: *almost affine codes, quasi-uniform codes, matroids.*

Introduction

Linear block codes play a key role in the theory of error correction. A q-ary linear code of length n is a k-dimensional vector subspace of $\mathcal{F}_q^n$ where $\mathcal{F}$ is a finite field with q elements, also known as the alphabet of the code. One of the reasons why linear codes dominate the industry is that linear code can be described completely with its generator matrix. Because of the convenience, linear codes possess some restrictions, and it can be shown [9] that linear codes are not sufficient to achieve the maximal capacity for information flow in a multi-source network.

In [1] Simonis and Ashikhmin proposed another class of error correcting codes, namely almost affine codes. The initial motivation for authors was studying the ideal perfect secret sharing schemas. Basically, almost affine codes are generalization for linear codes with less restrictions. However, its turs out that almost affine codes share some properties with linear codes, like the subject of this paper – duality of chains of codes. Or specifically the demi-matroids associated with such chains.

The other step towards to generalization in error correction is quasi-uniform codes [3]. It can be shown that for small length ($n \leq 7$) almost affine codes are linear and, therefore satisfy the Ingleton inequality. But there is exists a quasi-uniform code of length equal to 4 which violates the Ingleton inequality.

We continue with giving formal definitions of concepts discussed earlier, starting with almost affine codes.

Definition 1. Let F be a finite set of cardinality q. A code $C \subseteq \mathrm{F}^{\mathrm{N}}$ is called almost affine if it satisfies the following condition for any subset $X \subseteq N$

$$r(X) := log_q(|C_X|) \in \mathbb{N}$$

As we can see F from the definition above does not have to be a field. And the condition says that projection to any subset of $[N] := \{1, 2, \dots, n\}$ has an integer dimension. It is easy to verify that any linear code C satisfies this condition, therefore C is an almost affine code and r is called rank function of the code.

The main tool to study linear codes is their matrix representation. For almost affine codes we do not have such tool. But we have generalization of matrices – matroids. There are at least four equivalent definitions of matroids, we proceed with the definition via rank function.

Definition 2. Let E be a finite set called ground set, and r be a function $r: 2^E \mapsto \mathbb{N}$. Then matroid M is a pair (E, r) if r satisfies the following axioms for any $X \subseteq E$ and any $x, y \in E$

$(R_1)\ r(\emptyset) = 0$,

$(R_2)\ r(X) \leq r(X \cup \{x\}) \leq r(X) + 1$,

(R_3) If $r(X \cup \{x\}) = r(X \cup \{y\}) = r(X)$, then

$r(X \cup \{x, y\}) = r(X)$.

It can be shown that the function from definition 1 satisfies the axioms above, and an almost affine code C induces a matroid. If r from definition above satisfies only (R_1) and (R_2) axioms, then a pair (E, r) is a demi-matroid. We continue with the core theorem of the article.

Theorem 1. Let $C_m \subset C_{m-1} \subset \cdots \subset C_1$ be a chain of almost affine codes with respective rank functions $r_m \leq r_{m-1} \leq \cdots \leq r_1$. Then (E, ρ_m) with $\rho_m = \sum_{i=1}^{m} (-1)^{i+1} r_i$ is a demi-matroid.

The prove of this theorem can be found in [6].

Demi-matroids have two types of duality. The dual demi-matroid to a given demi-matroid $M = (E, r)$ is $M^* = (E, r^*)$, where $r^*(X) := r^*(X) = |X| + r(E \setminus X) - r(E)$. The supplement dual demi-matroid to a given one $M = (E, r)$ is $\overline{M} = (E, \overline{r})$, where $\overline{r}(X) := r(E) - r(E \setminus X)$. It is known fact due to [10], that $M^* = (E, r^*)$, $\overline{M} = (E, \overline{r})$ and combination of the two types $\overline{M^*} = (E, \overline{r^*})$ are demi-matroids.

Chains of almost affine codes

In this section we show that for any chain of almost affine codes $C_m \subset C_{m-1} \subset \cdots \subset C_1$ and rank functions $r_m \leq r_{m-1} \leq \cdots \leq r_1$ pairs (E, η_m), (E, θ_m) and (E, π_m) are also demi-matroids with

$$\eta_m := r_m^* - r_{m-1}^* + \cdots + (-1)^{m+1} r_1^*$$
$$\theta_m := \overline{r_1} - \overline{r_2} + \cdots + (-1)^{m+1} \overline{r_m}$$
$$\pi_m := \overline{r_m^*} - \overline{r_{m-1}^*} + \cdots + (-1)^{m+1} \overline{r_1^*}$$

To do so we look at these three functions individually and show that under some circumstances they are equal to ρ^*, $\overline{\rho}$, $\overline{\rho^*}$ or just ρ.

Lemma 1. Let $C_m \subset C_{m-1} \subset \cdots \subset C_1$ be a chain of almost affine codes with respective rank functions $r_m \leq r_{m-1} \leq \cdots \leq r_1$ and $\rho_m := r_1 - r_2 + \cdots + (-1)^{m+1} r_m$ and $\eta_m := r_m^* - r_{m-1}^* + \cdots + (-1)^{m+1} r_1^*$. Then $\eta_m = \rho_m^*$ if m is odd and $\eta_m = \overline{\rho_m}$ if m is even.

Proof. For any $n \in \mathbb{N}_0$ we need to show

$$(*) \quad \begin{cases} \eta_{2n} = \overline{\rho_{2n}} \\ \eta_{2n+1} = \rho_{2n+1}^* \end{cases}$$

The equalities hold with $n = 0$. Assume (*) holds for any $i \leq n$, prove the induction step and show that $\eta_{2n+2} = \overline{\rho_{2n+2}}$ and $\eta_{2n+3} = \rho_{2n+3}^*$. By assumption we have $\eta_{2n+1} = \rho_{2n+1}^*$, notice that $\eta_{2n+2} = r_{2n+2}^* - \eta_{2n+1}$ by definition. Then $\eta_{2n+2} = r_{2n+2}^* - \rho_{2n+1}^*$, so by the definition of the dual we have:

$$\eta_{2n+2}(X) = r_{2n+2}^*(X) - \rho_{2n+1}^*(X)$$
$$= |X| + r_{2n+2}(E - X) - r_{2n+2}(E) - [|X| + \rho_{2n+1}(E - X) - \rho_{2n+1}(E)] =$$
$$= (\rho_{2n+1} - r_{2n+2})(E) - (\rho_{2n+1} - r_{2n+2})(E - X) = \overline{\rho_{2n+2}}(X)$$

Now we look at $\eta_{2n+3} = r_{2n+3}^* - \eta_{2n+2}$, combining with the above we have $\eta_{2n+3} = r_{2n+3}^* - \overline{\rho_{2n+2}}$, so by the definition of the supplement dual we have:

$$\eta_{2n+3}(X) = r_{2n+3}^*(X) - \overline{\rho_{2n+2}}(X)$$
$$= |X| + r_{2n+3}(E - X) - r_{2n+3}(E) - [\rho_{2n+2}(E) - \rho_{2n+2}(E - X)] =$$
$$= |X| + (\rho_{2n+2} + r_{2n+3})(E - X) - (\rho_{2n+2} + r_{2n+3})(E) = \rho_{2n+3}^*(X).$$

Thus, lemma is proven by induction.

Lemma 2. Let $C_m \subset C_{m-1} \subset \cdots \subset C_1$ be a chain of almost affine codes with respective rank functions $r_m \leq r_{m-1} \leq \cdots \leq r_1$ and $\rho_m := r_1 - r_2 + \cdots + (-1)^{m+1} r_m$ and $\theta_m := \overline{r_1} - \overline{r_2} + \cdots + (-1)^{m+1}\overline{r_m}$, then $\theta_m = \overline{\rho_m}$.

Proof.

$$\theta_m(X) = \sum_{i=1}^{m} (-1)^{i+1}\overline{r_i} = \sum_{i=1}^{m} (-1)^{i+1}[r_i(E) - r_i(E \setminus X)] =$$

$$= \sum_{i=1}^{m} (-1)^{i+1} r_i(E) - \sum_{i=1}^{m} (-1)^{i+1} r_i(E \setminus X) = \overline{\rho_m}(X)$$

Before the last lemma we need the fact that $\forall X \subseteq E$ we have $\overline{r^*}(X) = (\overline{r})^*(X) = |X| - r(X)$. Indeed, by definition, we have

$$\overline{r^*}(X) = r^*(E) - r^*(E - X) =$$

$$= |E| + r(\emptyset) - r(E) - [|E| - |X| + r(X) - r(E)] = |X| - r(X)$$

At the same time, we have

$$(\bar{r})^*(X) = |X| + \bar{r}(E - X) - \bar{r}(E) =$$

$$= |X| + r(E) + r(X) - r(E) + r(\emptyset) = |X| - r(X).$$

Lemma 3. Let $C_m \subset C_{m-1} \subset \cdots \subset C_1$ be a chain of almost affine codes with respective rank functions $r_m \leq r_{m-1} \leq \cdots \leq r_1$ and $\rho_m := r_1 - r_2 + \cdots + (-1)^{m+1} r_m$ and $\pi_m := \overline{r_m^*} - \overline{r_{m-1}^*} + \cdots + (-1)^{m+1}\overline{r_1^*}$. Then $\pi_m = \rho_m$ if m is even and $\pi_m = \overline{\rho_m^*}$ if m is odd.

Proof. The proof is similar to the proof of lemma 1.

These three lemmas lead us to the following theorem.

Theorem 2. Let $C_m \subset C_{m-1} \subset \cdots \subset C_1$ be a chain of almost affine codes with respective rank functions $r_m \leq r_{m-1} \leq \cdots \leq r_1$, then the pairs (E, η_m), (E, θ_m) and (E, π_m) are demi-matroids.

Proof. By the theorem 1, $M = (E, \rho_m)$ is a demi-matroid, $M^* = (E, \rho_m^*)$, $\overline{M} = (E, \overline{\rho_m})$ and $\overline{M^*} = (E, \overline{\rho_m}^*)$ are demi-matroids as well. And by the previous lemmas we showed that the pairs (E, η_m), (E, θ_m) and (E, π_m) are

equal to (E, ρ_m^*), $(E, \overline{\rho_m})$, $(E, \overline{\rho_m}^*)$ or (E, ρ_m) depending on the parity of m. Hence, the theorem is proven.

The theorem above is also proven in the article [6], but this prove is different. Applications of duality of chains of almost affine codes can be found in [6], [7] and [10].

Quasi-uniform codes

For proper introduction to quasi-uniform codes one can look at the article [3], where authors introduced these codes via random variable vectors. The simple recap is that quasi-uniform code $C \subseteq \mathbb{Z}^{|E|}$ induces a random variable vector which is distributed uniformly over projection to any $X \subseteq E$. This class of codes does not have rank function r which can be used to construct its matroid. But quasi-uniform codes induce a polymatroids instead.

Definition 3. For a finite set E and h be a real value function $h : 2^E \mapsto \mathbb{R}$, then the pair (E, h) is a polymatroid if h for any $A, B \subseteq E$ satisfies the following axioms:

$(R_1)\ h(\emptyset) = 0$,

$(R_2)\ A \subseteq B \Rightarrow h(A) \leq h(B)$,

$(R_3)\ h(A \cup B) + h(A \cap B) \leq h(A) + h(B)$.

If h satisfies cardinality bound $h(A) \leq |E|$ and $h(A)$ is a non-negative integer, then (E, h) is a matroid. If h from definition above satisfies only (R_1) and (R_2) axioms, then a pair (E, h) is a demi-polymatroid.

Any given quasi-uniform code C induces a polymatroid by defining $h(X) := H(C_X)$, where $H(C_X)$ is the entropy function of the codeword random variable. We conjecture that the chain duality discussed in the previous section holds for chains of quasi-uniform codes with respective demi-polymatroids. Recently it was shown in [8] that similar chain duality holds for rank-metric codes with (n, m)-demi-polymatroids which are the special case of demi-polymatroids. However, the general case is still open.

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THE USE OF A RANKING SYSTEM IN THE SELECTION OF ACID COMPOSITIONS (AC) FOR EFFECTIVE TREATMENT OF THE NEAR-WELLBORE FORMATION ZONE (TWZ)

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Abstract. *This analytical work is based on the methodology and principles of integral assessment and point digitalization of the main eight qualitative and quantitative parameters of acid compositions (AC), characterizing the quality, efficiency and prospects of their use at specific (preselected by experts) development targets confined to the carbonate reservoirs of the Tournaisian, Vereian and Bashkir tiers.*

Keywords: *acid composition, carbonate reservoirs, dissolving capacity, fluid compatibility, ranking.*

Introduction

Selection of optimal formulations of multicomponent acid compositions for various conditions of specific development objects and fields is a relevant and significant topic for solving technological challenges of PJSC "Tatneft". For effective primary acid treatments, an individual selection of acid formulations is required. The expected end results of the work are the ranking and targeted selection of AC recipes for specific horizons of development objects, the creation of a digital library of acid composition recipes. It is planned to integrate the library into the design and automated selection system for AC. The technological goal is to reduce the negative impact of adsorption layers, high-quality contact with the rock, the absence of emulsion and sludge complexes, and intensification of oil production.

Scope: acid methods and technologies TWZ carbonate reservoirs in the fields of PJSC "Tatneft".

The purpose of laboratory studies

The purpose and result of laboratory test studies for the selected eleven ACs based on this scientific approach was the substantiation and selection of the three best acid compositions in terms of a complex of physicochemical properties with reference to a specific geology (lithology) of reservoirs and properties of formation fluids (water, oil).

Materials and methods

Based on this methodological approach, a conceptual scheme for the selection of AC formulations for the digital library of PJSC "Tatneft" has been determined. This scheme is based on the analytical results of large-scale test studies for eleven ACs based on the developed methodology for scoring control parameters and physicochemical properties of acid compositions. The essence of the technique is to translate the absolute values of physical and chemical properties into a ten-point scale, to determine the "significance" of each property with further ranking of the formulations by the highest sum of points. According to the three best ACs in physical and chemical properties with reference to geology and reservoir fluids, a recommendation for well testing is given.

The developed methodological approach is recommended for further detailing, development and generalization of the digital library for new promising ACs, based on the principles of "machine" learning, chemoinformatics and a statistical base for laboratory research with the formation of a design system for new ACs with predetermined physical and chemical properties.

On the basis of the experimental studies carried out, a point ranking of the values of the physical and chemical properties of acid compositions was carried out (tab. 1-3).

For this, the absolute values of physical and chemical properties were converted into a 10-point scale, where $X_{min} = 1$, and $X_{max} = 10$. Values between X_{min} and X_{max} are scored in proportion to the absolute values.

On a five-point scale, the significance of each of the physicochemical properties is determined, depending on their influence on the results of acid treatment, while the base value is 1, the maximum is 5.

For the final point ranking, the sum of the products of significance and points for each acid composition is taken.

The point ranking is based on the degree of importance of physical and chemical indicators, namely, the points of physical and chemical indicators are considered with the following significance:

- 5 – total solubility;
- 4 – compatibility with reservoir oil in the presence of iron ions (sieve analysis);

- 4 – compatibility with reservoir oil (sieve analysis);
- 3 – compatibility with reservoir oil in the presence of iron ions (phase separation);
- 3 – compatibility with reservoir oil (phase separation);
- 2 – surface tension at the border with the hydrocarbon carrier;
- 2 – contact angle of wetting at the boundary with the rock surface;
- 1 – acid corrosion rate.

Statistical processing of the data of physical and chemical indicators was carried out taking into account the regulatory boundaries approved in the technical and technological conditions (TTC):

1) surface tension at the border with the hydrocarbon carrier: 0.10-35.10 mN/m;

2) the contact angle of wetting at the boundary with the surface of the rock: 10.0-30.1°;

3) acid corrosion rate: 0.10-0.31 g/(m^2· h).

Analyzing the data in tables 1-3 according to this principle, choose AC.

Table 1 – *Ballistic ranking of physical and chemical properties for the Tournaisian stage of field № 1 using statistical processing taking into account regulatory requirements (TTC)*

Physiochemical properties	**Recipe № 1**	**Recipe № 2**	**Recipe № 3**	**Recipe № 4**	**Recipe № 5**	**Recipe № 6**	**Recipe № 7**	**Recipe № 8**	**Recipe № 9**	**Recipe № 10**	**Recipe №1 1**	**"Significance"**
Reservoir oil compatibility (phase separation)	9	9	9	8	8	10	6	10	9	10	10	3
Reservoir oil compatibility (sieve analysis)	10	10	10	10	10	10	10	10	10	10	10	4
Compatibility with formation oil in the presence of iron ions (phase separation)	8	8	8	8	8	8	8	10	10	9	9	3
Compatibility with reservoir oil in the presence of iron ions (sieve analysis)	10	10	10	10	10	10	10	10	10	10	10	4

Total solubility	5	10	5	2	1	1	1	7	7	2	1	5
Acid corrosion rate	6	8	6	6	7	7	7	7	6	6	6	1
Surface tension at the interface with a hydrocarbon carrier	9	9	9	9	9	10	10	8	10	9	10	2
Contact angle of wetting at the boundary with the rock surface	4	5	5	7	6	4	7	7	4	9	6	2
Points total	188	217	190	176	170	174	168	212	206	189	180	
Place in the ranking of acidic compounds	6	1	4	8	10	9	11	2	3	5	7	

Figure 1 shows a diagram with the values of the sum of the points of the recipes AC in descending order (tested with oil from the Tournaisian stage of the field № 1).

Figure 1 *– AC recipe sum scores in descending order*

Table 2 *– Ballistic ranking of physical and chemical properties for the Vereya stage of the field № 2 using statistical processing taking into account regulatory requirements (TTC)*

Physiochemical properties	**Recipe № 1**	**Recipe № 2**	**Recipe № 3**	**Recipe № 4**	**Recipe № 5**	**Recipe № 6**	**Recipe № 7**	**Recipe № 8**	**Recipe № 9**	**Recipe № 10**	**Recipe № 11**	**"Significance"**
Reservoir oil compatibility (phase separation)	10	10	9	8	7	6	9	10	9	9	8	3
Reservoir oil compatibility (sieve analysis)	10	10	10	10	10	10	10	10	10	10	10	4
Compatibility with formation oil in the presence of iron ions (phase separation)	10	10	10	8	10	8	10	10	8	10	10	3
Compatibility with reservoir oil in the presence of iron ions (sieve analysis)	10	8	8	7	10	7	6	10	10	10	10	4
Total solubility	5	10	6	3	1	2	3	8	8	2	2	5
Acid corrosion rate	6	8	6	6	7	7	7	7	6	6	6	1
Surface tension at the interface with a hydrocarbon carrier	9	9	9	9	9	10	10	8	10	9	10	2
Contact angle of wetting at the boundary with the rock surface	4	5	5	7	6	4	7	7	4	9	6	2
Points total	197	218	193	169	173	155	177	217	205	189	182	
Place in the ranking of acidic compounds	4	1	5	10	9	11	8	2	3	6	7	

Figure 2 shows a diagram with the values of the sum of the points of the recipes AC in descending order (tested with oil from the Vereisky stage of the field №2).

Figure 2 – *AC recipe sum scores in descending order*

Table 3 – *Ballistic ranking of physical and chemical properties for the Bashkirian stage of the field № 3 using statistical processing taking into account regulatory requirements (TTC)*

Physiochemical properties	**Recipe № 1**	**Recipe № 2**	**Recipe № 3**	**Recipe № 4**	**Recipe № 5**	**Recipe № 6**	**Recipe № 7**	**Recipe № 8**	**Recipe № 9**	**Recipe № 10**	**Recipe № 11**	**"Significance"**
Reservoir oil compatibility (phase separation)	10	10	9	8	7	6	9	10	9	9	8	3
Reservoir oil compatibility (sieve analysis)	10	10	10	10	10	10	10	10	10	10	10	4
Compatibility with formation oil in the presence of iron ions (phase separation)	10	10	10	8	10	8	10	10	8	10	10	3
Compatibility with reservoir oil in the presence of iron ions (sieve analysis)	10	8	8	7	10	7	6	10	10	10	10	4
Total solubility	7	10	10	5	1	1	3	6	4	2	3	5

Acid corrosion rate	6	8	6	6	7	7	7	7	6	6	6	1
Surface tension at the interface with a hydrocarbon carrier	9	9	9	9	9	10	10	8	10	9	10	2
Contact angle of wetting at the boundary with the rock surface	4	5	5	7	6	4	7	7	4	9	6	2
Points total	207	218	213	179	173	150	177	207	185	189	187	
Place in the ranking of acidic compounds	3	1	2	8	10	11	9	4	7	5	6	

Figure 3 shows a diagram with the values of the sum of the AC recipe scores in descending order (tested with oil from the Bashkirian stage of the field № 3).

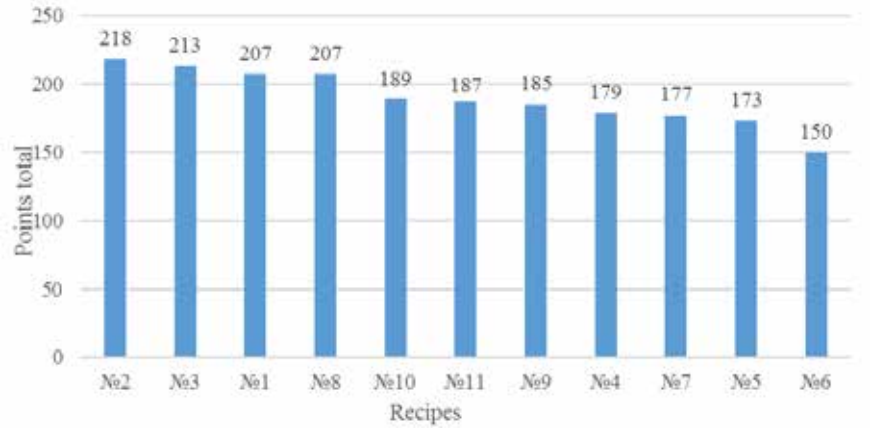

Figure 3 – *AC recipe sum scores in descending order*

Conclusions and recommendations:

1) On the basis of a joint analysis of specialists from the TWZ laboratory and the TWZ department of the UGTM, a method has been developed for a point assessment of the basic physical and chemical properties and parameters of acid compositions and compositions.

2) Statistical processing of the results of a large array of laboratory analyzes was carried out for eight qualitative and quantitative parameters, taking into account their expert significance on a five-point scale of eleven AC.

3) Based on the adopted methodology, an examination of the selected ACs was carried out, which made it possible for the first time to integrally digitize and rank AC, taking into account the peculiarities of the lithology of carbonate reservoirs

and the properties of native fluids of a number of specific objects of development of PJSC "Tatneft".

4) Thus, for the first time on a scientific basis, ranked digitization of AC quality was obtained (three best in terms of integral parameters were identified) with reference to a specific development object (Bashkir, Tourney), which is the beginning of the conceptual scheme for the selection of AC recipes and the development of a digital library at PJSC " Tatneft ".

5) The developed methodological approach is recommended for further detailing, development and generalization of the digital library for new promising ACs, based on the principles of machine learning, chemoinformatics and a statistical base for laboratory research with the formation of a design system for new ACs with predetermined physicochemical properties.

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HYDRODYNAMIC MODEL OF UNSTEADY MOVEMENT OF OIL AND GAS IN THE RESERVOIR-WELL SYSTEM

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Abstract. *A hydrodynamic model of unsteady movement of oil and gas in the reservoir-well system is constructed and solutions to the system of differential equations are given. The obtained analytical formula makes it possible to determine the dynamics of the pressure at the bottom of the well and the productivity of the formation, depending on the parameters of the system. Numerical calculations have been carried out for practical values of the reservoir-well system parameters.*

Keywords: *reservoir-wells, Laplace transform, fluid movement, gas movement, continuity equation.*

Introduction

Gas lifting of liquid from a well is widely used in oil production. The increase in the efficiency of the hoist is of great practical and scientific importance. Despite the fact that a lot of works [1-6] are devoted to this problem, the issue of increasing the efficiency of gas lift taking into account the movement of fluid in the reservoir-well system is still poorly understood. And the movement of fluid during oil production occurs in the reservoir-well system. Therefore, modeling and studying the movement of gas lift fluid in the reservoir-well system is of great practical and scientific importance.

Statement and solution of the problem

Consider plane-radial filtration of a homogeneous fluid in a circular homogeneous reservoir.

The differential equation of the piezoconductivity of a plane-radial fluid flow has the form [7,8]

$$\frac{1}{r}\frac{\partial}{\partial r}\left(\frac{\partial \Delta P}{\partial r}\right)=\frac{1}{\chi}\frac{\partial \Delta P}{\partial t} \qquad r_c \le r \le R_k;\ t>0. \tag{1}$$

where $\Delta P = P_k - P$; $\chi = \dfrac{k}{\mu\beta^*}$;.

Initial and boundary conditions

$$\Delta P\big|_{t=0} = \frac{P_k - P_c(0)}{\ln\dfrac{R_k}{r_c}} \ln\frac{R_k}{r}, \qquad r_c \le r \le R_k; \tag{2}$$

$$\Delta P\big|_{r=R_k} = 0, \qquad t > 0; \tag{3}$$

$$\Delta P\big|_{r=r_c} = P_k - P_c(0), \qquad t > 0 \tag{4}$$

The solution of equation (1) with the initial (2) and boundary conditions (3) and (4) has the form [7,9]

$$\Delta P(r,t) = (P_k - P_c(0))\left[\frac{\ln\left(\dfrac{R_k}{r}\right)}{\ln\left(\dfrac{R_k}{r_c}\right)} \cdot \frac{\Delta P_{cy}}{\Delta P_{c1}} - \pi\sum_{i=1}^{\infty} A(x_\nu \frac{R_k}{r_c}) u\left(x_\nu \frac{r}{r_c}\right) \cdot \exp\left(-\frac{x_\nu^2\, \chi t}{r_c^2}\right)\right] -$$

$$-\int_0^t \dot{P}_c(\tau)\pi\left[\frac{\ln\left(\dfrac{R_k}{r}\right)}{\ln\left(\dfrac{R_k}{r_c}\right)} \cdot \frac{\Delta P_{cy}}{\Delta P_{c1}} - \pi\sum_{i=1}^{\infty} A(x_\nu \frac{R_k}{r_c}) u\left(x_\nu \frac{r}{r_c}\right) \cdot \exp\left(-\frac{x_\nu^2\, \chi(t-\tau)}{r_c^2}\right)\right] d\tau \tag{5}$$

where $\Delta P_{cy} = P_k - P_c(0)$, $P_c(0)$pressure on the borehole wall, at the initial moment of time, $\Delta P_{c1} = P_c(0) - P_{c1}$ differential pressure to which the initial differential ΔP_{cy} decreases, P_{c1} - pressure on the borehole wall at the bottom of the borehole after pressure change $P_c(0)$

$$u_\nu\left(\frac{x_\nu\, r}{r_c}\right) = J_0\left(\frac{x_\nu\, r}{r_c}\right) Y_0\left(\frac{x_\nu\, R_k}{r_c}\right) - Y_0\left(\frac{x_\nu\, r}{r_c}\right) J_0\left(\frac{x_\nu\, R_k}{r_c}\right)$$

x_ν - roots of the transcendental equation

$$J_0\left(\frac{x\, R_k}{r_c}\right) Y_0(x) - J_0(x) Y_0\left(\frac{x\, R_k}{r_c}\right) = 0$$

$$A_\nu\left(x_\nu\frac{R_k}{r_c}\right)=\frac{J_0(x_\nu\frac{R_k}{r_c})J_0(x_\nu)}{J_0^2(x_\nu\frac{R_k}{r_c})-J_0^2(x_\nu)} \tag{6}$$

The fluid flow rate at the moment t through the lateral surface of the well with radius is determined by the formula

$$Q\big|_{r=r_c}=-2\pi r_c h\frac{k}{\mu}\frac{\partial\Delta P}{\partial r}\bigg|_{r=r_c} \tag{7}$$

Then from expression (7) taking into account formula (5), we obtain

$$Q_{смес}(t)=2\pi h\frac{k}{\mu}(P_k-P_c(0))\left(\frac{1}{\ln\left(\frac{R_k}{r_c}\right)}\frac{\Delta P_{cy}}{\Delta P_{c_1}}-2B_\nu\left(x_\nu\frac{R_k}{r_c}\right)\cdot\exp\left(-b_\nu t\right)\right)- \tag{8}$$

$$-2\pi h\frac{k}{\mu}\int_0^t\dot{P}_c(\tau)\left(\frac{1}{\ln\left(\frac{R_k}{r_c}\right)}\frac{\Delta P_{cy}}{\Delta P_{c_1}}-2B_\nu\left(x_\nu\frac{R_k}{r_c}\right)\exp\left(-b_\nu(t-\tau)\right)\right)d\tau.$$

where $B_\nu\left(x_\nu\frac{R_k}{r_c}\right)=\frac{J_0^2\left(x_\nu\frac{R_k}{r_c}\right)}{J_0^2(x_\nu)-J_0^2\left(x_\nu\frac{R_k}{r_c}\right)}, b_\nu=\left(\frac{x_\nu^2\chi}{r_c^2}\right)$

Gas movement in annular space.

Now consider the motion of gas in the annular space. The equations of gas motion in annular space and continuity are described by the equations of I.A. Charny [10,11]

$$-\frac{\partial P}{\partial x}=\frac{\partial Q}{\partial t}+2aQ,\qquad -\frac{\partial P}{\partial t}=c^2\frac{\partial Q}{\partial x},\quad Q=\rho u \tag{9}$$

Differentiating the first equation of expression (9) in the *x*, coordinate, and the second in time *t*, and subtract one from the other and get:

$$\frac{\partial^2 P}{\partial t^2}=c^2\frac{\partial^2 P}{\partial x^2}-2a\frac{\partial P}{\partial t} \tag{10}$$

Having placed the origin of the coordinate axis at the wellhead and directed it downward, for the initial and boundary conditions we will have:

$$P\big|_{t=0} = 0, \quad 0 \le x \le l; \tag{11}$$

$$\left.\frac{\partial P}{\partial t}\right|_{t=0} = 0, \quad 0 \le x \le l; \tag{12}$$

$$P\big|_{x=0} = P_0(t), \quad t > 0; \tag{13}$$

$$P\big|_{x=l} = P_c(0), \quad t > 0. \tag{14}$$

where P_0(t) - gas injection pressure, P_c(t) - bottomhole pressure, c - speed of sound in gas, a - drag coefficient, t time x - coordinate, $Q = \rho u$ - mass flow rate of gas in the flow area of the annular space, ρ - gas density at a given pressure, P - pressure in any cross-section of the annular space.

The solution of equation (10), taking into account the boundary conditions (13) and (14), will be sought in the form [12,13]

$$P = P_0(t) - \frac{P_0(t) - P_c(t)}{l} x + \sum_{i=1}^{\infty} \varphi_i \sin\frac{i\pi x}{l} \tag{15}$$

Substituting expression (15) into equation (10), multiplying both sides of the resulting expression by $\sin\frac{i\pi x}{l}$ and integrating it from 0 to l, we get the equation:

$$\begin{aligned} &\ddot{\varphi}_i + 2a\dot{\varphi}_i + c^2 \frac{i^2\pi^2}{l^2}\varphi_i = -\frac{4a\dot{P}_0(t)}{i\pi} + \frac{4a}{i\pi}(-1)^i \dot{P}_c(t) - \\ &- \ddot{P}_0(t)\frac{2}{i\pi} + \frac{2}{i\pi}(-1)^i \ddot{P}_c(t) \end{aligned} \tag{16}$$

Applying the Laplace transform [14,15] from expression (16) we obtain

$$\begin{aligned} &\overline{\varphi}_i(s) = \frac{S}{(s+a)^2 + \omega_i^2}\varphi_i(0) + \frac{1}{(s+a)^2 + \omega_i^2}\dot{\varphi}_i(0) + \frac{1}{(s+a)^2 + \omega_i^2} 2a\varphi_i(0) + \\ &+ \frac{1}{(s+a)^2 + \omega_i^2}\frac{2}{i\pi}(-1)^i \overline{\ddot{P}}_c + \frac{1}{(s+a)^2 + \omega_i^2}\frac{4a}{i\pi}(-1)^i \overline{\dot{P}}_c - \\ &- \frac{1}{(s+a)^2 + \omega_i^2}\overline{\ddot{P}}_0 \frac{2}{i\pi} - \frac{1}{(s+a)^2 + \omega_i^2}\frac{4a\overline{P}_0}{i\pi} \end{aligned} \tag{17}$$

$\varphi_i(0)$ and $\dot{\varphi}_i(0)$ are determined from expression (15) and have the form

$$\varphi_i(0) = -\frac{2}{\pi}\left[P_0(0) + P_c(0)\right], \qquad \dot{\varphi}_i(0) = 0$$

where $P_0(0)$ and $P_c(0)$ respectively, the initial value of the gas supply pressure P_0(t) and bottomhole pressure P_c(t).

Applying the Laplace transform from expression (15), we obtain

$$\overline{P} = \overline{P_0}(t) - \frac{\overline{P}_0 - \overline{P}_c}{l} x + \sum_{i=1}^{\infty} \overline{\varphi}_i(t) \sin \frac{i\pi x}{l} \tag{18}$$

Substituting expression (17) into formula (18), and the resulting expression into the first equation of system (9) after the Laplace transform, we obtain:

$$\overline{Q}_{газ} = \frac{\overline{P}_0}{l(s+2a)} - \frac{\overline{P}_c}{l(s+2a)} + \sum_{i=1}^{\infty} \frac{\overline{\varphi}_i}{(s+2a)} \cos \frac{i\pi x}{l} + \frac{Q_{газ}(0)}{(s+2a)} \tag{19}$$

where $Q_{газ}(0)$ - initial mass flow rate of gas.

The movement of the gas-liquid mixture in the riser pipe.

The gas supplied through the annular space and the liquid coming from the formation are mixed in the riser string and rises through it. The density of the mixture in this case can be determined by the formula [6]

$$\frac{1+\eta}{\rho_{см}} = \frac{1}{\rho_г} + \frac{\eta}{\rho_н}, \qquad \rho_{см} = \frac{(1+\eta)\rho_н \rho_г}{\rho_н + \eta \rho_г}$$

where $\rho_{см}$, $\rho_н$, $\rho_г$ - respectively, the density of the mixture, oil and gas at a given pressure, η - mass fraction of oil in gas.

In the first approximation, the mixture is assumed to be homogeneous and the interactions between the liquid and gas bubbles are neglected.

Then the equation of motion of the mixture will have the same form as equation (10). By placing the origin of the x_1 coordinate axis at the lower end of the pipe string and directing it upwards for the initial and boundary conditions, we will have

$$P\big|_{t=0} = 0, \quad 0 \le x_1 \le l \tag{20}$$

$$\left.\frac{\partial P}{\partial t}\right|_{t=0} = 0, \quad 0 \le x_1 \le l \tag{21}$$

$$P\big|_{x1=0} = P_c(t), \quad t > 0 \tag{22}$$

$$P\big|_{x1=l} = P_{усm}(t), \quad t > 0 \tag{23}$$

The solution of equation (10), taking into account the boundary conditions (22) and (23), will be sought in the form [9]

$$P = P_c(t) - \frac{P_c - P_{уст}}{l} x_1 + \sum_{i=1}^{\infty} \varphi_{1i} \sin \frac{i\pi x_1}{l} \tag{24}$$

Substituting expression (24) into equation (10), multiplying both sides of the resulting expression by $\sin \frac{i\pi x_1}{l}$ and integrating it from 0 to l, we will have:

$$\ddot{\varphi}_{1i} + 2a\dot{\varphi}_{1i} + c^2 \frac{i^2\pi^2}{l^2}\varphi_{1i} = -\frac{4a\dot{P}_c}{i\pi} + \frac{4a}{i\pi}(-1)^i \dot{P}_{yct} - \\ - \ddot{P}_c \frac{2}{i\pi} + \frac{2}{i\pi}(-1)^i \ddot{P}_{yct} \tag{25}$$

Applying the Laplace transform from expression (24), we obtain

$$\overline{\varphi}_{1i}(s) = \frac{S}{(s+a)^2 + \omega_i^2}\varphi_{1i}(0) + \frac{1}{(s+a)^2 + \omega_i^2}\dot{\varphi}_{1i}(0) + \frac{1}{(s+a)^2 + \omega_i^2} 2a\varphi_{1i}(0) + \\ + \frac{1}{(s+a)^2 + \omega_i^2}\frac{2}{i\pi}(-1)^i \overline{\ddot{P}}_{yct} + \frac{1}{(s+a)^2 + \omega_i^2}\frac{4a}{i\pi}(-1)^i \overline{\dot{P}}_{yct} - \\ - \frac{1}{(s+a)^2 + \omega_i^2}\overline{\ddot{P}}_c \frac{2}{i\pi} - \frac{1}{(s+a)^2 + \omega_i^2}\frac{4a\overline{\dot{P}}_c}{i\pi} \tag{26}$$

$\varphi_{1i}(0)$ and $\dot{\varphi}_{1i}(0)$ are determined from expression (24) taking into account the initial conditions (20) and (21) and have the form

$$\varphi_{1i}(0) = -\frac{2}{\pi}\left[P_c(0) + P_{ycm}(0)\right], \qquad \dot{\varphi}_{1i}(0) = 0$$

where $c^2 \frac{i^2\pi^2}{l^2} - a^2 = \omega_i^2$

Applying the Laplace transform from expression (24), we obtain

$$\overline{P} = \overline{P}_c(t) - \frac{\overline{P}_c - \overline{P}_{yct}}{l} x_1 + \sum_{i=1}^{\infty} \overline{\varphi}_{1i} \sin\frac{i\pi x_1}{l} \tag{27}$$

Substituting formula (27) into the first equation, system (9) after the Laplace transform, we obtain

$$\overline{Q}_{smes} = \frac{\overline{P}_c}{l(s+2a)} - \frac{\overline{P}_{yct}}{l(s+2a)} - \sum_{i=1}^{\infty} \frac{\overline{\varphi}_{1i}}{(s+2a)} \cdot \frac{i\pi}{l} \cos\frac{i\pi x_1}{l} + \frac{Q_{smes}(0)}{(s+2a)} \tag{28}$$

where $Q_{smes}(0)$ - the initial value of the mass flow rate of the mixture.

Continuity conditions

$$f_k Q_{qaz}\Big|_{x=l} + Q_{\phi}\Big|_{r=r_c} = f_T Q_{smes}\Big|_{x_1=0} \tag{29}$$

where f_T and f_k - respectively, the area of the flow section of the pipe string and the annular section. Applying the Laplace transform from expression (29), we obtain

$$f_k \overline{Q}_{qaz}\Big|_{x=l} + \overline{Q}_{\phi}\Big|_{r=r_c} = f_T \overline{Q}_{cм}\Big|_{x_1=0} \tag{30}$$

Substituting expressions (8), (19), and (28) into the continuity condition (30), taking into account only one term of the series in the first approximation, we obtain

$$\overline{P}_c = 2\pi h\rho_{ж}\frac{k}{\mu}\frac{1}{\ln\left(\frac{R_k}{r_c}\right)}\cdot\frac{\Delta P_{cy}^2}{\Delta P_{c1}}(s+2a)(s+b_\nu)((s+a)^2+\omega_i^2)\cdot\frac{1}{s\psi(s)}-$$

$$-4\pi h\frac{k}{\mu}\rho_{ж}B_\nu\left(x_\nu\frac{r_c}{R_k}\right)\cdot\Delta P_{cy}\frac{(s+2a)((s+a)^2+\omega_i^2)}{\psi(s)}+$$

$$+2\pi h\rho_{ж}\frac{k}{\mu}P_c(0)\cdot\frac{1}{\ln\left(\frac{R_k}{r_c}\right)}\cdot\frac{\Delta P_{cy}}{\Delta P_{c1}}(s+2a)(s+b_\nu)((s+a)^2+\omega_i^2)\cdot\frac{1}{s\psi(s)}-$$

$$-4\pi h\frac{k}{\mu}\rho_{ж}B_\nu\left(x_\nu\frac{R_k}{r_c}\right)\cdot P_c(0)\frac{(s+2a)((s+a)^2+\omega_i^2)}{\psi(s)}+$$

$$+\frac{f_k}{l}\cdot(s+b_\nu)\cdot((s+a)^2+\omega_i^2)\cdot\frac{\overline{P_0}}{s\psi(s)}+\frac{f_k}{l}\cdot i\pi\cdot(s+b_\nu)\frac{1}{\psi(s)}\cdot\left[s\varphi_i(0)+\dot{\varphi}_i(0)+\right.$$

$$\left.+2a\varphi_i(0)-\frac{2}{\pi}(sP_c(0)+\dot{P}_c(0))+\frac{4}{\pi}P_c(0)-\frac{2}{\pi}\overline{\ddot{P}}_0-\frac{4a}{\pi}\overline{\dot{P}}_0\right]+$$

$$+\frac{f_kQ_q(0)(s+b_\nu)((s+a)^2+\omega_i^2)}{\psi(s)}+\frac{f_t\overline{P}_{yct}(t)(s+b_\nu)((s+a)^2+\omega_i^2)}{l\cdot\psi(s)}+$$

$$+\frac{f_t\pi(s+b_\nu)}{l\cdot\psi(s)}\cdot\left[s\varphi_{i1}(0)+\dot{\varphi}_{1i}(0)+2a\varphi_{1i}(0)-\frac{2}{\pi}\overline{\ddot{P}}_{yct}-\right.$$

$$\left.-\frac{4}{i\pi}\overline{\dot{P}}_{yct}+\frac{2}{\pi}(sP_c(0)+\dot{P}_c(0)+\frac{4a}{\pi}P_c(0)\right]-\frac{f_tQ_{smes}(0)(s+b_\nu)((s+a)^2+\omega_i^2)}{\psi(s)} \qquad (31)$$

$$\psi(s)=F(s)\cdot\left[(s+a)^2+\omega_i^2\right]+2\frac{f_k}{l}(s+b_\nu)+4a\frac{f_k}{l}(s+b_\nu)s+$$

$$+2\frac{f_t}{l}(s+b_\nu)s^2+4a\frac{f_t}{l}(s+b_\nu)s$$

where,

$$F(s)=2\pi h\rho_{ж}\frac{k}{\mu}\frac{1}{\ln\left(\frac{R_k}{r_c}\right)}\cdot\frac{\Delta P_{cy}}{\Delta P_{c1}}(s+2a)(s+b_\nu)-4\pi h\frac{k}{\mu}\rho_{ж}B_\nu\left(x_\nu\frac{R_k}{r_c}\right)\cdot s\cdot(s+2a)+$$

$$+\frac{f_k}{l}(s+b_\nu)+\frac{f_t}{l}(s+b_\nu)$$

$Q_{см}(0)$ and $Q_г(0)$ are determined from the following formulas

$$Q_{см}(0) = Q_г(0) + \frac{\rho_ж Q_ф(0)}{2\pi r_c h}, \quad Q_ф(0) = 2\pi h \frac{k}{\mu} \frac{P_k - P_c(0)}{\ln \frac{R_k}{r_c}}$$

$$Q_г(0) = \frac{P_0(0) \cdot \exp(g \frac{\rho_{am}}{P_{am}} l) - P_c(0)}{\exp(g \frac{\rho_{am}}{P_{am}} l) - 1} \frac{\rho_{am} g}{2aP_{am}}$$

where ρ_{am} - gas density at atmospheric pressure; g - acceleration of gravity, P_{am} - atmospheric pressure; $Q_ф(0)$ - oil inflow from the reservoir per unit of time at the initial moment of time.

From expression (28), taking into account expressions (26) and (27), one can determine $Q_{см}(t)$.

Conclusion

A hydrodynamic model of unsteady movement of oil and gas in the reservoir-skavazhin system has been built and analytical expressions have been obtained that allow, depending on the parameters of the reservoir-well system, to determine the bottomhole pressure and well productivity.

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PICKLED FRUIT PLATTER OF MEDLAR (MESPILUS GERMANICA L.) AND ROSEHIP (ROSA CANINA L.)

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Abstract. *The common medlar, or Germanic medlar, was grown by the ancient Greeks as early as 700 BC. This plant has been cultivated in the Caspian regions of Azerbaijan for 3000 years. In the folk medicine of the Caucasus, unripe fruits and seeds of medlar are used for stomach and intestinal diseases, and an infusion of leaves is used as a gargle for throat diseases. Far behind the times of the ancient Roman period, when it, thanks to its healing properties, was the most important fruit crop. In the 17th and 18th centuries, interest in it gradually declined. And at present, this plant is grown quite rarely, since the prospects for its cultivation are not clear enough. This is largely due to the almost complete lack of industrial methods of processing the fruits of this specific plant. The development of methods suitable for processing the fruits of the Germanic medlar can be an incentive for the revival of interest in this culture. This circumstance led to the purpose of this study, which was at least partially to fill in the marked gap.*

Keywords: *Germanic medlar, nutritional value, pickling method.*

1. Introductions

This plant is native to Southwest Asia and Southeast Europe (despite the species epithet) and it was brought to Germany by the Romans. It prefers regions with warm summers and mild winters, sunny dry places and slightly acidic soil.

The fruits of this plant are special, attractive, as in the figure [1, p. 1].

Figure. *Shape and color of the fruit of the common medlar*

In the North Caucasus, the common medlar is usually called "cones" in Russian [1, p.2].

The aroma of medlar fruit is described as rich, wine-like. Fruits contain sugar, organic acids and tannins. Fructose, glucose, and sucrose are identified as the main sugars [2, p. 365]. Fruits contain up to 20 fatty acids (10 saturated and 10 unsaturated) [3, p. 441]. Of the volatile compounds, they contain alcohols, aldehydes, esters, terpenes, and acids, with a total of 32 volatile components [4, p.439].

In cultivated form, the common medlar is sometimes found in the gardens of Georgia, Azerbaijan and the North Caucasus, as well as in the United States and some European countries, especially in Hungary, Yugoslavia, Bulgaria, France and other European countries. In the wild state, it grows throughout the Caucasus, in the Crimea, as well as in Asia Minor and the Balkans.

Medlar has medicinal and dietary properties. Its fruits have a strengthening effect on the walls of the intestinal canal and stomach and have a positive effect in the treatment of intestinal catarrh. However, the medlar fruit can only be used fresh for 50-60 days.

In Azerbaijan, you can sometimes find marinated medlar on wedding tables as a snack for alcoholic beverages. It is delivered by private individuals without accompanying documents and therefore passes the test only for the taste, which is excessively sour.

We considered that obtaining a marinade from medlar fruits is a good clue for expanding the processing of this almost "forgotten" type of horticultural and medicinal raw materials. And we set ourselves the task of obtaining a slightly acidic marinade and increasing its biological value, given that medlar fruits are so rich in organic acids, and ascorbic acid is poorly represented in them.

2. 3. Theory /calculation

As an effective direction, we chose the previously tested method of designing multicomponent food systems based on the relationships between physical and chemical characteristics using food combinatorics [5, p.2].

3. Research methods.

Cultivated medlar fruits were collected for three years from the same trees on the farm of one of the local farmers. The fruits of the wild medlar with a relatively smaller size were bought at the market in Guba from the same harvester of forest fruits and berries.

It was meant that in the future, the raw material for industrial processing can be not only the fruits of cultivated medlar, but also wild. Wild medlar is widely distributed along with wild pomegranate and quince in the Lenkaran-Astara region of Azerbaijan. Some of the varieties of medlar cultivated here have such names as "Xan ezgili", "Nəlbəki", "Kitil", "Aghezgil", "Arkivanezgil". According to academician P. M. Zhukovsky [according to M. Musaev, 7, p. 141], the medlar was

cultivated by the inhabitants of the Caucasus, especially in the above-mentioned region.

As the fruits used in the preparation of the marinade, in addition to the fruits of wild and cultivated medlar, the fruits of various forms of dogwood (Cornusmas L.), hawthorn (Crataegus oxyacantha L.,) and dog rose (Rosa canina L.), widely distributed in the vicinity of Guba, were also tested. For this purpose, taking into account the preliminary assessment of the food-tasting advantages of the marinade samples, fresh dog rose (Rosa canina L.) fruits were selected. The choice of the optimal recipe was made taking into account the opinion of the tasters and on the basis of the chemical composition of the laboratory samples of the marinade.

The primary task was to choose the optimal time for processing the fruit, given that during the harvest, the medlar fruits are hard, and the aged softened fruits are delivered to the market.

This issue is partially covered in the scientific literature.

During harvesting, the medlar fruits were hard with a diameter of 24.4-27.8 mm and a weight of 14.2 to 17.4 g. Later they became soft (when storing the fruits in the refrigerator, softening occurs after a few months). During the post-harvest storage period until their full maturation, they decreased in diameter by 12.8 %, and in weight-by 23.4 %. Softening was accompanied by a decrease in the content of soluble solids and titratable acids [6, p.80].

The study of the chemical composition of the fruits of the German medlar after 134, 144, 154, 164 and 174 days after the full flowering of the plant showed that the content of ascorbic acid in them, the total amount of phenolic compounds decreased along with the deepening of the ripening time. During the same period, their total antioxidant activity decreased, and the concentration of trace elements and macronutrients (phosphorus and sodium) increased. The decrease in the total antioxidant activity occurred together with a decrease in the content of ascorbic acid and the amount of polyphenols, which in itself is evidence that ascorbic acid and polyphenols play a leading role in the formation of the total antioxidant activity of the fruits of the common medlar [5. p.79].

4. Results.

Immature fruits are dirty green in color, after maturing they acquire their characteristic cover color and maximum size and become reddish with yellow or brownish, about 2-3 cm in diameter with five seeds in a hard shell.

Table 1. *Chemical composition of medlar fruits during their mass collection and after 2 weeks of storage in the air until softening.*

Indicators of chemical composition	Fruit consistency:	
	firm	soft
Water, g/100 g	78.1±0.80	80.3±1.00
Soluble dry substances, °Brix	24.00±0.25	25.00±0.31
Acidity (according to malic acid), g/100 g	1.47±0.02	1.00±0.01
Sucrose, g/100 g	0.00	0.00
Monosaccharides, g/100 g	12.78±0.13	13.34±0.17
Protopektin, g/100 u	1.71±0.02	0.44±
İnstant pektin, g/100 g	0.78±0.008	1.68±0.005
Üater-soluble poliphenols, g/100 g	3.10±0.03	1.00±0.01
Ascorbic acid, mg/100 g	2.94±0.03	1.94±0.02
Sugars-acid index	8.7±0.09	13.3±0.17

Average value of 5 repeated definitions ± SD

As can be seen from Table 1, solid medlar fruits of the period of their mass collection in terms of the concentration of polyphenols and ascorbic acid are higher than softened fruits as a result of their two - week aging in the post-harvest period.

Therefore, the technological experiments included the still solid fruits of medlar.

Some residents of the Gusar district of our republic have long used the method of preserving medlar fruits at home, including washing them, cleaning them with a sharp knife from the sepals and the pointed tip and laying them all the way to the top in glass jars with a wide neck (volume 1, 2 or 3 liters). To them, add fresh sea buckthorn fruits (in the amount of 7-10 pieces), sugar (one teaspoon per liter jar of the product), fill the remaining free space with clean water and seal with nylon lids.

The time of full maturation of the product is determined by the degree of swelling of the medlar fruits in the jar – in the ready-to-use product, the fruits crack from the moisture absorbed in them and the state of the liquid part of the product, which by this time is enriched with soluble pectin diffused into it from the fruits. The maturation period of the product lasts at least two weeks.

Aging is carried out at room temperature for about two weeks. During this time, it acquires a special taste as a result of the fermentation processes occurring in it. As a result of this method, a product of the "fruit in cider" type is obtained with a pleasant refreshing taste, which gives it 2-4 % ethyl alcohol content, almost the same sugar content and an abundant content of organic acids.

This method of preserving medlar has also been tested by us; the results of these tests indicate that the sensory characteristics of this product are mainly determined by its recipe, which is selected quite successfully taking into account its final taste and the need to increase its durability. Therefore, we did not build our own options, since this product is very popular with local Lezgins as it is and corresponds to their ideas about food.

In Azerbaijan, as a snack to alcoholic beverages, you can also find marinade and pickles made from medlar fruits at home. They are delivered by private individuals to restaurants, having passed the taste test only.

The chemical composition of these three products is the same as in Table 2 .

As the closest analogue, we chose the method of making pickled fruits, which is described in the special literature [8, p. 246].

The essence of this prototype method is that fruits of different types are washed, low-value parts are removed mechanically, placed in glass jars, a component containing sugar, acetic acid and extracts from spices is added, corked and pasteurized.

Table 2. *Chemical composition of processed products of medlar fruit*

Types of canned fuood	Soluble dry substances, °Brix	Simple sugars, g/100 g		Acidity (according to malic acid), g/100 g	Vitamin C, Mg/100 g
		Sucrose	Monosaccharides		
Medlar fruit marinade	23.0±0.6	2.98±0.08	15.21±0.40	1.1±0.03	3.17±0.08
Soaked medlar fruit	7.0±0.25	0.78±0.03	0.59±0.02	0.60±0.02	1.58±0.06
Medlar pickle	7.0±0.25	0.00	0.47±0.02	0.53±0.02	1.58±0.07

Average value of 5 repeated definitions ± SD

Depending on the content of acetic acid in this way get:

Acidic marinades from grapes, cherries, dogwood, gooseberries, plums and currants with acetic acid content of 0.2 – 0.4 %; slightly acidic marinades from pears and apples with the content of acetic acid 0.41 – 0.60 %; sour pickles from grapes, plums and pumpkins with the content of acetic acid 0.61 – 0.80 %; disinfectants with the content of acetic acid of 0.41 – 0.80 percent .

Experiments were conducted on the preparation of a marinade from medlar fruits, which showed that with such a recipe, the product turns out to be too acidic in taste and low in vitamin C.

It should be noted that the low content of vitamin C and other vitamins is not only a disadvantage of this product. This disadvantage is typical for almost all

canned products produced today. Nutritionists recommend enriching canned food with biologically active additives of plant origin in order to avoid this disadvantage.

Table 3. *The chemical composition of the fruits of wild and cultivated German medlar and the marinades obtained from them by known and proposed methods*

Object of analisis	Soluble dry substances, °Brix	Simple sugars, g/100 g		Acidity, g/100 g	P-active phenols, mg/100 g	Vitamin C, mg/100 g
		Моно-сахариды	Сахароза			
Wild medlar fruit	22.3±0.25	0.46±0.01	14.04±0.16	1.37±0.02	830.0±	8.94±9.30
Marinade of wild medlar (according to the prototipe method).	21.8±0.50	2.44±0.06	14.14±0.33	1.54±0.04	300.0±6.88	3.87±0.09
Marinade of wild medlar and rosehip fruits (according to the proposed method).	22.1±0.60	1.52±0.04	14.30±0.39	1.00±0.03	400.0±10.86	36.4±0.99
Fruits of the cultivated medlar	23.7±0.25	1.45±0.02	14.26±0.15	0.65±0.01	620.0±6.54	6.4±0.07
Marinade of cultivated medlar (according to the prototype method).	22.0±0.55	2.34±0.06	14.76±0.37	1.12±0.03	250.0±6.25	3.52±0.09
Marrinade of cultivated medlar and rosehip (according to the proposed method).	22.7±0.60	1.76±0.05	14.96±0.40	0.60±0.02	300.0±7.93	29.92±0.79

Average value of 5 repeated definitions ± SD

To meet the requirements of modern science for healthy food made from fresh fruits, healthy food products must be free from these disadvantages.

For this purpose, the recipe of the marinade of assorted medlar fruits and dog rose fruits, which ripen at the same time, was selected. Table 3 shows that this significantly enriched the marinade with vitamin C and P-active polyphenols, as well as slightly reduced its overall acidity (by reducing the amount of acetic acid used).

The proposed method is patented [9, p. 2] and is carried out as follows.

Example 1.

In obtaining a new type of marinade, fresh fruits of cultivated medlar and dog rose with the following *characteristics are used*:

Medlar -width 32.77 mm, height 31.78 mm, weight 16.3 g;

Rosehip - width 18.0 mm, height 23.1 mm, weight 3.0 g.

Initial data for a glass jar 1-82-500 (capacity 500 cm3; diameter of the corolla neck 82 mm; height 118 mm; weight 240 g): net weight of the product 559.6 g; percentage ratio between medlar and rosehip fruits and filling 55.4 – 8.9 – 35.7.

Recipe bookmarks for 559.6 g of the finished product: fruits of cultivated medlar 310 g; dog rose 49.6 g; filling 200 g.

Mature (but not softened) fruits of cultivated common medlar and dog rose are first inspected for quality, washed, sorted by size, cleaned from pedicels and sepals by mechanical means, then put them in glass jars with a capacity of 500 cm^3. Put in cans of 310 g of medlar and in the free spaces between them-49.6 g of rosehip fruits. Cans filled with fruit are served to the filling filler. Add 200 g of filling to each jar (with a filler), put tin lacquered lids on their necks, roll them up with a seaming device and pasteurize them for 15 minutes at a temperature of 85^0 C, taking 15 minutes for heating and the same time for cooling.

Before use, store at least two weeks to impregnate the fruit and establish the same taste over the entire mass of the fruit filler.

The preparation of the filling includes three operations: preparation of the spice extract; preparation of sugar syrup; mixing sugar syrup with acetic acid and extract from spices.

The technology of extraction from spices for 559.6 kg of the product (with the above initial characteristics) consists in the fact that a mixture of spices in the composition of cinnamon 0.25 kg, cloves 0.10 kg, allspice 0.115 kg is poured 49 liters of water and brought to a boil. After that, the solution is kept for 12-24 hours in a hermetically sealed vessel. Then the contents are reheated to a boil and cooled, after which they are filtered through a cloth filter. The mass of the filtered hood should be 44.8 kg.

To prepare sugar syrup, pre-sifted sugar is weighed in an amount of 40 kg and loaded into a boiler, 113.6 liters of water is added, dissolved with stirring, brought to a boil and boiled for 2-3 minutes, then filtered through a linen filter. To the filtrate, add 1.6 kg of acetic acid (in terms of 80 %).

Mix sugar syrup with a spice extract immediately before packaging. To the acidified syrup, add a pre-prepared extract of spices in the amount of 44.8 kg and water in the amount necessary to bring the filling mass to 200 kg.

Example 2.

In obtaining a new type of marinade, fresh fruits of wild medlar and dog rose are used with the following *characteristics* are used:

Medlar-width 25.60 mm, height 26.60 mm, weight 11.0 g;

Rosehip-width 14.0 mm, height 17.8 mm, weight 1.3 g.

Initial data for a glass jar 1-82-500 (capacity of 500 cm3, diameter of the corolla neck 82 mm, height 118 mm; weight of 240 g): net weight of the product is 568.0 g; the percentage ratio between medlar and rosehip fruits and filling is 52.8 -8.5 - 38.7.

The recipe of the bookmark for 559.6 g of the finished product: fruits of cultivated medlar 300 g; dog rose 48.0 g; filling 220 g.

Mature (but not softened) fruits of cultivated common medlar and dog rose are first inspected for quality, washed in washing machines, sorted by size using calibration machines, cleaned from pedicels and sepals by mechanical means, then laid in glass jars with a capacity of 500 cm^3. Lay 300 g of medlar and in the free spaces between them – 48.0 g of rosehip fruits. Cans filled with fruit are served to the filling filler. Add 220 g of filling to each jar (with a filler), put tin lacquered lids on their necks, roll them up with a seaming device and pasteurize them for 15 minutes at a temperature of 85^0 C, taking 15 minutes for heating and the same time for cooling.

Before use, store at least two weeks to impregnate the fruit and establish the same taste over the entire mass of the fruit filler.

The preparation of the filling includes three operations: preparation of the spice extract; preparation of sugar syrup; mixing sugar syrup with acetic acid and extract from spices.

The technology of extraction from spices for 568.0 kg of product from the fruits of cultivated medlar and dog rose (with the above characteristics) consists in the fact that a mixture of spices in the composition of cinnamon 0.26 kg, cloves 0.10 kg, allspice 0.12 kg is poured 452 liters of water and brought to a boil. After that, the solution is kept for 12-24 hours in a hermetically sealed vessel. Then the contents are reheated to a boil and cooled, after which they are filtered through a cloth filter. The mass of the filtered hood should be 45.0 kg.

To prepare sugar syrup, pre-sifted sugar is weighed in an amount of 46 kg and loaded into a boiler, 128.0 liters of water is added, dissolved with stirring, brought to a boil and boiled for 2-3 minutes, then filtered through a linen filter. To the filtrate, add 1.6 kg of acetic acid (in terms of 80 %).

Mix sugar syrup with a spice extract immediately before packaging. To the acidified syrup, add a pre-prepared extract of spices in the amount of 45.4 kg and water in the amount necessary to bring the filling mass to 220 kg.

5. Conclusions

The proposed method allows you to use medlar fruits in obtaining a new product for a healthy marinade diet and expand the range of pickled fruits.

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RESEARCH AND PREDICTIVE ASSESSMENT OF METRIC AND TOPOLOGICAL PARAMETERS OF STRUCTURAL AND FUNCTIONAL MODULES IN COMPUTER – AIDED DESIGN SYSTEMS FOR ELECTRONIC MEANS

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Abstract. *The article presents a decision-making system in the field of computer-aided design of electronics - DEM_CAD, which allows the designer to make a predictive assessment of the parameters of modules in the design process; explore the interdependence of metric and topological parameters of modules; make a choice of a basic design solution from a variety of rational alternatives. The main principles of DEM_CAD software development are compatibility, system unity, standardization and the possibility of development. The stages of functioning of the DEM_CAD system are listed. A description of the models for the predictive assessment of metric and topological parameters for modules of electronic computing equipment is given.*

Keywords: *module, design engineering, models, electronic computing equipment module.*

Introduction

Systems-CAD of electronic computing equipment modules (ECE-modules) are a set of software, hardware and technological tools necessary for the automation of design processes [1].

The development of systems for integrated automation of production requires the solution of complex scientific and technical problems associated both with

the development of systems intended for the design and production of specific electronic computing equipment, and with the efficiency of using these systems to solve practical problems within the framework of an integral technology of computer-aided design and production. Integrated systems for the computer-aided design of electronic devices are widely used. Such systems include: CAD-systems (computer-aided design); CAM systems (Computer-aided manufacturing); CAE-systems (computer-aided engineering); decision support systems; training systems.

Purpose of the study – improving the efficiency of using computer-aided design systems for electronic means. The complexity of ECE-modules is increasing and there is a task (problem) to train the designer to understand the relationship of parameters in ECE-modules during design, which is relevant. Solving this problem will optimize the process of designing electronic means.

General information about the DEM_CAD system

The DEM_CAD system, which was developed, allows the designer to carry out a preliminary (predictive) assessment of the parameters of ECE-modules during the design process; to investigate the relationship of the parameters of ECE-modules, their influence on the quality of solution switching and installation tasks; analyze methods for choosing the best – basic solution.

A more detailed description of the DEM_CAD system is presented in [2].

The principles of DEM_CAD software development are compatibility, system unity, standardization and the possibility of development.

DEM_CAD system is intended for:

- calculation, assessment and analysis of metric, topological and structural parameters of electronic computing equipment modules;
- investigating relationship for parameters modules depending on the initial conditions;
- choosing basics solution for a module from a variety of alternatives.

The objects of research are the structural and functional modules of electronic computing equipment at the design stage. Figure 1 shows the interface for DEM_CAD.

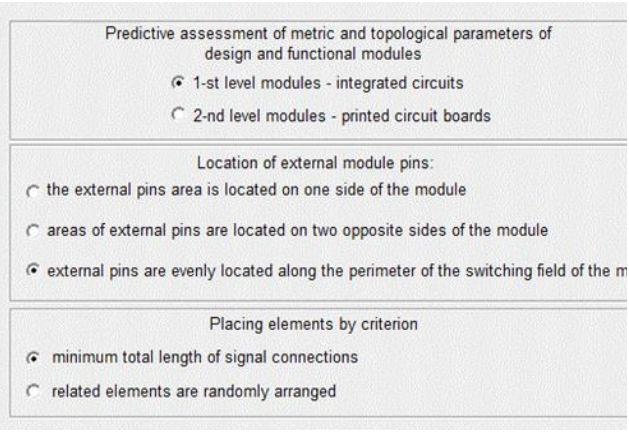

Fig. 1. *DEM_CAD interface.*

DEM_CAD enables the designer to analyze predictive models for metric and topological parameters of a module during development.

Predictive assessment of metric and topological parameters of modules

Here we describe some of the developed mathematical formulas for calculating the parameters of the module during its design, which are used in DEM_CAD.

The model for estimating the average link length based on calculation of the distribution of distances between two random points of a rectangle. Its area is determined by the so-called "average connectivity area" on the switching area of the elements. The area for connectivity elements is area not free elements. The average size of connection is average length two leads of elements, united by one chain of active withdrawal. You can denote it through lav.

When assessing the average bond length, it is advisable to single out two cases of element placement:

1) elements are placed according to the criterion of the minimum total length of links.

2) interconnected elements are located randomly on the switching field.

For the 1-st case, the formula for estimating the average connected area of the elements:

$$S_{av} = \frac{B^2 + (1 + n_x n_y)B - 2n_x n_y}{2B - 2}, \quad (1)$$

where: B is the coefficient of connectivity of the elements; n_x and n_y are number elements on X and Y axes.

For the 2nd case - the formula for calculating the average area of connectivity:

$$S_{av} = \frac{B + n_x n_y + 1}{2}, \quad (2)$$

Let the average connected area of the elements have the shape of a rectangle with sides proportional to the size of the commutation field along the X and Y axes. If we denote by L_x the side of the rectangle on X, through L_y - on Y, then:

$$L_x = \sqrt{\frac{S_{av} n_x}{n_y}} t_x \,, L_y = \sqrt{\frac{S_{av} n_y}{n_x}} t_y \,, \quad (3)$$

where: t_x and t_y are the step of the arrangement of the elements on X and Y, respectively.

The l_{av} is determined taking into account (3) by the formula:

$$l_{av} = l_{avx} + l_{avy} = \frac{P_{xy}}{3} = \left(\sqrt{\frac{S_{av} n_x}{n_y}} t_x + \sqrt{\frac{S_{av} n_y}{n_x}} t_y \right) / 3 \,, \quad (4)$$

where: $\boldsymbol{P_{xy}}$ is half-perimeter of the rectangle under consideration with sides $\boldsymbol{L_x}$, $\boldsymbol{L_y}$.

Estimation of the overall size of semi-perimeters of circuits realization zones:

$$P_{\Sigma} = P_{av} N_s \,, \quad (5)$$

where: P_{av} is the average length of the half-perimeters of the implementation zone of one circuit; N_s is number of circuits in module.

The value of N_s can be calculated as:

$$N_s = \frac{n_x n_y C + V}{n_{av}}, \quad (6)$$

where: C is active leads of one element (average); V is the number of external leads; n_{av} is active pin chain (mediumsize); n_x and n_y are elements along the X, Y.

Estimation of average length of semi perimeters for the zone for realization of one circuit [3]:

$$P_{av} = P_{sx} + P_{sy} = \sqrt{\frac{S_{av} n_x}{n_y}} t_x + \sqrt{\frac{S_{av} n_y}{n_x}} t_y \,, \quad (7)$$

where: P_{sx} and P_{sy} are respectively the size of the zone of implementation of circuit along the X-axis and along the Y-axis; S_{av} is active lead chain size (medium); t_x and t_y are the step of placing elements on X and Y.

Taking into account formulae (5), (6), (7):

$$P_{\Sigma} = \left(\sqrt{\frac{S_{av} n_x}{n_y}} t_x + \sqrt{\frac{S_{av} n_y}{n_x}} t_y \right) \frac{n_x n_y C + V}{n_{av}}. \quad (8)$$

Assessment of the total area of the circuits realization zones can be made as:

$$S_{\Sigma} = S_{\mu} N_s \,, \quad (9)$$

where: S_μ is the average area of the implementation zone of one circuit; N_s is – (6).

Average area of the zone of realization of one chain:

$$S_\mu = P_{sx}P_{sy} = S_{av}t_x t_y, \quad (10)$$

where: P_{sx} and P_{sy} are respectively, the value of the zone of realization of one chain on X, Y; S_{av} is connectivity area of elements (average).

Then by formulas (6) (9), (10) it will be obtained that:

$$S_\Sigma = \frac{S_{av}t_x t_y (n_x n_y C + V)}{n_{av}}. \quad (11)$$

The assessment of the overall dimensions of the module is based on the graph model. This is an undirected weighted multigraph, in which each vertex corresponds to a column or row of elements on the commutation field, and an edge corresponds to the presence of connections between elements of the i-th and j-th columns of the i-th and j-th rows.

Overall dimensions of the structural and functional module can be considered as a function of the number of intersections of signal connections of its vertical and horizontal sections.

The maximum permissible length of a graph edge depends on the average length of the horizontal and vertical components of the inter-element connections and is determined by:

$$l_{max_x} = \sqrt{\frac{S_{av}n_x}{n_y}}, \; l_{max_y} = \sqrt{\frac{S_{av}n_y}{n_x}}, \quad (12)$$

where: S_{av} is area average; n_x and n_y are elements on X, Y (result is rounded to the nearest integer).

The average number of inter-element connections crossing boundaries of one column (row) of matrix of elements, excluding transit connections:

$$V_x = n_s P = n_s(P' + P'') = \frac{N}{n}(P' + P''), \quad (13)$$

where: n_s is number of active circuits of elements in this module; P is probability of crossing the boundaries of a column (row) by a chain of active outputs; P' is probability that the contacts of the circuit of active outputs are at same time both within the given column (row) of elements and outside it; P'' is the probability that the initial and final contacts of the active output circuit are in the same column of the matrix; N is active conclusions; n is active average chain

The number of active pins module:

$$N = n_x n_y C - V_p, \quad (14)$$

where: C is average number of active outputs of one element.

The probability P' in (13) is defined as:

$$P' = 1 - P_1 - P_2 = 1 - \frac{1}{n_x^n} - \frac{(n_x-1)^n}{n_x^n}, \quad (15)$$

where: P_1 and P_2 are respectively, the probability of the location of the contacts of the network of active outputs within the considered column of elements and outside it; n is network of active terminals (average length).

Weight of the graph vertex along the X-axis:

$$V_x = \frac{N}{n}\left[1 - \frac{(n_x-1)^n}{n_x^n} + \frac{1}{n_x^n}\sum_{j=1}^{n_x}\frac{1}{n_x}\left(1 + \sum_{r=1}^{n_x-1} S_r\right)\right], \quad (16)$$

$$S_r = \frac{\cos^{n-1}\frac{\pi r}{n_x}\left[\sin\frac{\pi r j}{n_x} - \sin\frac{\pi r (j-1)^2}{n_x}\right]}{1-\cos\frac{\pi r}{n_x}},$$

where: n_x is number of item columns.

Y-axis:

$$V_y = \frac{N}{n}\left[1 - \frac{(n_y-1)^n}{n_y^n} + \frac{1}{n_y^n}\sum_{j=1}^{n_y}\frac{1}{n_y}\left(1 + \sum_{r=1}^{n_y-1} S_r\right)\right], \quad (17)$$

$$S_r = \frac{\cos^{n-1}\frac{\pi r}{n_y}\left[\sin\frac{\pi r j}{n_y} - \sin\frac{\pi r (j-1)^2}{n_y}\right]}{1-\cos\frac{\pi r}{n_y}},$$

where: n_y is the number of lines of elements on the commutation field.

The calculation of the weight of the edge of the graph along the X and Y-axes is performed using the formulas:

$$T_x = \frac{V_x}{r_x}, T_y = \frac{V_y}{r_y}, \quad (18)$$

where: V_x and V_y are the weight of the graph vertex along the X, Y; r_x, r_y - minimum degree graphs vertex along the X and Y axes.

The number of intersections by inter-element connections of the considered vertical or horizontal section, taking into account (18):

$$Q_{xi} = T_x q_{xi}, \; Q_{yi} = T_y q_{yi}, \quad (19)$$

where: Q_x and Q_y are the number of intersections by inter-element connections of the i-th vertical and horizontal section; T_x, T_y – weight of the rib along the X and Y axes; q_{xi} and q_{yi} are the number of edges intersecting the section under consideration.

Transit connections are connections passing through columns (for vertical sections) or rows (for horizontal sections) of the matrix of elements on the commutation field.

The number of transit connections passing through the column (row) of the matrix of elements:

$$Q_{xi}^{T} = T_x q_{xi}^{T}, Q_{yi}^{T} = T_y q_{yi}^{T}, \quad (20)$$

where: Q^{T}_{xi} and Q^{T}_{yi} are respectively, the number of intersections by inter-element connections of the *i*-th vertical and horizontal transit section; T_x and T_y are weight of the edge of graph on *X*, *Y*; q^{T}_{xi} and q^{T}_{yi} are the number of edges.

When calculating, it is necessary to take into account the influence of the location of the external terminals of the module on the density of conductors in vertical and horizontal sections:

1) area externals terminals is located on one of the sides of the module;

2) external terminals are located on two opposite sides of modules;

3) external outputs are located evenly along the perimeter of module commutation field.

The number of external leads located on the horizontal and vertical sides of the module:

$$V_{lx} = \frac{V_p n_x}{2(n_x+n_y)}, \; V_{ly} = \frac{V_p n_y}{2(n_x+n_y)}, \quad (21)$$

where: V_p is the total number of external pins of the module.

The total length of the bond L_{sum} with reference to formulae (4) and (21) is:

$$L_{sum} = l_{avx}\left(Cn_x n_y + V_p - 1\right) + l_{avy}\left(Cn_y n_x + V_p - 1\right), \quad (22)$$

where: L_{sumx} and L_{sumy} are the length of the *X* and *Y* links.

l_{av} is determined from formula (4), V_p is found from (21). The value of *B* taken into account in (1) or (2).

DEM_CAD allows you to calculate for the module the minimum switching field area required for successful connection tracing.

Minimum permissible size for switching field along the *X* axis is determined by as:

$$Q_x = (a+b)(Q_x^k + n_x C_x H_x + B_{zp}), \quad (23)$$

where: Q_{xk} is number signals connections crossing the horizontal critical section; *a* is permissible signal connection width; *b* is permissible distance between two adjacent signal connections; n_x is elements on *X*; C_x is number of external leads of the element along the *X* axis; H_x is signal connections (number); B_{zp} is signal buses "Ground" and "Power".

Switching field size *Y*-axis:

$$Q_y = (a+b)(Q_y^k + n_y C_y H_y + B_{zp}), \quad (24)$$

where: Q_{yk} is the number of signal connections crossing the horizontal critical section; n_y is the number of elements on *Y*; C_y is the number of external leads of the element on *Y*; H_y is signal connections blocked by one external output of the element.

Considering (12) - (24), the minimum area of the commutation field required for successful routing of connections:

$$S_{min} = Q_x Q_y . \quad (25)$$

How the DEM_CAD system works

The main stages of the DEM_CAD system operation are:

1. Input of initial data.

2. Calculation and assessment of the relationship between the parameters of the structural and functional ECE-module.

3. Formation of a list of rational technical solutions.

4. Ordering solutions, choosing a base solution.

5. Results.

The input parameters that the user specifies are: connectivity coefficient of elements; distance for positioning elements (step) on *X*, *Y*; element (it number) on *X*, *Y*; active output (average); terminal blocking connections on *X*, *Y*; the number of tracing channels blocked by the "Ground" and "Power" buses; step of the signal connections tracing grid; active terminals circuit of an element (average value).

The output (calculated) data are: connections between elements (average length) on *X*, *Y*; the number of external leads of the element - the structural and functional ECE-module; total length of inter-element bonds; overall dimensions of the module commutation field along the *X* and *Y* axes; number interlayer transitions formed when routing signal connections (only for the printed circuit board); lists for technical solutions for ECE-module.

The DEM_CAD system allows you to investigate the relationship between the metric and topological parameters of ECE-module in the process of their design. The designer can plot the dependencies on the parameter that is most important. When building dependencies, only the values of the current parameter are changed. Figure 2 illustrate example of changing the output parameters.

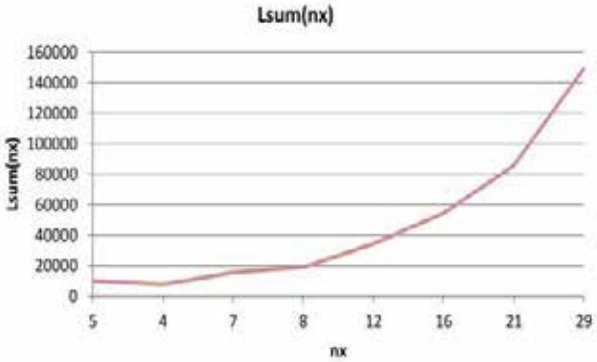

Fig. 2. *Dependence of Lsum on the number of nx elements.*

After evaluating relationship of parameters, DEM_CAD orders the solutions. In this case, the basic solution comes first.

Conclusion

The experimental study has shown the high accuracy of the models for predictive estimation of the parameters of the structural and functional modules of electronic computing equipment.

The developed mathematical apparatus and software can be used in integrated systems for computer-aided design of electronic means. This will increase the efficiency of designing electronic means and reduce the design time of structural and functional modules of electronic computing equipment by an average of 30-55% [2, 4].

The DEM_CAD system can also be used in the educational process for students of technical faculties who study the theory of electronic design.

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STOCHASTIC MODELLING FOR EVOLUTION OF GLOBULAR STAR CLUSTER OMEGA CENTAURI

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Abstract. *The preliminary stochastic model for the evolution of the globular star cluster NGC 5139 is presented, including technique to simulate ecosystems associated with parent stars based on terrestrial exoplanets. The approach is based on the Monte Carlo method using generation of the rate of star formation in discrete time intervals in accordance with the available data on the prevalence of spectral classes of stars within the modeling area. A mechanism for recursive correction of the star formation rates based on the comparison of the model structure with astronomical data has been developed. The equation of convolution functions for birth and death of stars with ecosystems passing through cosmological filters in connection with a composition of the nearest stars in the tetrahedral network is introduced. The proposed stochastic model can be used to evaluate the transmissions between technospheres in habitable zones of cluster. The transportation or signal propagation along the edges of the tetramesh is an alternative method compared to the Landis approach based on percolation theory for the numerical solution of the Fermi paradox. The Delaunay 4D mesh and Voronoi's mosaic can be used to outline the location hulls of cluster regions with biosignatures where technospheres are likely in state of communicative phases and may be detected by SETI programs.*

Keywords: *stochastic model, globular cluster, star evolution, convolution equation, spectral class, Delaunay tetrahedralization, Voronoi mosaic, SETI, biosignature.*

Introduction

Star Cluster NGC 5139 Omega Centauri is the largest in our Galaxy, the brightest and most massive globular cluster known. It is 15000 ly distant from Earth, making it one of the closest clusters. The cluster is about 150 ly across and includes about 10^7 stars, the mass of the cluster is $5 \cdot 10^6 M_\odot$. The density near the center of the cluster is about $2 \cdot 10^3 M_\odot / pc^3$. Most of the stars are main

sequence stars in the Hertzsprung-Russell diagram. There are a number of red giants - stars in the final stages of evolution. Recently radio pulsars have been found in the center of the cluster.

To evaluate planetary products and astrobiological aspects of evolution with the well-known energy classification of cosmic civilizations by Kardashev H.C. [2] we are using also the next classification based on communicative opportunities of possibile intelligent life signatures inside the boarders of their planet Ns – noosphere, in the star planetosphere Ts – technosphere, in interstellar space inside the volume of the Galaxy Gs - galosphere and in the metagalaxy or in the universe Ms - metasphere. These characteristics are also taken into account as probabilistic parameters in the model of cluster evolution based on the stochastic approach using the Monte Carlo method, Markov chains [1], and the equation for the convolution of the birth and death functions of stars.

Purpose of the study – to establish the stochastic evolutionary model of globular star cluster NGC 5139 in connection with the star formation rates and spectral composition of the population throughout the lifetime of the cluster. One of the favorable features of the Omega Centauri cluster is that the stars in it consist of main-sequence spectral types and have different ages and metallicities, while in most clusters they form almost simultaneously and practically do not differ in chemical composition. The stars in the cluster are generally up to 10 Gyr in age, that is, they were not formed uniformly but during at least two bursts of star formation. Taking into account the peculiarities of the object Fig. 1 shows a block diagram of stochastic modeling.

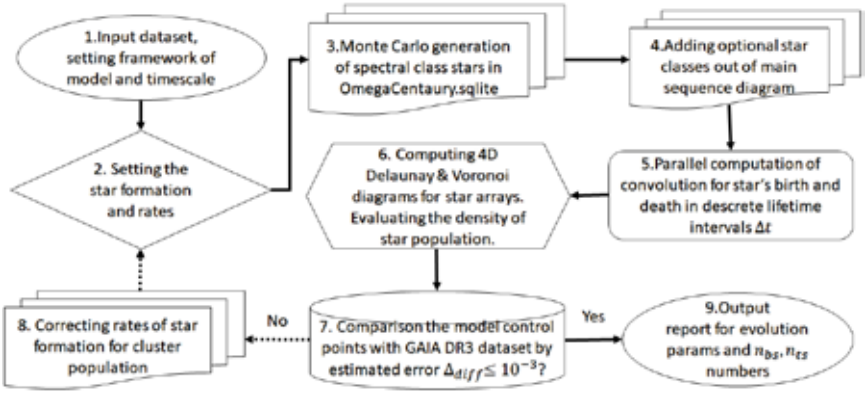

Fig.1. *Block diagram of stochastic evolution modeling star cluster NGC 5139*

An important point is setting the rate of star formation, SFR. If the Milky Way is currently forming up to $10M_{\odot}$ masses of the Sun per year and 10^{7} per 0.1 Gyr, then in the globular cluster NGC 5139, the activity of star formation is about 5 orders of magnitude less intense. As a first approximation, the model uses a uniform distribution over time intervals. Stellar dynamics based on taking into account gravitational forces using the N-body method [4] and the kinetics of fragmentation of gas clouds during compaction of matter can be included in the model to increase the detail of the evolution of the cluster at all stages of its formation.

Materials and methods

The GAIA mission data release (DR3) provides the positions and mean proper motions for $> 10^{9}$ and more then 150 Milky Way globular clusters with a typical uncertainty of 0.05 mas yr −1 limited systematic errors. We use also some variants of Monte Carlo Markov Chain (MCMC) technique and common parameters from [5]. Table 1 shows the initial initialization settings for the stochastic model.

Table 1. *Initialization parameters of the stochastic model*

Spectral star class	Star formation rate n_s / 0.1 Gyr	Fraction, units	Lifetime, Gyr
O	10^{3}	0.00001	0.01
B	$2 \cdot 10^{3}$	0.00109	0.10
A	$5 \cdot 10^{3}$	0.0519	1.00
F	10^{4}	0.037	3.50
G	$2 \cdot 10^{4}$	0.06	10.0
K	$4 \cdot 10^{4}$	0.12	50.0
M	$6 \cdot 10^{4}$	0.73	200.0

The algorithm for simulating the evolution of the globular cluster includes:

Step 1. Setting the number of stars in a representative sample of input data $N_s = 10^{7}$. The modeling area is a sphere with a diameter of 150 light years with a given distribution of stars, chosen depending on the generation method. To record and store dataset the OmegaCentauri.sqlite tables of SQLite data base is implemented.

Step 2. The coordinates within the framework of the model and the spectral class of the main sequence stars are set using the Monte Carlo method. Non-main sequence star types for classes W, L, T, Y, C, S and D may be generated optionally. The lifetime of stars is installed in relative units within each spectral class.

Cluster age is installed in the range from 0 to 10 Gyr. In the population, 20% of stars are considered binaries and triples in different proportion.

Step 3. After the end of the life span of stars in classes O, B, A, F, G, new stars of one of the spectral types are generated in a random position or, in the case of the third generation, at a distance of one light year from the previous position to maintain a constant number and density in generations of stars. The processes of the formation of new stars from gas-dust clouds and stellar dynamics in the model are partially taken in account by according to the data of their own velocities. The probabilities of transition from blue giants to red supergiants or from blue giants to red giants and so on with a relatively short lifetime can be taken into account as optional parameters.

Step 4. Stars of all classes except O, upon reaching the age $T_s \geq 0.1\ Gyr$ form planetospheres with the probability $P_{ps} \sim 1$, stars of all classes, except for O and B, with an age exceeding $T_s \geq 1\ Gyr$ can have planets with lithospheres (with an earth-similarity index $PHI \geq 0.7$) with a probability $P_{ls} = 0.4$.

Step 5. Stars of classes F, G, K, M at age $T_s \geq 3\ Gyr$ can form earth-like planets with biospheres with probability $P_{bs} = 0.3$. The lifetime of stars of the K and M classes is much longer than the entire age of the cluster.

Step 6. Stars of classes G, K, M with age exceeding T_s≥4 Gyr can have earth-like planets with noospheres with probability P_ns = 0.2. , and stars of classes G, K, M with age exceeding T_s≥4.5 Gyr with probability P_ns = 0.1 can have Earth-like exoplanets with technospheres

Step 7. The marking of stars with lithospheres, biospheres, noospheres and technospheres is performed in the database tables in accordance with the established probabilities.

Step 8. Construction of Delaunay grid diagrams and Voronoi mosaics to compare options for a) isotropic transmission of communication signals and b) transmission of SETI messages with signal amplifiers and repeaters located at the nodes of the tetrahedral network.

Step 9. Calculation of integral values according to the discrete equation of convolution of the birth and death functions of the population of stars and statistical indicators of the expansion of the search to the peripheral regions of the cluster.

When constructing grid models of DT / VD stellar arrays, Delaunay tetrahedralization and Voronoi diagram, the TetGen grid generator is used [10]. In the calculation of the local cosmic filter of evolution φ (s, t), the data on the nearest neighbors of each star, their spectral classes, are determined by the tetrahedral Delaunay network. After comparing the model with the actual data on the spectral classes of the cluster, there is also a change in the Markov chain of transition probabilities and a restructuring of the star formation rate over discrete time periods.

Based on the available data that the composition of the stars of the observed

cluster NGC 5139 is close to the ones of the stars of the main sequence of the Milky Way, it is possible to estimate the probability of the formation of planetospheres and exoplanets in the habitable zones of stars. Random processes η (t) are taken into account by specifying the values of the Markov chain in the form of star formation intensity rates for the evolution intervals. The resulting convolution of the functions η (s, t) of creation and death of stars for the discrete case was taken in the following form

$$\eta(s,t) = g \otimes f = \sum_{\lambda=\lambda_0}^{S} \sum_{\tau=\tau_0}^{T} g(\lambda,\tau) \cdot (\psi(\lambda,\tau) \cdot \varphi(s-\lambda, t-\tau)) \qquad (1)$$

where the summation is performed over spectral classes S with characteristic radiation wavelength λ and over time T intervals τ within each time interval. The population density is estimated. Thus for each spectral star class Markov chains of transition probabilities for the stages with planetospheres to ones with metaspheres are specified, as shown in Table 2.

Table 2. *The matrix of markov chains for transition probabilities between stages*

j \ i	O	B	A	F	G	K	M
P_s	p_{Ps}^{O}	p_{Ps}^{B}	p_{Ps}^{A}	p_{Ps}^{F}	p_{Ps}^{G}	p_{Ps}^{K}	p_{Ps}^{M}
L_s	p_{Ls}^{O}	p_{Ls}^{B}	p_{Ls}^{A}	p_{Ls}^{F}	p_{Ls}^{G}	p_{Ls}^{K}	p_{Ls}^{M}
H_s	⊗	p_{Hs}^{B}	p_{Hs}^{A}	p_{Hs}^{F}	p_{Hs}^{G}	p_{Hs}^{K}	p_{Hs}^{M}
B_s	-	⊗	p_{Bs}^{A}	p_{Bs}^{F}	p_{Bs}^{G}	p_{Bs}^{K}	p_{Bs}^{M}
N_s	-	-	⊗	p_{Ns}^{F}	p_{Ns}^{G}	p_{Ns}^{K}	p_{Ns}^{M}
T_s	-	-	-	⊗	p_{Ts}^{G}	p_{Ts}^{K}	p_{Ts}^{M}
G_s	-	-	-	-	⊗	p_{Gs}^{K}	p_{Gs}^{M}
M_s	-	-	-	-	-	⊗	p_{Ms}^{M}

In the table 2 there are O, B, A, F, G, K, M – spectral classes of stars; $P_s, L_s, H_s, B_s, N_s, T_s, G_s, M_s$ – stages of stars with namely planetospheres, lithospheres, hydrospheres, biospheres, noospheres, technospheres, galosphere and metaspheres correspondingly; p_{Bc}^{A} - transition probabilities between one stage and another. ⊗ - the cell with Great Filter of life evolution. An illustration of the Markov chain in the form of graph for evolutionary stages for stars of spectral class M is shown on Fig. 2.

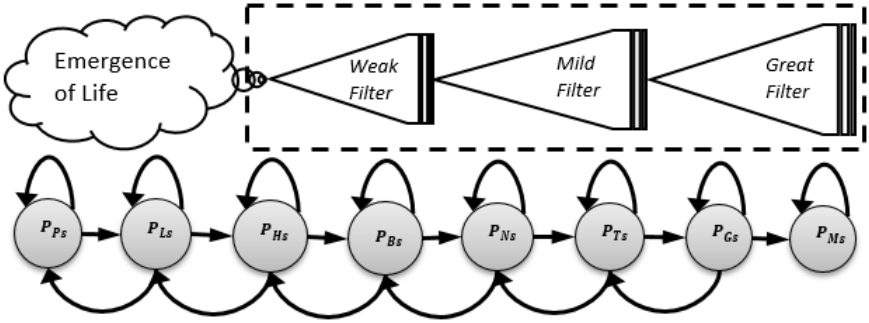

Fig.2. *The graph of Markov chain for transition probabilities between stages of parent stars and filters of life evolution*

The nearest neighbors are determined by the tetrahedral network of the Delaunay diagram. Expansion is possible to stars of classes F, G, K, M if they have formed planets with lithospheres. Short-lived blue giants, pulsars, magnetars, red giants like Aldebaran, and supergiants like Betelgeuse are not suitable for inclusion in the sphere of influence. In contrast to the Landis percolation model [6], the colonization process is modeled using the Delaunay tetrahedral stellar grid, rather than a two-dimensional grid of cells.

To simulate expansion, transport and colonization, the probability of the expansion of technospheres and metaspheres to neighboring stars is set with the conditional probability P_ex = 0.1 per unit time. The movements are limited by the speed of light and can take place along the optimal paths along the edges of the tetrahedral grid for bypassing areas with dangerous objects of the Galaxy. When the N-body stellar dynamics mechanism is included in the model [4], the effect of the global ψ (λ, τ) and local φ (λ, τ) filters of the φ (s, t) evolution can be enhanced by increasing the probability of collisions of stars and ejection from the system or destabilization of planetospheres in the central regions of the cluster.

The habitable zone of the SHZ cluster is not assessed as such, but for all stars the average distance between them should be at least $D_{pair} \geq 0.1ly$, otherwise, the formation of planetospheres around this pair of stars is an unlikely event. Delaunay tetrahedral networks and polyhedral networks of Voronoi mosaics are constructed using the TetGen mesh generator (https://wias-berlin.de/software/tetgen/index.html) as a whole for the entire set of stars, including stars outside the main sequence of the Hertzsprung-Russell diagram and separately for each spectral class. It is assumed that if a higher probability of the formation of technospheres in K-class stars is revealed, the network of communications and transport will develop mainly among stars of this type.

The visualization was performed using the GLScene graphic engine (https://github.com/GLScene/GLScene) with Fermi Paradox Simulator software, where different cadencer components were used to process the discrete age intervals for each spectral class of stars. The color palette for the visual spectral types corresponded to the colors of stars of the Harvard scale to allow comparison of the resulting images of the model and astronomical images obtained with satellite telescopes. Figure 2 shows images of the cluster and the Delaunay tetrahedral network of its central part.

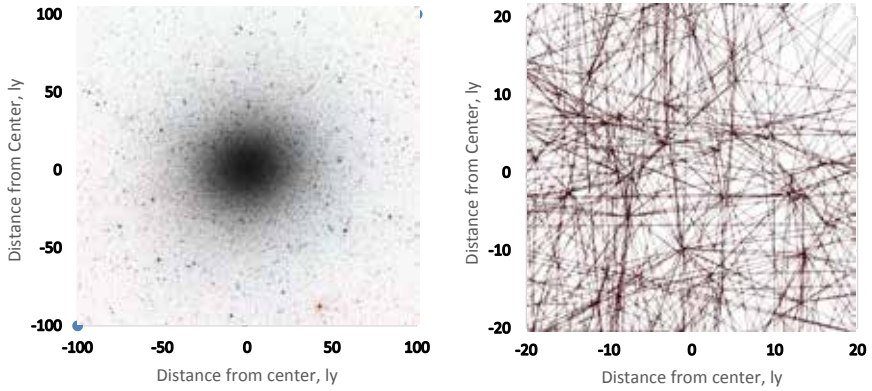

Fig.2. *The globular star cluster Omega Centauri NGC 5139 (left, credit ESO) and Delaunay tetrahedral mesh for G-class stars near central core (right)*

In the center of the cluster, the distance between the stars is about 0.2 ly. When visualizing the evolution of the model in a time period from 0 to 10 Gyr, discrete time intervals of the timer are selected in the range from a millisecond to an hour. Color of glow sprites for stars with clOlive biospheres, clGreen noospheres and clLime technospheres.

The stellar evolution is spawned and closely related to the likelihood of the formation of planetospheres with Earth-like exoplanets. In this regard, to reflect the connection with the spectral types of stars, it is proposed to use the Drake equation [3] in the following modification:

$$n_{ts} = I_{ts} + (N_s - I_{ts}) \cdot f_{GHC} \cdot \sum_{k=O}^{M} \left(P_k^{gr} \cdot P_k^{fl}\right) \cdot \left(p_k^{ps} \cdot p_k^{ls} \cdot p_k^{bs} \cdot p_k^{ns} \cdot p_k^{ts}\right) \qquad (2)$$

where n_{ts} – number of stars with technospheres; I_{ts} – number of technospheres actually known, currently $I_{ts} = 1$; N_s - the number of stars in the cluster is estimated as 10^{7}; f_{GHC} – fraction of stars in a safe zone or outside close proximity;

P_k^{gr} - the abundance of stars of the spectral type; $p_k^{ps}, \ldots, p_k^{ts}$ - the probabilities of the formation of stars of various classes of ecospheres on terrestrial planets with the index $PHL \geq 0.9$; e.g. $p_k^{bs} = \frac{T_k^s - T_{sb}}{T_k^s}$ - the probability of the formation of biospheres, T_k^s – the average stellar class lifetime, T_{sb} – the average time to start bioevolution $\geq 3\ Gyr$; p_k^{ns}, p_k^{ts} - the likelihood of the noospheres and technospheres formations.

Results and discussion

The Monte Carlo method with markov chain matrices and descrete convolution equations for star’s birth and death in different spectral classes the new treatment to solving Fermi paradox was implemented. Parallel computational software project SFPS (Stochastic Fermi Paradox Simulator) has included two evolutional filters for the dynamic convolution as a global cosmological strong $\Psi(s,t)$ and a local planetary weak $\Phi(s,t)$. Markov triangular matrix of transition probabilities in conjunction with $N-body$ and relaxation method could be used for procedural generation of planetary worlds which connected with appropriate spectral star classes. The L / T coefficient of the probability to find a technosphere in the communicative phase, that is, the ratio of the length of the message transmission period to the age of the cluster, is not used, since it is not the total number of technospheres in history that is determined, but their possible number at the current moment. The self-destruction of technospheres or the scenario of space wars are not considered; therefore, the upper optimistic threshold for the growth of the number of semi-potential signal sources is estimated. Figure 3 shows the growth curves of the population of stars at a fixed rate of star formation and the growth curves of ecosystems in the form of biospheres and technospheres associated with parent stars.

To characterize the communication potential of a cluster for SETI, one can use the volumetric W_{vt} coefficient of the prevalence of technospheres in the signal transmission phase. The estimate of the potential W_{vt} – is the ratio of the volume of the cells of the Voronoi mosaic v_{ts} , with active technospheres to the total volume of the network of polyhedra v_s in the Voronoi diagram of the NGC 5139 cluster. Thus, the communication potential to find technospheres in globular cluster Omega Centauri, according to the optimistic scenario is $W_{vt} \sim 10^{-5}$ in the current time interval τ for $N_s \sim 10^7$ stars.

Based on the simulation results, the stochastic model gives an estimate of the number of biospheres in a cluster of almost 18200, while the number of noospheres does not exceed 170 units, and technospheres, presumably, about 7. But if we take into account the possibility of the formation of terrestrial exoplanets in binary and triple systems, then these figures can be higher. If we assume that the radius of reliable registration of bio- and technosignatures by spectroscopic methods is no more than 20 pc, and the range of isotropic signal propagation is not over

50 pc, then it is possible that technospheres of the cluster have established contacts with each other for information exchange.

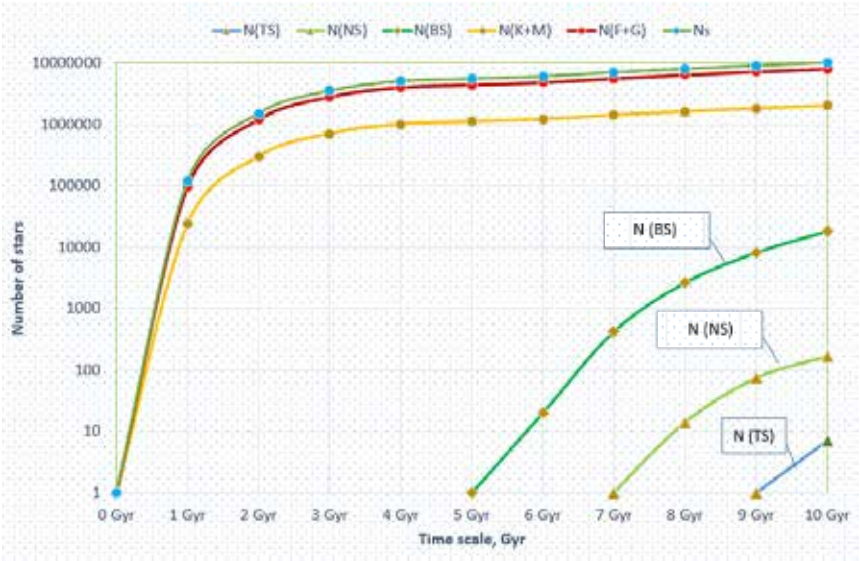

Fig.3. *The star formation rates and associated potential numbers of bio- noo- and technospheres*

Conclusion

In the paper a stochastic approach to simulate star cluster evolution on the base of NGC Omega Centauri is presented. A new approach is outlined to follow the known star locations together with stochastic procedural generations of main-sequence stars for the cluster from the beginning of evolution by a Monte Carlo technique. An advanced convolution function for the birth and death of stars was used in descrete form in accordance with Markov chain matrix of transitive probabilities. The Delaunay 4D tetrahedral meshes and Voronoi mosaics are required to take in account nearest star neighbours and find distances for isotropic transport propagations or network communications with space restrictions. The parallel computational method can be further extended to generate an efficient and realistic models for large star clusters. This results of the simulation of star evolution in the local Solar neighbourhood [9] coud be applied also as alternative to Landis percolation approach to quantify the Fermi paradox. In the article [10] is argued that the factor L as lifetime of communicative civilization in Drake formula [3] is in fact the most important regarding the practical implications SETI, because it de-

termines the maximal extent of the "sphere of influence" of any technological civilization or technospheres in our names. In the described above stochastic model only lifetime L of technospheres is limited by the age of stars of the corresponding spectral classes but not associated and more advanced entities.

In future work the simulator can be verified with a more accurate adjustment of astrobiological parameters and values for the probabilities of the formation of terrestrial exoplanets, both earthlike and superearth ones based upon data processing from ground-based telescopes and new surveys from the mission of GAIA satellite telescope [5]. The probabilistic evaluations for the rates of evolution for biospheres, noospheres and technospheres in more then 150 globular clusters of our Galaxy can represent an additional justification in solving the Fermi paradox [7, 8] by numerical methods, taking into account the metallicity and star types of various spectral classes.

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BIOMETRICS AS A METHOD OF COMBAT WITH COVID-19

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Abstract. *The main purpose of the following work is to study the ways of reducing the spread of COVID-19 and ending the pandemic. The article presents the benefits and drawbacks of biometrics and some examples of its use in different countries.*

Today, biometrics has already become an integral part of the global information technology market and it is used as a convenient and reliable mechanism to ensure information security.

Biometrics is used for identification, authentication, and authorization which are three sequential processes inseparably linked. During identification, we present the system with a unique sample as an identifier, after which the system compares this sample with the template stored in the database, and authentication takes place. If the presented sample matches the template, the user is granted access with a certain set of rights, and authorization occurs.

Keywords: *biometrics, identification, contactless technologies, security, health, COVID-19.*

Introduction

Biometric authentication is a method of authentication based on the presentation of unique biological characteristics of a person: fingerprint, retina or iris of the eye, face geometry, palm shape. Biometric characteristics also include the shape of the ear, body odor, heartbeat, the pattern of veins on the hands, DNA which are also unique biometric identifiers of a particular person. In short, biometric authentication means that your body becomes the key to access.

In practice, biometric authentication methods have been effectively used in many industries including the military, law enforcement, finance, and e-commerce. They are also used by developers of mobile devices and computers as an alternative to password protection. Biometric authentication methods are actively

implemented by banks, providing customer service without presenting a passport, allowing you to link your biometric data to a personal account and make purchases without a bank card or gadget but by face recognition. Facial recognition systems are used in public places, airports, train stations, and they allow law enforcement agencies to fight crime. Biometric data is embedded in electronic passports in many countries around the world.

Today, the issue of switching to contactless technological solutions such as contactless analysis of fingerprints, retinas, voice and behavioral characteristics, and their combination, is particularly acute. Due to these technologies, we can not only verify identity and access many financial, government and other services, pass through airport and railway station security, receive money from ATMs but also protect the health of the population and reduce the risks of COVID-19 spread.

Market experts estimate the global segment of contactless biometric technologies at $6.92 billion in 2019 and forecast an annual growth of 20.3% in the period between 2020 and 2027. A great future for the development of contactless biometrics is seen in the areas of commercial security, public and private sector including the field of payment services.

Benefits

Firstly, it's convenient as the user does not need to remember complex passwords, carry some kind of key card. It is enough to show a finger, eye, ear or face, and access will be obtained. Biometric data is always with you, it is impossible to lose or forget it.

Secondly, biometric data is not as easy as a key or password to steal. At first glance, biometric authentication solves the problem of weak passwords, which according to statistics, 80% of cases are the cause of account hacking.

Thirdly, the use of biometric authentication reduces the likelihood of a virus infection through the PIN pad.

Fourthly, the use of biometric authentication complicates remote hacking. Even knowing the password, an attacker will not be able to gain access to the target system or device if two-factor authentication is configured where biometric data acts as an additional identifier.

Drawbacks

Despite these advantages, biometric authentication methods are associated with certain risks and threats:

Biometric "spoofing". Spoofing is the practice of deceiving a security system by using fake or copied information, particularly biometric information. For example, you can take a picture of a fingerprint from an object and copy it. A fake fingerprint can be used to unlock a mobile device or payment system by allowing attackers to gain access to the user's data and bank account.

Facial recognition systems often used to protect smartphones or tablets are also vulnerable. There are some known cases when the devices protected with their help could be unlocked by simply showing the owner's photo.

Biometrics Application in Different Countries

Sweden

One of the most exciting new areas we are observing is the growing potential of biometric access applications, especially in smart homes and workplaces.

While improving workplace security and remote work has been a long-standing priority for many organizations, the past year has certainly reinforced the need for more secure and convenient access. Biometric access cards with on-card authentication are the examples of increasing security, convenience, and hygiene when entering shared workspaces. Contactless biometric authentication by using the face, iris, or a combination of the two is another convenient means to safely enter buildings and busy hygienic spaces such as hospitals.

Meanwhile, biometric authentication is in high demand as a more convenient and secure authentication method for both consumer and enterprise PCs. The study found that the majority of consumers (66%) are tired of pins and passwords, and 51% would prefer to use biometric data for authentication. By 2026, it is estimated that approximately two-thirds of the 260 million PCs shipped annually will have a touch-sensitive fingerprint sensor.

USA

In early April 2021, it became known that the US Army had been developing a new system of biometric cameras for recognizing the faces of the military. The new software will compare images taken by the camera with a pre-created gallery of approved faces.

The new method will combine a one-to-one identification algorithm to compare a new image with already known photos of a given person, and a one-to-many identification algorithm that compares the resulting image to a broad database in search of a specific person. For army checkpoints, this will be an important factor. The Army intends to introduce the new cameras as a result of working with small businesses as part of a phased development program.

France

Entering 2021, biometric payment cards are no longer beyond the reach, they are actually available with major commercial deployments by French banks BNP Paribas and Crédit Agricole.

The momentum has been steadily gathering pace for several years but it has undoubtedly gained further popularity as a truly contactless, hygienic and secure payment method against the backdrop of current public health measures around the world. Studies show that nowadays a third of consumers when paying in the store are worried about infection from PIN-pads.

Existing biometric technologies

Some of the biometric authentication technologies listed below can be used on a daily basis. Others may be less common. The four most common uses of biometric authentication technology in the modern world are done below:

– Fingerprint recognition uses a person's unique fingerprint to verify their identity. This is one of the most common biometric authentication technologies which is used to protect everything from mobile devices to cars and even buildings.

– Face recognition uses a person's unique facial anatomy to identify them. It is used in a wide variety of places such as smartphones, identity verification for credit card payments, and etc.

– Retinal recognition uses a unique retinal pattern for identification. This type of biometric authentication is more difficult to implement because the scan requires an infrared light source, a camera, that can see infrared radiation and minimal light pollution to ensure accuracy. However, it is one of the most accurate biometric authentication systems available under these conditions. Therefore, it is usually used in situations where security is most important.

– Voice biometrics or voice recognition uses the unique tone and frequency of someone's voice to authenticate them. Today, it is most often used to verify users when they contact a call center for customer support.

New biometric technologies

The two methods of biometric authentication listed below have not been widespread yet, but they are gradually becoming more common:

– Gait recognition allows you to identify a person by the way they walk. Since each person walks a little differently, the way they put one foot in front of the other is an effective way to confirm their identity. We expect gait recognition to become more common in the future as forms of continuous authentication become more popular.

– Vein Recognition: Vein recognition uses a unique pattern of blood vessels on a person's hand (or finger) to identify them. It uses infrared light to map the veins under the skin on the hands or fingers. Vein recognition is extremely accurate, even more accurate than the retina, and it is one of the most advanced biometric identification systems to date.

Conclusion

The field of biometric authentication is promising and rapidly developing, and the number of research and development in this area is growing every year. However, these methods are imperfect and there is always the possibility of errors. It is worth carefully studying all the pros and cons before using biometrics in order to protect your confidential data and money.

The pandemic has given a powerful impetus to the development of contactless technologies including the field of biometric identification. If previously remote

recognition of a person by retina, face geometry, voice, or other unique biometric parameters seemed an unreasonably expensive solution, now consumers are willing to install such systems in order to save the business from much more serious costs inevitable in the case of a mass COVID-19 infection of personnel.

In 2020, equipment and software sales for contactless biometrics began to grow and according to experts, it will last for a long time. Thus, according to Markets and Markets, the global market for facial recognition systems will reach $ 7 billion by 2024 with an average annual growth rate of 16.6%.

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ANALYSIS OF GREEN BUILDING STANDARDS IN RUSSIA AND THE EFFECTIVENESS OF THEIR USE

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Abstract. *Every year the negative impact of construction on the environment is becoming more and more evident. These are: degradation of vegetation cover, waste problem, atmospheric air pollution, as well as a number of other environmental problems. In order to reduce the impact of the construction industry on the ecological situation of cities and to control the impact of construction on the environment various systems of certification of buildings have been created. In this article an analysis of environmental standards, as well as an assessment of the implementation of "green" construction in Russia was made. Based on the findings a number of recommendations have been developed, the implementation of which would increase the number of "green" buildings in our country.*

Keywords: *ecology, construction, green construction, green buildings, environmental safety.*

Introduction

The rapid urbanization of cities, the development of industry and the introduction of new technology in operation have a negative impact on the environment [1]. The construction industry, as one of the leading sectors of the economy in the Russian Federation, is constantly improving and developing, which leads to the introduction of modern construction technologies, as well as the use of the latest materials. Only in St. Petersburg by the end of 2019, 3.47 million m2 of housing was commissioned [2]. However, only a few construction companies care about the environmental safety of the city.

The relevance of this work is that every year in urbanized cities there is a huge number of new implemented construction projects. Due to the high demand for the construction industry in the modern world, it is possible to identify a number

of environmental problems directly related to construction. These include: problems arising during construction (depletion of mineral reserves, degradation of vegetation cover) and problems arising during operation (the problem of waste, atmospheric air pollution, violation of the hydrological regime of the city).

Environmental safety is the state of protection of the natural environment and vital human interests from the possible negative impact of economic and other activities, emergencies of natural and man-made nature and their consequences [3] One of the main directions of environmental safety is environmental control [4]. In order to reduce the impact of the construction industry on the ecological situation of cities and control the impact of construction on the environment various systems of certification of buildings have been created. Buildings certified under these systems are commonly referred to as "green", and the direction of construction involved in the design, construction and commissioning of "green" buildings - "green construction" (green buildings). For the first time this type of construction was applied in the U.S. in the early 70s [5]. This technology is not widespread, but in connection with the official support of environmental movements at the state level at the end of the 20th century construction of houses using environmentally friendly materials has become in high demand. However, in Russia this technology began to be used with a delay.

Purpose of the study – to establish the assessment of the implementation of "green" construction in Russia and the formation of a number of recommendations, the introduction of which would simplify the process of environmental certification and in the future would increase the number of "green" buildings in the country.

Materials and methods

In the course of this work, the environmental standards currently in force in Russia were studied and analyzed. Also, statistical information on the number of green buildings in the country was analyzed and summarized. Generalization and specification of the information received allowed to compile a number of measures, the implementation of which would increase the number of green buildings in Russia.

Results and discussion

All over the world there are various standards governing the "green" construction. At the moment in 24 countries there are 32 standards for assessing the impact of construction and reducing the negative impact on the environment [6]. For example, the Australian standard Green Star, the German standard DGNB and many others. However, when developing and implementing their own standards for assessing the quality of construction, most countries are guided by two international standards LEED and BREAM.

Both BREEAM and LEED carry a lot of weight in the field of green building certification, but each certification system has its own strengths and weaknesses.

Table 1 shows the advantages and disadvantages of each certification system.

Table 1

Advantages and disadvantages of LEED and BREEAM

	Advantages		**Disadvantages**	
	LEED	**BREEAM**	**LEED**	**BREEAM**
1	International promotion system	Ability to adapt the system of standards to the economic realities of different countries	Adapted only to U.S. economic realities	Weak marketing campaign
2	Universal approach to many construction sites	Ability to assess buildings based on its individual characteristics	Relationship of functional purpose with the architectural forms of the object	High cost of obtaining a certificate
3	Based on international Ashrae technical standards	Provides high quality because it is based on British quality standards	High requirements for the execution of documents	Serious requirements that do not allow for deviations

As can be seen from Table 1, the LEED system is most often used to evaluate buildings in the U.S. and other foreign countries because of its adaptation to the economic realities of the United States. Due to the fact that LEED has a unified approach for the evaluation of different types of objects, it is very important to link the functional purpose with the architectural forms of the object, which makes it less flexible than BREEAM. However, due to this there is an opportunity to reduce costs for the developers themselves. BREEAM is a more flexible certification system, due to the possibility of individual assessment of buildings, but due to the weak marketing campaign and high requirements for the assessed objects of construction, it is not as popular as LEED.

In Russia, "green" construction is not regulated by any special regulations, resulting in difficulties even at the design stage of "green" houses. In addition, Russia does not yet have a sufficient number of specialists who would ensure the functioning of all kinds of ecosystems in new houses [7]. In 2009, in our country the "Green Building Council" was created, which at the beginning of its development was responsible for the regulation and evaluation of buildings designed and implemented in the Russian Federation under BREEAM and LEED standards. Subsequently this non-commercial partnership set out to create its own "green building" assessment system, based on the sections in the LEED standards.

As a result of the activities of this working group, in February 2010 the Federal Agency for Technical Regulation and Metrology registered the first Russian national voluntary certification system for real estate - "Green Standards".

Since April 2011 the second, improved version of the System of voluntary certification of real estate objects, "Green Standards" [8].

A comparison of the standards created by the "Green Building Council" and the sections in LEED is shown in Fig. 1.

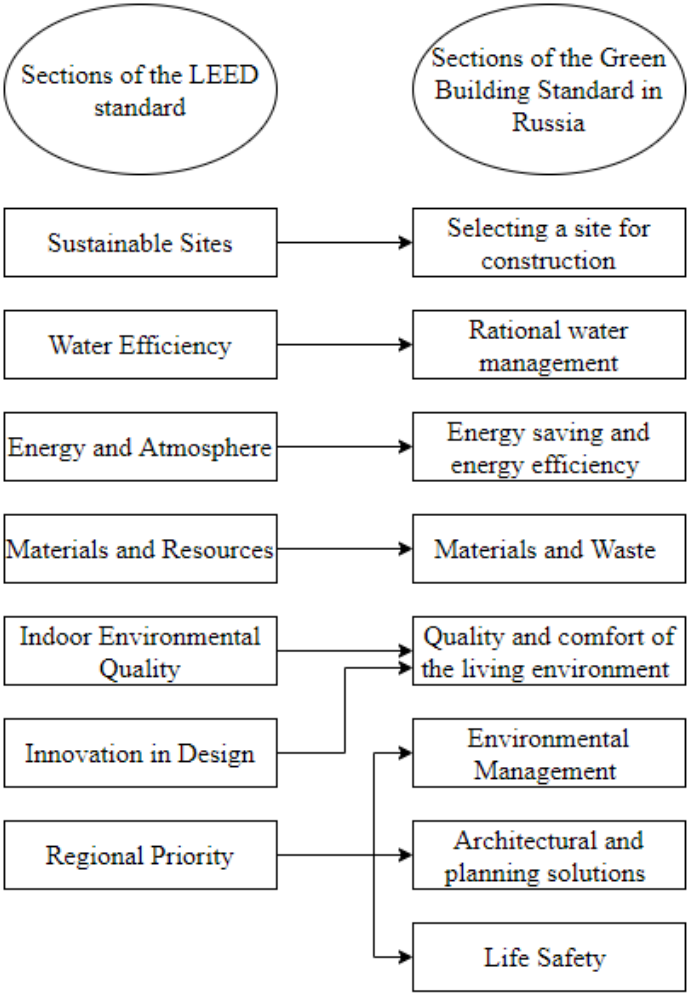

Figure 1. *Composition of sections of the LEED and "green" standards*

Certification for compliance of the property with the approved requirements of "Green Standards" is carried out by accredited organizations authorized to conduct certification within the System.

According to the results of the examination, the customer is issued a certificate of conformity, which, depending on the rating points can be "simple", "silver", "gold" and "platinum".

Availability of a certificate confirms that the building structure is the most comfortable for living working, uses environmentally friendly materials and advanced energy-efficient and other resource-saving technologies, and is provided with the most convenient and accessible infrastructure. All these factors increase the value of a square meter for the purposes of sale/lease, and therefore reduce the payback period of the facility and increase the attractiveness of investments for potential investors.

The system of voluntary environmental certification is shown in Figure 2 and Figure 3.

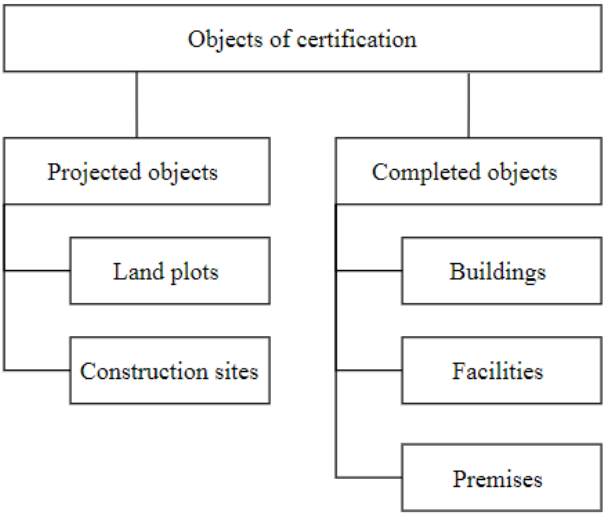

Figure 2. *Objects subject to voluntary certification*

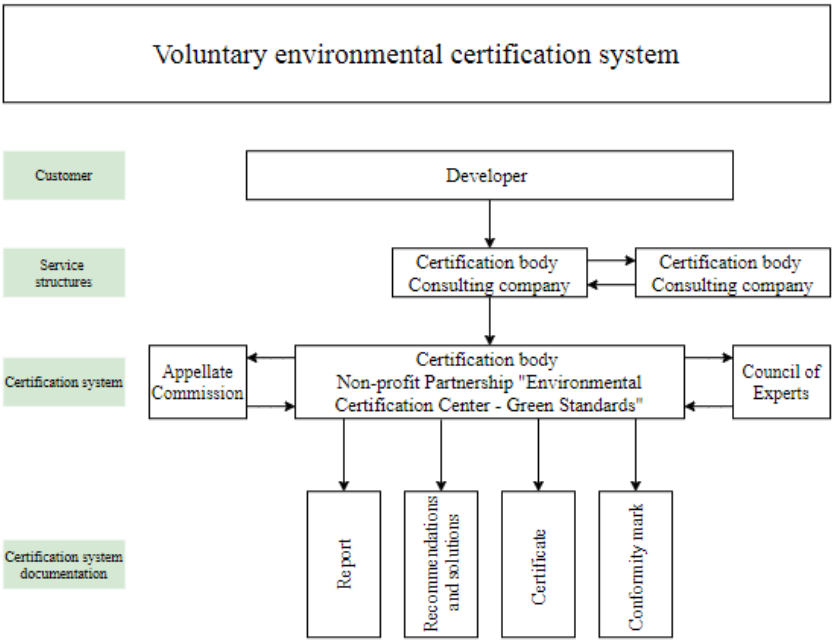

Figure 3. *Structure of the certification system [9]*

At the moment, the main document regulating this direction of construction in our country is GOST R 54964-2012 "Conformity Assessment. Environmental requirements for real estate objects". This state standard came into force in March 2013. National standard was compiled in accordance with the following list of international standards ISO:

- ISO 15392:2008 "Sustainability in Building Construction. General Principles."
- ISO/TO 21929-1:2006 "Sustainability in the construction of buildings. Sustainable indicators. Part 1. Basis for the development of indicators for buildings";
- ISO 21930:2007 "Sustainability in the construction of buildings. Environmental declaration of building products";
- ISO/TO 21931-1:2010 "Sustainability in the construction of buildings. Fundamentals of methods for evaluating the environmental performance of construction work. Part 1. Buildings".

Environmental requirements for real estate objects are defined by a set of the following 9 basic categories:

- environmental management;

- infrastructure and quality of the external environment;
- architectural quality and layout of the object;
- comfort and ecology of the internal environment;
- quality of sanitary protection and waste management;
- water management and storm water management;
- energy saving and energy efficiency;
- environmental protection during construction, operation and disposal of the facility;
- life safety [10].

Due to the fact that the requirements of national standard are recommendations, their compliance is often neglected. This is due to a number of difficulties faced by developers in our country. This is a relatively low price for electricity, and low or no motivation to introduce energy saving measures in domestic companies, the high cost of implementing innovative building and operating technologies, as well as the limited financial resources of companies.

However, even despite all the difficulties, there are projects in Russia that have been able to pass environmental certification. Many companies in Russia are now interested in obtaining international environmental quality certificates, as this is a huge step for a company to enter the international market. A big role in increasing the number of certified facilities in Russia was played by the Olympic Games in Sochi in 2014 and the World Cup, held in our country in 2018, because one of the prerequisites for these events was the presence of an international environmental certificate for the sports facilities used. These include the reconstruction of the Luzhniki stadium in Moscow in 2017, which received the "Certified" status under the BREEAM system, and the educational and administrative building of the Russian International Olympic University in Sochi, which received the "Very Good" status under the BREEAM system, and some other construction projects. According to Knight Frank (a real estate and consulting agency for residential and non-commercial real estate), there will be a total of 177 green buildings in Russia in 2020. This number is incomparably low, especially considering that there are 120,000 "green" buildings in the world [11].

In the Russian market, most of the buildings with any of the environmental certificates belong to the segment of offices - 39% of the total number of "green" buildings. In second place is retail real estate - 24%. In third place in Russia are warehouse and industrial buildings - 19%. A similar structure is observed in Moscow, where offices are the absolute leaders with a share of 80% (Fig. 4) [12].

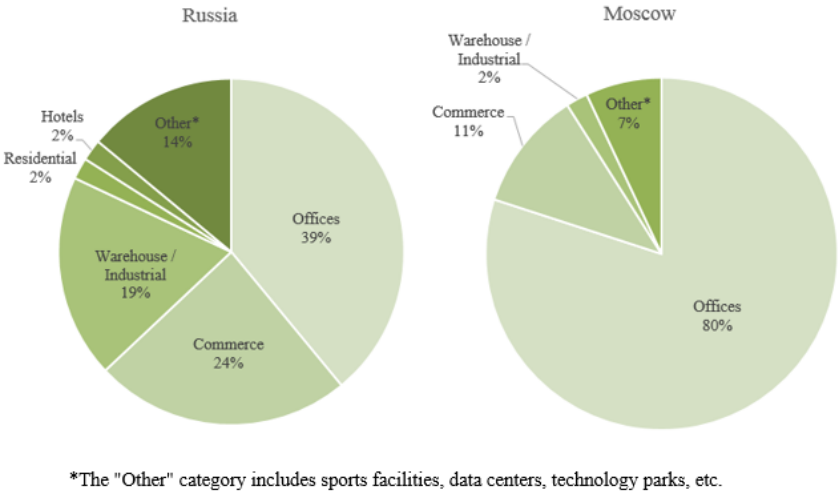

Figure 4. *Structure of the number of green buildings by real estate segment [12]*

It should be noted that all office buildings with one of the certificates under consideration are located in Moscow (83%) or St. Petersburg (17%). There are no such objects in the regions.

That is why we propose a number of measures whose introduction would simplify the process of environmental certification and in the future would increase the number of "green" buildings in Russia:

1. Introduction at the state level of mandatory regulations related to the design, construction and operation of "green" buildings.

2. Support for developers from the state. This item includes both financial aid to construction companies when designing and implementing "green" buildings, and economic protection for companies who decide to build environmentally friendly facilities.

3. Increasing the interest of buyers by informing them in the field of "green" construction. The implementation of this measure provides an opportunity to reduce costs for developers by increasing the price of environmentally friendly housing. However, the implementation of such a step is only possible if the buyers will agree to pay for environmentally friendly materials used during the construction of facilities, as well as additional costs arising during the operation of energy efficiency systems of the building (the use of motion detectors, detectors of fire [13], collecting rainwater and melt water for watering lawns and green spaces, the implementation of construction waste processing system, reducing heat loss [14], etc.).

4. Protecting the interests of investors and increasing the interest of shareholders.

Conclusion

Thus, in the course of this work an analysis of existing global and domestic environmental standards used to evaluate "green" buildings. As a result of comparing the number of implemented "green" facilities in Russia with the global indicators, it was concluded that it is necessary to introduce measures, the implementation of which would increase the number of environmentally safe facilities in our country. Such measures include: the creation of new regulations governing "green" construction, which would be mandatory; state support for construction companies, shareholders and investors; improving environmental literacy of the population in the field of "green" construction.

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SIMULATION AS AN ESSENTIAL COMPONENT IN SYSTEMS DESIGN TRAINING COURSES

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Abstract. *The article deals with the problem of the availability of the implementation of design techniques in the educational process of higher education that implement a systematic approach to the problems of the subject area. The question is raised about the need to teach students the practical skills of project work, including collective, based on modern information technologies.*

Keywords: *information technology design, simulation, project management.*

Introduction

When training specialists focused on the release of new scientific and technical products of high quality in the shortest possible time at minimal costs, it is necessary to introduce examples of the use of modern technologies using automated equipment, new ways of organizing the process of creating products, monitoring compliance with the highest level of product quality at all stages of the product life cycle (LC).

The higher education standard for training specialists in the design, production and operation of products of high scientific and technical complexity obliges educational institutions to provide students with the opportunity to acquire skills in modeling products and engineering facilities using standard packages and computer-aided design tools.

Currently, the tasks of product support throughout the LC are solved using spatially distributed systems (SDS) and the so-called virtual enterprises (VE).

SDS is based on free resources of real enterprises available for information interaction. In the modern sense, VE is a kind of production community created for a while to achieve a certain goal, for example, when it is necessary to integrate efforts within the framework of research and development, the development of

various services (maintenance, logistics, communications). The most important characteristic of VE is the presence of complex high-speed information interactions in various modes; the ability to process large amounts of data in a single distributed information space. All this creates a need for teaching students the practice of collective online work on a project to introduce them to the world of advanced information technologies.

Purpose of the study

Show that the inclusion of important aspects of modeling and the use of modern software systems in design courses will not only lead to the formation of modern competencies in students, but will also give a vector of development to the teachers of technical specialties. It is necessary, in order to teach students the basic concepts of modern computer technology, the principles of their work and innovations in the field of hardware and software tools and computer networks, to introduce practical exercises into the curriculum with the following tasks:

- Building conceptual models of systems of various types;
- Determination of the structure of subsystems, establishment of interconnections of elements;
- Verification of models;
- Formation of specification of requirements for the project;
- Registration of technical documentation and presentation of the project;
- Establish ways to carry out projects and use resources.

This list assumes the mandatory use of a significant amount of software and hardware in the educational process.

To acquire skills that provide the greatest competitive advantages in modern production, it is necessary to introduce into the educational process the implementation of practical tasks on the principle of collective development, coordination and operational control of project work [3].

Materials and methods

Based on the goals set, examples of tasks for improving the education process can be: studying the most effective ways of project execution and resource allocation; the assignment of roles and tasks for the implementation of basic design work, the development of specific technical specifications, the implementation of conceptual design, the preparation of technical specifications and instructions. If the final product of the design is an information system, then it is advisable to single out the stages of analyzing the organization's infrastructure, integrating subsystems into a single system and testing them; revision of the software; preparation for the implementation of the system; control and regulation of the main indicators of the project. If these requirements are met, the quality of students' final certification work will significantly increase, they will be able to compete more successfully in the labor market.

In terms of scientific and methodological support, the most promising can be considered a systematic approach, which allows, according to many modern publications, first of all, to link the procedures for analyzing both the design subject and the process of developing complex technical objects. By analogy with the use of a systematic approach in the design of information control systems, where the methodology combines modeling and reengineering operations, it is possible to identify in the designed product a set of product parameters that are optimal from the point of view of the entire life cycle of a technical system.

To solve this problem, it is necessary to consider the design object as a system, or a set of elements combined into a structure corresponding to the specified goals. The classical method, based on a systematic approach, involves the study of each of the objects that make up the system, as endowed with a set of properties that give them an unambiguous characteristic, elements. This complex also includes a description of the interaction between the individual elements that define the best mode of operation. The methodology has unique advantages for information support of technical systems, from the standpoint of a holistic model, including a description of each element of the system.

Localization of solving problems of the process of design, production and support of products no longer meets modern challenges, since it does not guarantee either high quality, or an appropriate level of organization of production processes, or a strict time frame for creating competitive products.

As is known, within the framework of the concept of CALS (Continuous Acquisition and Life cycle Support - information support of products, ISI), using an integrated information environment (IIS), the principles of design, construction, manufacture and maintenance of products are implemented. Modern project data management systems (PDM - Product Data Management) adapted for the educational process will teach students the basic functions of information support: a set of operations for working with design data, product configuration, project management, data protection. Such systems, which allow, within the framework of the educational process, to build a typical information model of a product based on objects, attributes, links from the standpoint of structural design, will significantly increase the quality of teaching. [4]

A systematic approach to the tasks of computer-aided design involves the implementation of joint design of a technological process (TP) and an automated control system for this process (ATPCS).

As an example, we can point to the **MasterSCADA™** software environment — the most modern domestic, innovative, powerful and convenient tool for fast and high-quality system development, which implements technologies in the field of creating large distributed software systems designed for real-time operation. [6] This product is implemented in the modern paradigm of an object-oriented

approach, the development of all elements of the MasterSCADA project is carried out in a single tool environment, which significantly expands the user's ability to create new projects with high labor productivity. Documentation of project work is supported by the multifunctional Master Report editor. It is possible to build various options for the network architectures of the system within the project. The developer company implements a program of cooperation with Russian universities, it is possible to install a free demo version of the product, which is especially important in conditions of distance training of students, and makes it possible to allocate a significant amount of hours for independent work, to simulate a remote access mode in the design organization of work, under the guidance of a teacher [1].

In addition to this system, we can also mention as an example the product **PDM STEP Suite** presented on the market – a computer system for managing data on a mechanical engineering product. According to the documentation [7], the purpose of the PDM Step Suite is to collect information about a product in an integrated database and ensure the sharing of this information in the design, production and operation processes. The PDM STEP Suite is based on the international standard ISO 10303 (STEP) (GOST R ISO 10303 is in force in the Russian Federation), which defines the schema (model) of data in the database, a set of information objects and their attributes required to describe the product.

In recent years, educational literature has appeared that takes into account these trends, however, the focus on specific industries does not allow to provide students with universal basic skills in the processes of modeling and support at various stages of LC products and designed systems without relying on the fundamental methods of the systems approach in the educational process.

One of the possible ways to overcome this contradiction can be the use of the **AnyLogic** software package in educational practice. This successful product, which has a modern visual interface, supports all conceptual models of systems analysis: simulation modeling, system dynamics models, multi-approach modeling, agent-based modeling [5]. The use of objects from built-in libraries, a developed training module, the presence in the reference module of examples of implemented models that imitate the behavior of systems in a real subject area, allow us to consider this product as a successful methodological means of implementing a systematic approach to research, design or management of complex processes. To the significant advantages of this product, in addition to the listed features, you can add the ability to use the cloud version in the work, the authors wrote about the benefits of these technologies in training earlier [2].

Results and discussion

Introduction to the educational process of practical exercises based on modern applied software requires some training on the part of the teacher. These methods

give a significant positive effect when using project teams, where students have the opportunity to master various roles in the learning process within the competence of the future specialty.

Based on the material presented and the concept of education, as close as possible to the demands of the market for specialists in the development and design of software systems, it is possible to start mastering new techniques in the directions indicated in the article by using such software products as: MasterSCADA™, PDM STEP Suite in the learning process, AnyLogic [5-7].

Conclusions

1. In the course of researching new trends in education and their tested use within the framework of the courses taught on design, the authors concluded that it is advisable to introduce elements of simulation modeling, build conceptual models of systems of various types, determine the structure of subsystems, establish relationships between system elements, verify models and others. modeling and design operations in the learning process.

2. The use of the AnyLogic software product allowed the trainees to master the skills of building a typical information model of a product based on objects, attributes, links from the standpoint of structural design, thereby significantly improving the quality of training.

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PREDICTING CAVITIES AND DEFORMATION OF THAWING SOIL AROUND THE UNDERGROUND HORIZONTAL WORKINGS

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Abstract. *The article deals with the cases of the formation of parabolic cavities around horizontal workings due to uneven thawing of the soil after the termination of the freezing station. A solution to the problem of predicting the formation of cavities around workings is proposed.*

Keywords: *frozen rocks, artificial thawing of rocks, heat gain, parabolic cavity in the soil massif.*

After driving a working in the area of frozen rocks, the work of the freezing station stops and the thawing of frozen rocks begins. Thawing of rocks can be natural and artificial. The duration of natural thawing of rocks depends on the amount of cold transferred to the rocks during their freezing, on the temperature at which the freezing was carried out, as well as on the thermophysical properties of the frozen rocks (thermal conductivity, heat capacity, etc.). The rate of temperature rise of rocks under the influence of the earth's heat influx is on average 0.10C Per day. Accordingly, the rate of natural thawing of rocks is on average 0.1 cm/day.

The natural thawing process of the soil can lead to uneven thawing of the ice wall. The uneven flow of the thawing process occurs due to different physical, mechanical and thermophysical properties of the soil, which change not only in layers of different rocks, but also within the same rock layer. Unfortunately, during the natural course of the thawing process, it is impossible to influence the heat transfer processes in the massif.

During artificial thawing of rocks around horizontal workings, discontinuities of rocks often occur in the form of various kinds of cavities. The formation of a parabolic cavity and the formation of a self-supporting rock arch around the mine

are very often observed. With further thawing, the stability of the vault was broken, then a new vault was formed and the process was repeated [1].

To predict the development of the process of formation of cavities, a simplified solution of the following problem is proposed. To find the temperature distribution in the rock at the end of active freezing, we use a one-dimensional solution for a semi-bounded body, on the surface of which at the initial moment a constant temperature is established, in the conditions of Moscow city t = -7°C.

The solution to the problem has the following form [2]:

$$T(h,T) = -7\mathrm{erf}(\frac{h}{2\cdot\sqrt{at}}) \quad (1)$$

where T(h,t)- average temperature of rocks during freezing;

h - distance from the heat exchange surface to the cavity;

t- time of coolant entering production;

α – thermal diffusivity of frozen rocks.

It is known that the physical and mechanical properties of frozen rocks depend on temperature.

Let us take the quadratic dependence of the soil deformation modulus E and the ultimate strength $\sigma_{сж.табл}$ on temperature.

$$ET = -1_6T \cdot (1 + 0{,}03125 \cdot T) \quad (2)$$

Taking into account formula (1), it is possible to calculate the mechanical characteristics of frozen rocks at a height h from the working surface.

If we assume that the thawing mass is a set of arches located one above the other with a modulus of deformation variable in height, then it can be considered three-hinged, close to a circle at small angles θ. Under the action of their own weight of thawing soils, these vaults produce pressure on each other (Fig. 1). As a result of their compression, vertical displacements occur, which leads to a break in the continuity of the thawing soil mass at a certain height from the working surface. Let us take the presence of limiting tensile stresses $\sigma_{дл}^{р}$ for the moment of crack appearance. Then the condition for disrupting the continuity of the soil massif can be expressed as follows:

where $k = \frac{h}{h_0}$

h_0- distance from the inner surface of the vault to rocks with negative temperatures;

ε – relative deformation along the height of a self-supporting vault;

$\varepsilon = \frac{dU}{dh}$

u - vertical movement of the lock section of the vault from the action of its own weight.

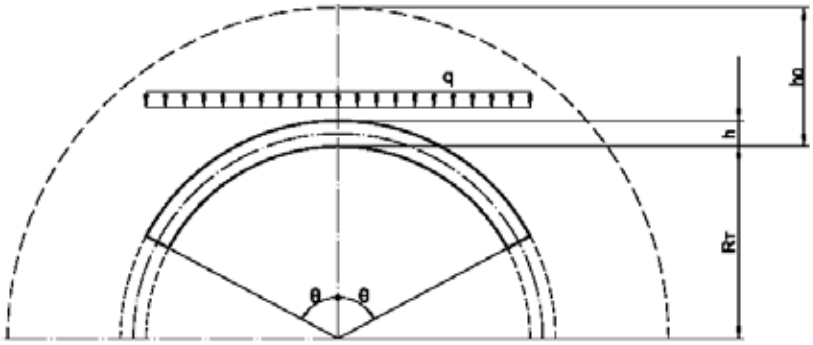

Fig.1. *Calculation scheme of a self-supporting rock arch*

This movement can be determined by Mohr's formula:

$$U(h) = \int_S^h \frac{N \cdot N_q}{EF} dS \quad (4)$$

where N, N_q- normal forces in the vault of height h from the action of single unknowns and the vault's own weight;

S - the length of its arc;

$F = h \cdot 1$ - cross-sectional area.

Omitting intermediate calculations, we write expression (4) in the form

$$U = \frac{q \cdot A \cdot (R_T - y_c)^2}{EF} \quad (5)$$

where q - uniformly distributed load from the dead weight of a vault of unit thickness $(q = \gamma h)$ (;

γ – average volumetric mass of rocks of its own arch;

R_T- thawing depth;

y_c- coordinate of the center of gravity of the reduced section, measured from the inner surface of a self-supporting rock arch;

A- the value of the integral in expression (5), depending on the value of the central angle θ of the arch, given as θ=30^0;45^0;60^0;90^0; A=1.31; 1.597;1.825;1.89.

Let us introduce the notations $k_1 = \frac{R_T}{h_0}$ and $k_2 = \frac{y_c}{h_0}$

Let us determine the coordinate of the center of gravity of the reduced section:

$$y_c = \frac{\int_0^h E(h) \cdot h \cdot F \cdot d_h}{\int_0^h E(h) \cdot F \cdot d_h} = h_0 \cdot k_2 \quad (6)$$

Differentiating (5) with respect to h_1, we obtain the condition for the discontinuity of the soil massif

Studies have shown that underground cavities can form in both thawed and frozen soils. With an increase in the thawing depth, the lock of the cavities tends to move into a more durable frozen rock mass. (Fig. 2) shows the graphical dependences of the vertical rock pressure on the size of the thawing halo.

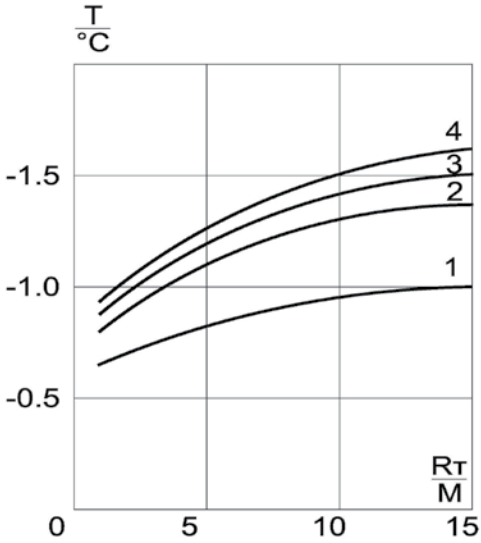

Fig. 2 *Dependence of the temperature in the joint of the rupture of the continuity of the soil mass on the size of the thawing halo (curves 1, 2, 3 and 4 with the value of h_0 equal to 1.3, 9 and 15 m, respectively)*

The established dependence of the temperature in the joint of the discontinuity of the soil mass on the size of the thawing halo is very useful for predicting the formation of cavities in natural conditions, as well as determining the risks of possible phenomena of surface subsidence due to the formation of the above cavities.

The fact of an increase in the size of cavities, which is associated with an increase in the thawing depth, established in practice, can be interpreted as a change in the size of an unsupported underground mine, in particular, an increase in its span. The dependence shown in (Fig. 2) allows one to predict the maximum soil temperature on the unsecured surface of the roof of the excavation at various spans of the excavation, which will save the massif from collapse.

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CONTINENTAL GLACIATION AND CONDITIONS FOR THE FORMATION OF EXARATION RELIEF ON THE TERRITORY OF THE BALTIC SHIELD

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Abstract. *The hypothesis about the absence of a powerful multi-kilometer ice sheet on the territory of the Baltic Shield is discussed. It is believed that in the Quaternary period, the glacier plowed up powerful strata of crystalline rocks on the shield and spread their boulders for thousands of kilometers. The article analyzes the arguments of supporters of the concept of continental glaciations. Modern studies have shown that the bottom layers of glaciers do not participate in the general movement of ice masses, and there are no moraine layers at their base. As for the exaration relief, "curly rocks", "sheep's foreheads", fiords, lake basins, finite moraine ridges, etc., their origin is associated with neotectonic processes, large vertical and horizontal movements of blocks of crystalline rocks, shallow and large scale scaly thrust faults.*

Keywords. *Baltic shield, glaciation, exaration relief, scaly thrust faults.*

Introduction

In the middle of the century before last, a group of naturalist scientists (J. Charpentier, L. Agassitz and others), in an attempt to substantiate the reasons for the accumulation of boulders of crystalline rocks on the plains of Europe, put forward a hypothesis of powerful continental glaciation in the Quaternary period in northern Europe, Asia and America. The works of the German geologists A. Penck and E. Brueckner on the alpine ice sheets and "moraine formations" of the r. Danube - formed the basis for the periodization of the ice ages: gunz, almond, riss, wurm. Subsequently, the supporters of this hypothesis (O. Torrell, A. Geiki and others) argued that the glaciers of Scandinavia actively formed the so-called exaration relief, plowing lake basins, deep fjords, furrowed and polished "sheep's foreheads", "curly rocks" and other "glacial" landforms. Since then, the number

of publications based on the glacial hypothesis has amounted to many thousands.

However, in parallel, the greatest naturalists C. Darwin, C. Lyayel, R. Murchison, A. Keyserling put forward a drift theory of the formation of boulder accumulations in the Northern Hemisphere due to the spread of boulders by floating ice during transgressions of sea basins. During the war, Professor I.G. Pidoplichko, as part of the active army, examined all the known "glacial" deposits in the Alps. In his works, he argued that all these glacial constructions of German scientists and their followers are deeply mistaken and based on self-hypnosis and a kind of mass hypnosis. In the 50-60s, many domestic geologists (A.I. Popov, I.D.Danilov, R.B.Krapivner, P.P.Generalov, etc.) came to the conclusion that the northern territories of Europe and Siberia were were not exposed, and thick strata of boulder loam accumulated as a result of transportation of boulder material by icebergs and fast ice floes. In the scientific world on the issues of continental glaciation of Western Siberia and the European North, two points of view coexist - glacial and “marine”. However, the "exaration relief" of Scandinavia and Canada until recently was considered indisputable proof of the inviolability of the main prostates of the glacial theory.

Postulates of the glacial theory and the results of drilling out modern ice sheets

University and academic scientists, united in scientific and glacial schools, constantly refer to the ice sheets of Antarctica and Greenland, which, in their opinion, did a great job of transforming the ancient surface of platforms and crystalline shields. It is believed that the very existence of these mighty glaciers testifies to the inviolability and fidelity of the glacial doctrine, and that in the Quaternary period, such glaciers plowed up and carried away from the Baltic shield strata of crystalline rocks up to 200 m thick and carried rocks and boulders of bedrock for thousands of kilometers, dragged huge rejects hundreds of kilometers.

However, to date, the dynamics and patterns of movement of ice sheets throughout their section have been studied by the works of glaciologists, geologists, drillers and geophysicists. The results of the through - to the basement, drilling out of the ice of Antarctica and Greenland, obtained under international projects, are of unique importance. It turned out that instead of strata of moraine-containing ice, completely filled with huge blocks and boulders (which is usually depicted in diagrams and figures in textbooks on general and Quaternary geology), only inclusions of sandy-loamy and fine-earth matter are recorded in the continental ice. Even in the bottom parts of glaciers - where it is customary to place a powerful bottom moraine filled with huge blocks and iron-like boulders (for example, in the schemes of V.M. Kotlyakov and N.V. Koronovsky), only small lenses and clots of clay and sandy loam matter, and rare sandy grains are recorded. These mineral inclusions are mainly represented by volcanic ash, aeolian dust of distant deserts,

rare inclusions of fine-earth terrigenous matter, as well as spores and pollen. Glaciologists also found that the bottom layers of ice of the cover glaciers (according to the canons of glacial theory and must do all the geological work) do not participate in the general movement of ice masses, they lie in place as a dead weight for hundreds of thousands of years, protecting the underlying rocks from denudation. Moreover, the cover ice preserves large paleotectonic lakes, with their relict, very ancient water, and protects them from the notorious glacial plowing out.

Origin and mechanism of formation of textbook-exaration relief. Based on almost fifty years of geological work in the Kola-Karelian region, V.G. Chuvardinsky resolutely opposes the generally accepted doctrine of enormous ice ages, the cover glaciers of which, plowing the bedrock of the glacier bed, moved huge boulders and kilometer-long rock outcrops and moved southward, covering Europe and North America with ice sheets up to 3 km thick. In his works [1,2,3,] he analyzes the arguments of the supporters of the concept of continental glaciers, which ascribes the role of an active relief-forming factor to the powerful glaciers rapidly advancing on Europe.

Glaciological studies on the continental glaciers of Antarctica and Greenland have shown that the bottom layers of ice are practically motionless, and they do not produce any “plowing out” of the glacier bed - all movements in the glaciers occur higher as a result of viscous-fluid sliding of packets of ice plates along intraglacial cleavages. The bed of mountain-valley glaciers keeps the primary rock surface, soil layers and even the grass cover completely intact under the moving ice masses. And the bed of the Greenland and Antarctic huge glaciers is generally mothballed for hundreds of thousands of years, and kilometer thick ice calmly glides over this bed without affecting it. The modern researcher of the glaciers of Antarctica D.Yu. Bolshiyanov concludes: "... Cover-type glaciers are not able to actively transform the continental bed."

Fig. 1. *Tectonic formation of "sheep's foreheads" in granodiorites, in the process of neotectonic growth of granite domes*

Fig. 2. *Locations of fossil remains of mammoths in Fennoscandia during the last (Würm) ice sheet (age 26000-10000 years)*

As for the exaration relief, "curly rocks", "sheep's foreheads", fiords, lake basins, finite moraine ridges, etc., V.G. Chuvardinsky connects all these formations with neotectonic processes, vertical and horizontal movements of rocks, small- and large-scale scaly thrust faults (Fig. 1).

The materials of the 2014 Geological Meeting in Lund (Sweden) devoted to the problem of glaciation in Scandinavia are presented in the last article by D.Yu. Bolshiyanova (Bolshiyanov, 2015). The final communiqué says: "... The latest geographic, geological and botanical studies indicate the absence of a continuous ice sheet on the Scandinavian Peninsula during the last glacial maximum. Instead of ice sheets, small ice domes developed in these territories, which could not actively mechanically influence the ice bed".

New literary data on paleontology, paleobotany and Quaternary climatology cast doubt on the presence of powerful continental glaciation even in the citadel of the adherents of the glacial theory - in Scandinavia. Numerous publications point to permanent finds of mammoth remains where, according to the glacier theory, the thickness of the ice in the wurm reached 4 km (Fig. 2).

Numerous Würm radiocarbon dates of mammoth remains (26-11 thousand years) indicate the comfortable living conditions of these voracious animals in the valleys of the rivers of Finland and Norway overgrown with lush vegetation. Modern studies show that the climate of Scandinavia in wurm was colder and more continental than the modern climate, but on the whole is close to the modern climate of Siberia, and forest-tundra steppes with permafrost in the basement and lush vegetation in river valleys occupied vast territories in Europe, including Scandinavia.

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SAVE AUSTRALIA'S GREAT BARRIER REEF FROM HUNGER

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Abstract. *Reefs of all eras in the development of the Earth represent the base of mineral resources for all of Mankind. The Great Barrier Reef of Australia, according to the observations of scientists, is at the stage of extinction due to the fact that reef builders and their biota experience mineral and oxygen starvation due to the lack of iron, manganese, aluminum and other elements that has arisen in recent years. It is proposed in natural conditions to immediately conduct experiments on the development of an optimal diet for reef builders of the Great Barrier. Simultaneously with the experiments, it is necessary to organize feeding of the reefs in the areas of their discoloration with iron-manganese wastes, including the Australian bauxite mines.*

Keywords: *Australia, Great Barrier Reef, coral death, stromatolites, dust storm, iron, bauxite, experiment, Riphean reefs.*

On 6 July 2009 in London at the Royal Society Chair at Caraton House Terrace, renowned naturalist David Attenborough introduced former Australian Marine Research Institute Chief Scientist John Veron, who reported on the extinction of Australia's Great Barrier Reef.

John Veron has analyzed past reef extinctions and has collected much evidence of the effects of sea level change, heatstroke, starfish destruction of reefs, and anthropogenic impacts on nutrient content. All of this has exacerbated his long-standing concerns about the health of the Great Barrier and other reefs in the world.

The Verona study found that during weather cycles associated with El Niño (El Niño - Warm Ocean Current), surface waters in the Great Barrier Reef Lagoon, already heated to unusually high values by warming caused by greenhouse gases, fueled by a mass of warm ocean waters from the western Pacific Ocean, splashing onto the delicate living corals of the reef. For corals, exposure to temperatures two to three degrees above their maximum (31° C for the Great Barrier Reef species), combined with increased levels of solar radiation, is lethal.

Heat is not the only problem faced by corals, however. Other destructive mechanisms of interaction cannot be stopped. According to Verona, reefs are natural archives containing evidence of environmental change millions of years ago. These archives tell us that four out of five previous massive destruction of coral reefs on our planet have been linked to the carbon cycle. They were caused by changes in ocean chemistry due to the absorption of two major greenhouse gases, carbon dioxide and methane, during the acidification of ocean water.

Phytoplankton - the food of tiny crustaceans, a key element in the food chain in southern ocean waters - will also be affected by acidification. And who knows what kind of chain of environmental consequences can come.

There is no more heartfelt spectacle than the final moment of Verona's performance in July 2009 in a quiet audience. Throwing away his notes, he apologizes for such a depressing speech. He encourages listeners to reflect on what they have just heard: "Use your influence. For the future of the planet, help make this story public. This is not fiction - this is reality." So ended the description of the meeting David Attenborough.

Imbued with the appeal of D. Verona, being thousands of kilometers from still living reefs, having fossil reefs with a billion-year history under our feet, we conducted this study. Let's see what is happening in another living reef oasis 22500 thousand km from the Great Barrier Reef in the west Atlantic in the Bahamas using the example of stromatolites. Stromatolites are reef thin-layered pillars or mounds of various shapes, consisting of calcium carbonate and sandy-argillaceous material (fig. 1).

Figure 1 *– Modern stromatolites (Australia)*

Stromatolite is formed as a result of the vital activity of a community of bacteria called cyanobacterial mat (cyanobacteria are also called blue-green algae). Mats exist in many parts of the world, but in modern times, true stromatolites exist only in Shark Bay on the west coast of Australia and on the Atlantic coast of the Bahamas. Stromatolites reliably appear in the geological record in the oldest sedimentary formations of Warrawuna (Western Australia) with an age of 3.5 billion years - this is the oldest known form of life. The greatest flowering of cyanobacteria fell on the Proterozoic eon.

Paleontologists from the United States, Australia and the United Kingdom have shown that the stramatolite structures of the Strelley Pool Formation in western Australia are biological in nature. Until now, the origin of these stromatolites, formed about 3.45 billion years ago, in the early Archean, has been in doubt. Now a team of researchers led by Abigail Allwood has managed to find traces of the bacteria that formed these deposits.

Paleontologists from the Allwood group published the first results of their research back in 2006. Now an article by scientists dedicated to their discovery has appeared in the publication "Proceedings of the National Academy of Sciences" (PNAS).

Stromatolites inhabited salt and fresh waters. In the Proterozoic, huge reefs with a thickness of hundreds of meters consisted of stromatolites. Individual deep-sea stromatolites reached a height of 75 m. Proterozoic stromatolites reached a high level of complexity: forms with all kinds of branching columns, peaks, various layering and microstructure, etc. appeared. Modern stromatolites formed by bacterial mats are much simpler.

Bahamas stromatolite bacterial mats are the subject of study by UM Rosenstiel Lewis G. Weeks School under the supervision of Professor Peter Swart. The professor and his colleagues drew attention to the fact that cyanobacteria contain a lot of iron, sources of which are not found in the vicinity of the Bahamas and the adjacent land.

Researchers at the University of Miami (UM) Rosenstil School of Marine and Atmospheric Science have shown that iron-rich sugar dust provides the nutrients specialized bacteria need to build the carbonate backbone of the Bahamas chain.

Professor Peter Swart and colleagues at UM Rosenstiel Lewis G. Weeks analyzed the concentrations of two trace elements characteristic of atmospheric dust - iron and manganese - in 270 seabed samples collected along the Grand Bahamas Bank over a three-year period. Scientists have found that the highest concentrations of these micronutrients are found west of the island of Andros, an area that has the highest concentration of proteins made by photosynthetic cyanobacteria. The study's lead author, Peter Swart, noted that "Cyanobacteria consume 10 times more iron than other photosynthesizers because they fix atmospheric nitrogen. This process assimilates carbon dioxide and precipitates calcium carbonate. Traces of atmospheric nitrogen by its isotopes are visible in precipitation."

Swart's team suggests that high concentrations of iron-rich dust brought by storms across the Atlantic from the Sahara are responsible for the existence of the Great Bahama Bank, which has been formed over the past 100 million years by precipitation of calcium carbonate. The dust particles, blown into the waters of the Bahamas and directly onto the islands, provide the nutrients needed for cyanobacterial blooms, which in turn produce carbonate proteins in the surrounding waters.

Persistent winds from Africa's 3.5 million square miles of Sahara desert lift the mineral-rich sand into the atmosphere, where it travels 5,000 miles towards the United States and the Caribbean.

Thus, we can state that the indispensable nutrient medium of the Bahamian stromatolite reefs is iron and manganese, brought by dust storms from the Sahara in Africa.

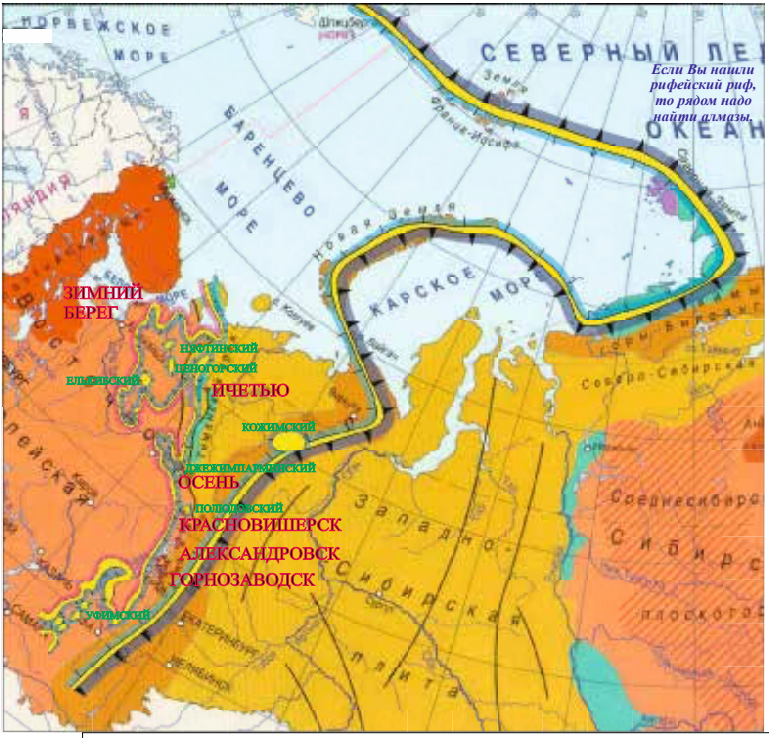
Stromatolites are one of the main reef builders of the Riphean Volga-Timan (fig. 2, 3) and the East European barrier reefs of the East European platform, available for comfortable study in the outcrops and quarries of the Chinya-Voryk village in the Komi Republic of Russia. [2, 3, 5, 6,7].

Figure 2 – *Riphean reef builders (stromatolites) in the Chinya-Voryk quarry (Middle Timan) (photo by Bogdanov B.P., 2015)*

The ancient reef-bearing complex is the Riphean one, the reefs of which are established in outcrops and wells of Timan, Vychegodskiy trough, Perm Prikamye, eastern slope of the Tatar arch, Bashkirian anticlinorium, Subpolar Urals, Pai-Khoi [2, 3, 5, 6, 7]. We have established the barrier nature of two cycles of reefs stretching from the Kanin stone through the Tsilmensky stone, Chetlasky stone, Vymskaya ridge, Ochparma, Nivshera, Keltmensky shaft, Perm Prikamye, Tatar arch. It was proposed to call this reef the Volga-Timan reef (Bogdanov et al, 2000) (fig. 3, 4, 5) At different distances from the deep-water slope of the barriers in the depression zone on horsts and other uplifts, the Vymsky, Dzhezhim-Parminsky, Polyudovsky, Karatau single reefs were formed. The height of the reefs when combined is 2000 m or more. It was established from a set of data that the Volga-Timan barrier reef arose on the northeastern slopes of the Russian plate, which were fractured flexures with zones of deep faults saturated with intrusions and mineralized fluids.

The reef sections of the Bashkir anticlinorium, the Kazhim uplift of the Subpolar Urals, Pai-Khoi, Spitsbergen are called by us the East European barrier reef that arose in the Middle Riphean on the slope of the paleocontinent of the same name, the Riphean-Paleozoic slope of which passes through Novaya Zemlyuyatiya, the modern Taimyr Lands, Franz Josef Lands, Spitsbergen (fig. 3). The reef also formed over two cycles separated by a hiatus.

Within the Middle and South Timan, a large bauxite-bearing province has been established, which includes two stratigraphic levels: Devonian (Middle Riphean) and Carboniferous (fig. 7) [1,8]. Devonian bauxites on reef carbonates of the Riphean were discovered in the Middle Timan in 1970. They belong to two groups of deposits: Vorykvinskaya and Zaostrovskaya.



Волго-Тиманский барьерный риф (значки направлены в глубоководную зону)

ОСЕНЬ Месторождения или проявления алмазов

Одиночный риф и его название

полюдовский Восточно-Европейский барьерный риф (значки направлены в сторону глубоководной зоны шельфа и континентального склона)

Figure 3 – *Riphean reefs of the East European platform on a fragment of a tectonic map*

There are 4 known deposits in the Vorykva group: Vezhayu-Vorykvinskoye, Verkhne-Shchugorskoye, Vostochnoye and Svetlinskoye. The Zaostrovskaya group includes 2 deposits: Zaostrovskoe and Volodinskoe. All these deposits are products of laterite weathering of Late Proterozoic carbonate-terrigenous rocks and are represented by both sedimentary and redeposited bauxites.

The bauxites of the Chetlassky Kamen are more diverse in composition and type of section (composition of the substrate rocks). All known deposits here are

confined to the zone composed of rocks of the Bystrinskaya series, forming a reef formation with a full complex of typical facies: pre-reef, reef, and back-reef.

The upper part of the bauxite-bearing layers of reef deposits has a red-crimson color due to the content of iron and manganese. Along the entire length of the Volga-Timan barrier reef, in the single reefs of Dzhezhim Parma, Polyudova Kamen, Karatau, the rocks have a red-crimson coloration (fig. 4). In the zone of the East European barrier reef in the Bashkir anticlinorium, the reef rocks of the Satka and Bakal formations are red-brown-brown in color.

***Figure 4** – Bauxites of the Chetlasky Stone deposits of the Middle Timan*

On the East European Platform, the zones of development of reefs (carbonate structures) of the Riphean often coincide with the zones of development of different types of reefs of the Upper Devonian, Carboniferous - Lower Permian, sometimes building on each other, although between the epochs of their life there are about 1 billion years.

Carboniferous bauxites are developed mainly in South Timan, where two groups of deposits have been identified. These deposits are confined to the weathering crust of carbonates of the Frasnian stage, enclosing various types of reefs of the Domanik-Upper Frans.

Thus, on the example of Riphean, Upper Devonian reefs, reefs of other stratigraphic levels, we see that their obligatory components are iron and manganese.

Dust storms rage over Australia every year, bringing iron from Australia itself, from India and Africa. And dust always settled on the mainland and the water area, framed by reefs from north to east for 2500 km. And suddenly, on the northern coast of Australia, the reefs began to discolor. And it can be assumed that the reef builders began to lack iron, manganese, and other elements in their food - the reefs began to starve.

And this is quite likely if you pay attention to the following changes on Earth. Scientists are alarmed: the northern latitudes are heaving. In the Arctic, where bare land stood quite recently, dense vegetation has appeared. Northern latitudes are covered with tall bushes, low, creeping vegetation, in turn, moves to more northern latitudes. The authors of the article observed this personally on the example of the Bolshezemelskaya tundra in the Komi Republic and the Nenets Autonomous Okrug north of latitude 67°, where river floodplains were rapidly overgrown with bushes.

In the taiga and tundra, the area of vegetation cover has increased by more than 40% over the past 30 years. It should be noted that the growth of vegetation is also observed in the western part of Australia, in the African Sahel, in the arid regions of India.

The rapid greening of the Earth in the last 30-40 years means that the surface from which iron and manganese particles rise up during dust storms has decreased, which is also noted for Western Australia. From recent news, directly related to dust storms, it must be said about the catastrophic fires in Australia in 2019-20, which covered most of its eastern coast, facing the Great Barrier Reef, which turned the surface into a desert. In Russia there is a saying – "there would be no happiness, but misfortune helped" ... It can be understood as follows - dust storms can again arise over the scorched earth of Australia, which will bring iron and manganese to the Reef.

British scientists have carefully studied the waters of the world's oceans and found that the pH level continues to rise rapidly. In the near future, this could lead to tragic consequences for coral reefs and its other inhabitants. The work was published in the American edition of Earth and Planetary Science Letters. The study focuses on the history of ocean acidity - in particular, over the past 22 million years. Experts believe that within 80 years the pH level will exceed 7.8. And this will be a record since the Miocene era, dating back 14 million years.

The acidity level of ocean waters is increasing due to the high content of carbon dioxide in the atmosphere, which dissolves and breaks down into weak carbonic acid. In 2017, scientists recorded a record for the concentration of CO_2 - over the past 150 years, the level of the substance has increased by 43%. Environmentalists predict its further increase. According to their calculations, the level of carbon dioxide will increase 2.5 times.

Following D. Veron, ecologists note that changes in the level of acidity in the ocean cause significant harm to corals. Oxidation has a depressing effect on the formation and regeneration of coral skeletons, which are composed of carbonate. This leads to massive death of corals. By 2100, the Great Barrier Reef may become lifeless. And today, 1500 species of fish and 400 species of coral are found here.

It is believed that the inhabitants of the ocean adapt to changes in the chemical composition of the water in the ocean, but whether this will actually happen and how quickly is unknown. Israeli scientists, for example, note that creatures that inhabit the ocean and build their skeleton from calcium carbonate (corals, some types of plankton) are already replacing part of this element with strontium and other substances.

While trying to find information on the chemical composition of reefs in the literature, we came across the website of the RED SEA company on the Internet, which specializes in growing corals in aquariums and notes: modern laboratory analysis of the Red Sea water showed the presence of 57 individual chemical elements and, although water parameters are affected most of them, some are more important in maintaining overall chemical stability. These elements form the basis for the reef environment and include three main elements: calcium, magnesium and bicarbonate. These 3 basic elements significantly affect the chemical characteristics of water (pH stability, alkalinity, ionic strength of seawater) and many of the biological processes that take place in corals (skeleton formation, ion exchange, photosynthesis).

Using the example of the deposits of the Vorykvinskaya and Zaostrovskaya bauxite groups of the Chetlassky Kamen above, we showed which elements of the periodic table they contain: iron, manganese, niobite, tantalum, thallium, scandium, vanadium, rare earths. And it is quite obvious to assume that these elements, together with aluminum, were extracted from seawater by reef builders, which means the entire reef biota together with polyps, algae, fish, crustaceans, etc.

First of all, using the example of the reefs of the Bahamas, it seems to us that the reefs of the Great Barrier Reef are simply starving, deprived of iron, manganese and other elements from the reduced dust storms. And it is very simple to fight such hunger, realizing that without reefs, humanity itself will starve tomorrow - it is necessary to feed the reefs with elements from the dumps of deposits of bauxite, iron, manganese.

There is an example of the development by reef builders of the SS Uondala passenger ship that sank in 1911 at a depth of 30 m, the hull and fragments of which were overgrown with soft corals, which attracted thousands of species of fish and marine life. Moreover, the authors of this episode from the life of corals believe that the reason for the fouling of the body with corals is its morphological expression on the seabed. It seems to us that this is not the main factor in the settlement of reef builders, since the depth of 20-30 m is not the most favorite place for corals to live - they love the zone of action of surf waves, and the main thing is that the hull of the ship is all of the iron so necessary for reef builders.

Of course, one should think that initially the reefs of all epochs in the history of the Earth were inhabited in the zones of tectonic faults. This was the case in the

Middle Riphean, when the Volga-Timan barrier reef began to grow on the eastern slope of the Russian plate from Kanin Nos to the eastern slope of the Tatar arch and on separate horst-like blocks such as Tsilmensky and Chetlasky Stones, Vymskaya ridge, Ochparma, Dzhezhimparma, Permsky, Krasnokamsky, Karatau (fig. 3). The East European barrier reef began to grow on the oceanic slope of the East European paleocontinent, stretching from the Bashkir anticlinorium through the North, Subpolar, Polar Urals, Paykhoi, Novaya Zemlya, Taimyr, Severnaya Zemlya, Franz Josef Land to Spitsbergen. The elements of the periodic table and minerals, necessary for reef builders, entered the overlapping reefs along the faults. This process continued until the end of the collisions between the East European continent and the Siberian oceanic plate (up to the Early Permian in the Ural zone).

It became apparent that the Great Barrier Reef of Australia is experiencing mineral and oxygen starvation. Possible causes of mineral ("iron-manganese") starvation are discussed above, and oxygen starvation is provoked by an increase in the temperature of seawater due to global warming.

From literary sources, films and videos, Universities in Australia have great laboratories and specialists to study the seas and their inhabitants, and they can conduct long-term experiments on feeding reef builders to find out their rational menu.

On the example of the oceans of the Soviet Union D.V. Naumova, M.V. Propp, S.N. Rybakov [4], it is known that after death for various reasons, the reef biota of Oceania can recover in 7 years. And one can think that under laboratory conditions with artificial feeding, the recovery process of sick, including discolored, reef-builders will occur faster. Naturally, experiments should be carried out on the marine reef plantations of the Barrier Reef.

The required elemental-mineral diet of reef builders can be established by determining such a composition of healthy varieties. Without fail, the diet should contain waste from bauxite mines in Australia, which the continent has been rich in for a long time (fig. 5).

Figure 5 – *Bauxite Mine of Australia*

It will not be difficult for the human community to "feed" Australia's 2500-kilometer Barrier Reef for the duration of its subsequent existence, since it is located in ideal conditions for life.

The authors of this article for 40 years have been "land" researchers of the billion-year history of the life of reefs, sometimes touching on their modern life [Bogdanov B.P., American Scientific Journal № (18)/2018], and are aware of their greatest role in the creation of mineral resource base, beauty for the rest of mankind. And we must heal our smaller brothers, because we are thinking people.

Conclusions:

1. Explorers of the World Ocean are concerned about the state of Australia's Great Barrier Reef, the colonies of which are rapidly discoloring and dying off. There are dramatic predictions by scientists who fear the death of a 2,500-kilometer oasis of life of thousands of species by 2050.

2. Based on the example of modern studies of the stromatolite reefs of the Bahamas, carried out by American scientists, the most important role in the nutrition of iron and manganese stromatolites, which give rocks red hues, the main source of which are dust storms from the African Sahara, is shown.

3. On the East European Platform, stromatolites are the main reef builders of the Volga-Timan and East European Riphean barrier reefs, which are often red-fulvous-brown in color due to the presence of iron, manganese, bauxites, other elements and minerals.

4. The accumulation of iron, manganese, aluminum and other elements is a regularity in the life of reefs at all epochs of the Earth's development. Dust storms are typical for Australia, but with the dramatic greening of the continent in the last 30 years, the transport and deposition of these elements has decreased, which has led to an ordinary "starvation" of the reefs.

5. Therefore, it is necessary to immediately begin experiments on the introduction of iron, manganese from bauxite waste in the experimental areas of the Great Barrier Reef. In case of positive results, a reasonable person will have to take custody of the reef for a long time of mutual existence.

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DAIRY PRODUCTIVITY OF COWS OF DIFFERENT AGES

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Abstract. *The article presents material on the comparative assessment of milk productivity of Holsteinized black-and-white cows. The age of cows is one of the important physiological factors affecting milk productivity. The purpose of the study is to determine the milk productivity of cows of different ages in JSC "Plemzavod" Dmitrievo "of the Kasimovsky district of the Ryazan Oblast. As a starting material for the research, the information of zootechnical registration was used, obtained in JSC "Plemzavod" Dmitrievo "of the Kasimovsky district of the Ryazan Oblast, where Holsteinized black-and-white cattle are bred. The studies were carried out by grouping animals for each of the studied factors, followed by mathematical processing of digital material. The data obtained on the milk productivity of Holsteinized black-and-white cows of different lactation ages indicate that the maximum milk yield in 305 days is observed in cows in the second lactation (6825 kg of milk, 4.05 and 3.36%), which is 452 kg of milk, 0.05% fat and 0.02% protein more than the average heifer. At the same time, lifelong indicators of milk productivity increase from 1 lactation to 6 lactation and, only 7 lactation, there is a decrease in milk productivity. The highest lifetime milk productivity is observed in cows with six lactations. There are cows in the herd that have milked more than 40 tons of milk. Thus, in JSC "Plemzavoda" Dmitrievo "Kasimovsky district of Ryazan Oblast, Holsteinized black-and-white cows will have the highest lifetime productivity at six lactations.*

Keywords: *milk yield, mass fraction of fat, mass fraction of protein, lactation, age of the cow, breed.*

Introduction

Currently, the provision of the country's population with dairy products largely depends on the efficiency of dairy farming, the fullest use of its potential [5].

The age of cows is one of the important physiological factors affecting milk production [1,4,10]. The influence of the age of cows on milk production is determined by their individual characteristics. With the general growth and development of the whole organism, especially the mammary gland, the milk production of animals increases. Upon reaching a certain maximum due to the subsequent aging of the body, it begins to fall.

The results of many studies indicate that Holsteinized black-and-white cows can maintain milk productivity at a high level with a long period of use [8, 9].

Purpose of the study - to determine the milk productivity of cows of different ages in JSC "Plemzavod" Dmitrievo "Kasimovsky district of Ryazan Oblast.

Research methods

As a starting material for the research, the information of zootechnical registration was used, obtained in JSC "Plemzavod" Dmitrievo "of the Kasimovsky district of Ryazan Oblast, where Holsteinized black-and-white cattle are bred.

The level of milk yield, mass fraction of fat and protein in milk was established according to the results of monthly control milking for two adjacent days. The milk yield per month was determined by multiplying the daily milk yield of the control milking by the number of days in a month, and the milk yield for 305 days of lactation by the total milk yield per months in accordance with the "Rules for assessing the milk productivity of dairy cows of dairy breeds SNPplem R-23-97".

The mass fraction of fat and protein in milk samples was determined according to the results of monthly control milking in a certified laboratory for selection control of milk quality.

The studies were carried out by grouping animals for each of the studied factors, followed by mathematical processing of digital material.

Research results and their discussion

Table 1 shows data on milk productivity of Holsteinized black-and-white cows of different ages for lactation. The maximum milk yield in 305 days with a high content of mass fractions of fat and protein is observed in cows in the second lactation (6825 kg of milk, 4.05 and 3.36%), which is 452 kg of milk, 0.05% of fat and 0.02% more protein than the average of first-calf cows.

Table 1. *Milk productivity of cows of different ages*

Lactation	Number of heads	Full milk yield, kg	Productivity in 305 days				
			milk yield, kg	fat		protein	
				%	kg	%	kg
1	306	6986	6373	4.00	280	3.34	233
2	242	7277	6825	4.05	296	3.36	245
3	122	7073	6773	4.02	285	3.35	237

4	88	7209	6788	4.02	293	3.34	243
5	30	6954	6456	4.00	278	3.34	231
6	23	6794	6167	4.02	274	3.35	228
7	5	6332	5249	4.02	253	3.35	211

When comparing the best indicators for 2 lactation with data for 7 lactation with the number of heads -5, then the milk yield in cows decreased by 1576 kg, the content of mass fractions of fat by 0.03% and protein by 0.01%.

One of the main features affecting the breeding process, the quantitative and qualitative growth of the herd, life-long milk yield and economic indicators of the dairy farming industry is the duration of the economic use of cows. The economic life of individual animals under the same conditions of feeding and keeping varies within very wide limits. Some animals reduce fertility and productivity early and, for this reason, are culled from the herd at a relatively young age. At the same time, many animals retain their economic qualities at a high level for a long period and remain in the herd for a long time. Lifetime performance indicators are presented in table 2.

Table 2. *Lifetime indicators of milk production*

Lactation	Number of heads	Period of productive use, days	Lifetime productivity on average for 1 head, kg			
			full milk yield	milk yield in 305 days	milk fat	milk protein
1	148	434	7446	6449	298	248
2	130	819	14195	12985	569	480
3	75	1195	20385	19254	811	685
4	63	1593	28625	26925	1149	953
5	19	2001	31259	29292	1249	1029
6	18	2423	39280	37119	1607	1298
7	4	2939	37552	35216	1539	1230

Table 2 shows that lifelong indicators of milk productivity increase from 1st lactation to 6th lactation, and only 7th lactation leads to a decrease in milk productivity. The highest lifetime milk productivity is observed in cows with six lactations. This is consistent with the studies carried out by I.P. Baranova [2], N.D. Vinogradova [3], M.V. Kukina [6] and K.S. Mekhtiyeva [7].

There are cows in the herd that have produced more than 40 tons of milk (tab. 3). For example, the cow Sputnik 175 for 5 lactations produced 63897 kg of milk, 2553 kg of milk fat and 2087 kg of milk protein. It should be noted that the milk yield of a younger cow Svetlitsa 2230 for three lactations was 40645 kg of milk, 1569 and 1349 kg of milk fat and protein. Among the best cows in terms of lifelong productivity are mainly daughters of Leningrad breeding bulls Bubenchik 712 bred in "Petrovsky" breeding farm, Peach 3601 bred in "Lesnoye" breeding farm.

Table 3. *The best cows in terms of lifetime productivity*

Name and № of the cow	Date of birth	Name and № of the father	Age in lact.	Lifetime productivity, kg		
				Milk yield, kg	Fat, kg	Protein, kg
1	2	3	4	5	6	7
808 Murzilka	24.02.07	Graf 4742	5	40413	1649	1326
2230 Svetlitsa	09.02.10	Bubencik712	3	40645	1569	1349
8555 Acacia Ax	08.08.10	Fels 462090	4	40835	1601	1360
100 Nalyvka	10.02.07	Peach 3601	6	41158	1708	1354
2113 Gospozha	07.11.09	Bubencik 712712	4	41192	1664	1368
603 Vyatka	30.11.08	Peach 3601	6	41331	1662	1360
763 Zhdanka	28.01.06	Lazurit 632844	7	41401	1689	1354
2069 Gubka	17.07.09	Drozd 889	5	42710	1696	1409
2158 Cherry	08.12.09	Bubencik 712	4	42788	1699	1421
856 Volzhanka	19.06.06	Lazurit 632844	7	43371	1822	1418
373 Prima	02.03.08	Peach 3601	6	44245	1827	1482
9001 Chrysanthemum	05.05.06	Lazurit 632844	6	44866	1898	1463
235 Rosynka	01.03.08	Peach 3601	6	45056	1793	1496
1608 Zorka	03.10.09	Lombardo 61740360	5	46471	1826	1533
487 Ulovka	05.04.08	Peach 3601	6	47422	1973	1598
31 Mozaika	10.12.07	Peach 3601	6	53479	2177	1760
900 Metelica	29.04.06	Lazurit 632844	6	56846	2410	1876
175 Sputnitsa	03.04.08	Peach 3601	5	63827	2553	2087

Thus, in order to improve the economic indicators of the establishment, it is necessary to increase the milk yield not only for lactation, but also for the entire period of the productive life of animals. A high lifetime milk yield characterizes the strength of the constitution, the health and longevity of cows.

Conclusions

Thus, in JSC "Plemzavoda" Dmitrievo "Kasimovsky district of Ryazan Oblast, Holsteinized black-and-white cows will have the highest lifetime productivity at six lactations.

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GREAT SANDY
DESERT
GIBSON
DESERT
SIMPSON
DESERT
GREAT VICTORIA DESERT
Great Australian
Bight
CANBERRA