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МОДЕЛИРОВАНИЕ ЭЛЕКТРИЧЕСКИХ СВОЙСТВ ТВЕРДЫХ ГЕТЕРОСТРУКТУР И КЕРАМИКИ НА ОСНОВЕ КАРБИДА КРЕМНИЯ

MODELING OF ELECTRICAL PROPERTIES OF SOLID HETEROSTRUCTURES AND CERAMICS BASED ON SILICON CARBIDE

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Аннотация. *В настоящей работе рассмотрены методы расчета, анализа и математического моделирования электрических свойств и характеристик структур и керамических полупроводниковых материалов на основе карбида кремния. Сформулированы преимущества метода МДФГ – динамических функций Грина, формул Кубо-Гринвуда и их применение к мезоскопическим и размерным эффектам, андерсоновской локализации носителей, переходам Мотта: эффект гигантского усиления диэлектрической проницаемости (SiC-AlN), концентрационная зависимость проводимости (SiC-AlN, SiC-BeO) и др.*
В целях детального исследования электрических свойств и характеристик полупроводниковых материалов возникает необходимость в изучении особенностей поведения диэлектрической проницаемости в керамических структурах SiC-AlN.

Материалы и методы. *Предложенные модели использованы для интерпретации особенностей поведения электропроводности в зависимости от температуры и диэлектрической проницаемости широкозонных полупроводников и структур $(SiC)_{1-x}(AlN)_x$. Развитая на основе МДФГ и аналитических выражений Кубо-Гринвуда модель температурной зависимости электропроводности для полупроводниковых структур $(SiC)_{1-x}(AlN)_x$, позволила при различных допустимых значениях температуры построить логарифмические зависимости электропроводности этих гетероструктур.*

Результаты и обсуждение. *В настоящей работе продемонстрированы основные особенности температурного поведения проводимости $\sigma_x(T)$ в широкозонных карбидокремниевых гетероструктурах: особенности электропроводности, которые обусловлены андерсоновской локализацией носителей – немонотонная температурная зависимость электропроводности $\sigma_x(T)$, а также особенности, связанные с наличием фазового перехода Мотта изолятор-металл – стандартные температурные зависимости $\ln(\sigma/\sigma_0)$. Полученные на низких частотах результаты анализа и моделирования эффекта усиления диэлектрической проницаемости хорошо согласуются с данными проведенных экспериментов.*

Заключение. *В работе представлены основные результаты математического моделирования, анализа и расчетов, важных электрофизических характеристик и свойств широкозонных полупроводниковых материалов, керамик и гетероструктур SiC - AlN с использованием метода функций Грина и аналитических соотношений Кубо-Гринвуда. В рамках рассмотренного подхода предложены математические модели, проведен анализ, выполнены расчеты и представлена интерпретация разных аномальных эффектов и выявлены особенности свойств широкозонных полупроводниковых материалов и структур микро- и наноэлектроники. Результаты вычислений и моделирования свойств, а также новых эффектов в широкозонных полупроводниковых материалах рассмотренных структур показали, что изученный и развитый подход на основе МДФГ и соотношений Кубо-Гринвуда могут быть использованы для математического описания, анализа различных характеристик полупроводниковых гетероструктур, а также при проведении исследователями соответствующих экспериментов.*

Ключевые слова: электроповодность, диэлектрическая проницаемость, переход Мотта, гетероструктуры, карбид кремния.

Abstract. *In this paper, methods for calculating, analyzing, and mathematical modeling of electrical properties and characteristics of structures and ceramic semiconductor materials based on silicon carbide are considered. The advantages of the MDFG method – dynamic Green functions, Kubo-Greenwood formulas, and their application to mesoscopic and size effects, Anderson carrier localization, Mott transitions are formulated: the giant dielectric constant gain effect (SiC-AlN), the concentration dependence of conductivity (SiC-AlN, SiC- BeO) et al. In order to conduct a detailed study of the electrical properties and characteristics of semiconductor materials, it becomes necessary to study the behavior of the dielectric constant in ceramic jets SiC-AlN textures.*

Materials and methods. *Materials and methods. The proposed models were used to interpret the features of the conductivity behavior depending on the temperature and dielectric constant of wide-gap semiconductors and structures (SiC) 1-x (AlN) x. The model of the temperature dependence of the electrical conductivity for (SiC) 1-x (AlN) x semiconductor structures developed on the basis of MDFG and Kubo-Greenwood analytic expressions made it possible to construct the logarithmic dependences of the electrical conductivity of these heterostructures at various permissible temperatures.*

Results and discussion. *In this work, we demonstrated the main features of the temperature behavior of conductivity in wide-gap silicon carbide heterostructures: features of electrical conductivity due to the Anderson localization of carriers – the nonmonotonic temperature dependence of electrical conductivity, as well as features associated with the presence of the Mott insulator-metal phase transition – standard temperature dependences. The results of analysis and modeling of the effect of amplification of the dielectric constant obtained at low frequencies are in good agreement with the data of experiments.*

Conclusion. *The paper presents the main results of mathematical modeling, analysis and calculations, important electrophysical characteristics and properties of wide-gap semiconductor materials, ceramics and SiC – AlN heterostructures using the method of Green functions and Kubo-Greenwood analytic relations. Within the framework of the considered approach, mathematical models are proposed, analysis is carried out, calculations are made and interpretation of various anomalous effects is presented, and features of the properties of wide-gap semiconductor materials and structures of micro- and nanoelectronics are revealed. The results of calculations and modeling of properties, as well as new effects in wide-gap semiconductor materials of the considered structures showed that the studied and developed approach based on MDFG and Kubo-Greenwood relations can be used for mathematical description, analysis of various characteristics of semiconductor heterostructures, as well as when researchers experiments.*

Key words: electric conductivity, dielectric constant, Mott transition, heterostructures, silicon carbide.

1. The calculation of the electrical conductivity of solid heterostructures based on silicon carbide. We know that the main quantities characterizing the physical properties of semiconductor structures are such parameters as: electrical conductivity σ, carrier mobility μ, concentration n, band gap ΔE_g, activation energy $\Delta E_{1,2}$, lifetime τ, diffusion length L, and some others. Many of the listed values can be found from the dependence of electrical conductivity on temperature.

To find the electrical conductivity of solid silicon carbide heterostructures, we use the 4-probe method that is most suitable for our purposes, because it surpasses the others in its metrological parameters and also does not require the manufacture of a special form of samples and attachment of ohmic contacts to it to find conductivity of solid silicon carbide heterostructures. For applying the method, a necessary condition is the flat surface of the sample under study, the linear dimensions of which significantly exceed the linear dimensions of the probe system. The highest temperature (~ 1000K) achievable during measurements was limited by the design and physical capabilities of the measuring unit, as well as an error not exceeding 5%. Knowing that the intrinsic electrical conductivity in silicon carbide SiC begins to appear at a temperature of about 1700 K, the electrical conductivity we measured will be purely impurity.

In order to calculate and simulate the temperature dependence of electrical conductivity, using the Kubo - Greenwood relations for semiconductor silicon carbide heterostructures with relatively low carrier mobility, we obtain the expression ($g_i(\varepsilon)$ and $M_{\alpha i}$ – the density of states and the effective mass of the density of states in the i-th part of the spectrum, $\Delta\varepsilon_i$ – bottom shift of the conduction band due to spontaneous deformation and polarization; $k_Á$ – Boltzmann coefficient; $f_i(x)$ – Fermi function):

$$\sigma^i_{\alpha\beta}(T) = 2e^2\int_0^\infty\left(-\frac{\partial f_i}{\partial\varepsilon}\right)\upsilon^i_\alpha(\varepsilon)\upsilon^i_\beta(\varepsilon)\tau^i_{\alpha\beta}(\varepsilon,q_i^F)g_i(\varepsilon)d\varepsilon,$$

$$\hbar\upsilon^i_\alpha(\varepsilon)=\frac{\partial\varepsilon}{\partial k^i_\alpha},\quad f_i(x)=[\exp(x-j_i)-1]^{-1},$$

where $x = \varepsilon/k_Б T$, $j_i = j - \Delta x_i, \Delta x_i = \Delta\varepsilon_i / k_Б T$, $j = \zeta / k_Б T$, $q_i^F = k_i^F / \sqrt{M_{ai}}$, ζ, k_i^F – is chemical potential and Fermi momentum.

Comparing with the formula for thermal conductivity, we similarly get the dependence:

$$\sigma(\varepsilon) = \frac{\pi e^2 \hbar^2}{m} < |D_\varepsilon|^2 > N(\varepsilon),$$

where N(ε) – is the density of states, D_ε – is the matrix element of the wave vector ($\hbar k = m\upsilon$); <…> is the averaging over all states with wave functions Ψ_l, $\Psi_{l'}$,that correspond to the transition energy ε. In the case of sufficiently strong scattering (S~τ^{-1}), using the standard formulation of the molecular kinetic theory will be impossible, while the mean free path cannot be taken sufficiently large (L>a) relatively a≈π/k (L>a, Lk>>1).

In this case, using the analogy with silicon carbide films, it is necessary to allow the formation of impurity bands from "deep" ones in the case of relatively large *x* » (O: E_c – 0,90÷0,95; V: E_c – 0,7÷0,97eV) and "shallow" N: E_c – 0,081÷0,142; Al: E_c + 0,10÷0,27eV) allowed states of impurities and their complexes (the so-called nanoinclusions). In this case, wide-gap semiconductor silicon carbide structures manifest themselves as semimetals with a pseudogap $\varepsilon_C - \varepsilon_F$, where ε_C and ε_F are the critical energy for the Mott insulator-metal transition and the Fermi energy, respectively.

It should be noted that at temperatures in the range 300<T<1000 K in the semiconductor silicon carbide structures $(SiC)_{1-x}(AlN)_x$ there is an unconditional dependence of the electrical conductivity σ(T) depends on impurities, therefore, the magnitude and temperature behavior of the conductivity become characteristic for systems with a pseudogap. Moreover, with an increase in the composition $x \to x_0 \le 1$ in these heterostructures, the pseudogap can decrease to zero ($\Delta E = \varepsilon_C - \varepsilon_F \to 0$), and then, at relatively low temperatures, we can expect that the electrical conductivity will begin to change according to the law

$$\sigma = \sigma_0 \exp(-\Delta E / 2k_B T)$$

Such structures are characterized by the fact that the activation energy will be quite close to wide-gap semiconductors (Figure 1), which possess mainly impurity conductivity $\Delta E_1 \approx 0{,}987$ eV и $\Delta E_2 \approx 0{,}123$ eV

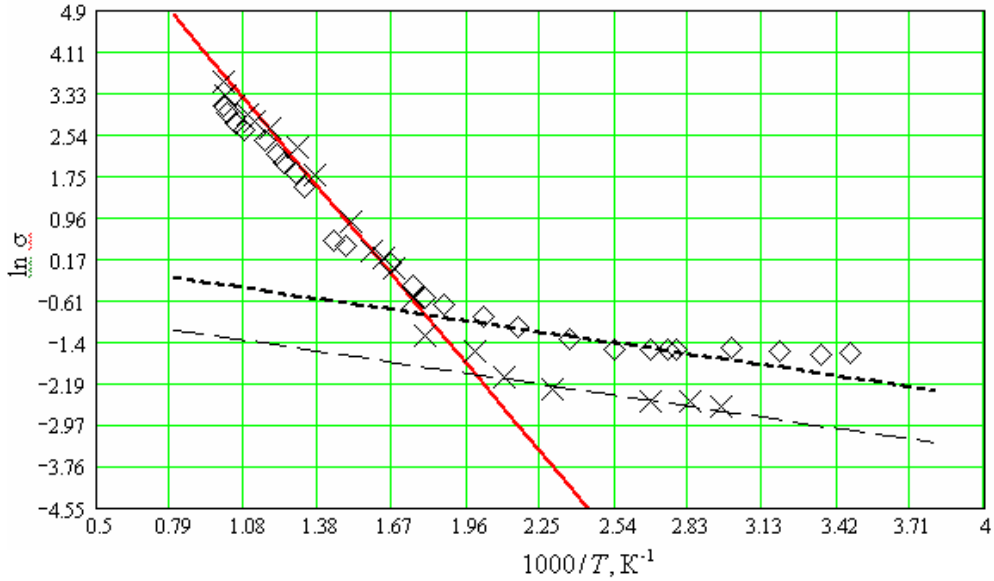

Fig. 1. The temperature dependence of conductivity in heterostructures $(SiC)_{1-x}(AlN)_x$:

– ++ – x = 0,033; ◇ – x = 0,042 ;

- solid line: $\Delta E_1 \approx 0{,}987 eV, \sigma_{01} = 10{,}9 \cdot 10^3$ Ом$^{-1}$ · см$^{-1}$;

and dashed lines: $\Delta E_2 \approx 0{,}123$ eV $\sigma_{02} = 2{,}7$ Ом$^{-1}$см$^{-1}$ (up); $\Delta E_2 \approx 0{,}123$, $\sigma_{03} \approx 0{,}7$ Ом$^{-1}$ · см$^{-1}$

(bottom) lines – model

With a decrease in temperature in such systems, the Mott transition can occur [1,2], then the dependence is known as $\ln(\sigma/\sigma_0) \approx (\varepsilon_a / T)^{1/4}$. This dependence at temperatures T<400^{0}K corresponds to the experimental data and we presented it in Figure 2. In this figure we see that on the $\ln\sigma = c - kx$ (*c*=3; *k*=19.3; $x = 1/T^{1/4}$) (it is indicated by a

dash-dot line) in the indicated temperature regime, all points obtained during the experiment fall, and on the graph $\ln\sigma \approx (1000/T)$,corresponding to the temperature dependence of the conductivity for *N* and *Al* in *TP-SiC* SiC (dashed line) these points are absent.

Thus, the validity of the assumption presented above is confirmed by our obtained temperature dependences of the electrical conductivity ln$\sigma(T)$, and our studies of various types of impurities indicate the possibility of overlapping impurity zones and the appearance of an insulator-metal phase transition in these systems at a critical value of $x=x_0$, for certain sufficiently large *x*. A detailed measurement of the concentration dependence of electrical conductivity $\sigma(x,T)$ at $x=x_0$ in silicon carbide based heterostructures $(SiC)_{1-x}(AlN)_x$ x also confirms the implementation of this electrical conductivity mechanism in SiC heterostructures at temperatures below 400 K.

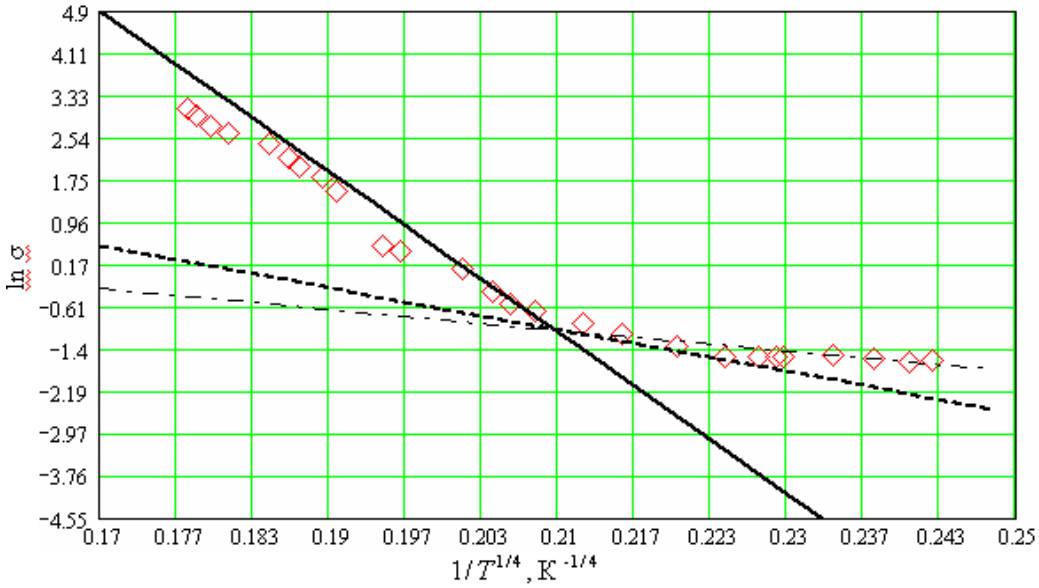

Fig. 2. The electrical conductivity of semiconductor heterostructures $(SiC)_{1-x}(AlN)_x$ as a function $1/T^{1/4}$; solid and dashed lines - theory $\ln\sigma(1000/T)$ and dash-dotted line - model $\ln\sigma(1/T^{1/4})$; ◇ – the experience [3]

2. A model of the effect of giant enhancement of dielectric permeability (DP) in silicon carbide ceramics. To understand the reasons for the behavior in silicon carbide-based heterostructures, we consider the most common theoretical approaches to modeling DP of composite materials. In such models, a uniform distribution of filler particles in the form of a sphere or ellipsoids in the base material is allowed. The following models are most known [2]:

1) Maxwell-Garnett model

$$\varepsilon = \frac{\varepsilon_2\left[\varepsilon_1 + 2\varepsilon_2 + 2\eta(\varepsilon_1 - \varepsilon_2)\right]}{\varepsilon_1 + 2\varepsilon_2 + \eta(\varepsilon_2 - \varepsilon_1)}; \quad (1)$$

2) Bruggeman model

$$(1-\eta)\frac{\varepsilon_2 - \varepsilon}{\varepsilon_2 + 2\varepsilon} + \eta\frac{\varepsilon_1 - \varepsilon}{\varepsilon_1 + 2\varepsilon} = 0;$$

3) model Lounge $\varepsilon^{\frac{1}{3}} = \eta\varepsilon_1^{\frac{1}{3}} + (1-\eta)\varepsilon_2^{\frac{1}{3}}$.

Here ε, ε_1, ε_2 – are, respectively, the DP of the composite, filler, and matrix; $\eta = V_1/V_0$ – the ratio of the volume of filler and the total volume of the composite.

During experiments [3] in ceramic structures of SiC-AlN, it was found that the concentration of aluminum nitride η in the matrix (SiC) at sufficiently low frequencies of the external electromagnetic field ($\omega \to 0$) has a very large DP. In this regard, the need arose for a detailed study of these processes in SiC-AlN semiconductor ceramics in order to improve the technological parameters of these materials and obtain such structures with the required DP values $\varepsilon(\omega)$.

This paper presents the results of the development of the DP model for SiC-AlN ceramics, and also shows the possibilities of obtaining samples of such semiconductor materials with the effect of a "giant" increase in DP.

In this regard, to model the dielectric constant, we used the well-known Maxwell-Garnett approach, which explains the effect of the enhancement of DP in matrix media containing microinclusions in the form of a sphere or ellipse. This model is implemented under the assumption that the nanoinclusions of molecules or clusters of nitrogenous aluminum in the SiC matrix are polarized along the sphere (or ellipse) [2].

In this case, the calculated formula DP (1) allows one to obtain good results at low ($\eta \to 0$)and high ($\eta \to 1$) concentrations of inclusions, is quite well known and is used to analyze the behavior of $\varepsilon(\omega)$ matrix systems. In SiC-AlN ceramic structures, for calculation, it is necessary to replace, for inclusions in the form of a sphere, the depolarization factor equal to 1/3 with the depolarization factor of the spheroid $0 < A_c(\xi) < 2$, corresponding to a given field orientation along the c axis and depending on the aspect ratio of the ξ spheroid in the Maxwell-Garnett expression. For semiconductor ceramics based on SiC-AlN, we obtain the formula:

$$\varepsilon = \varepsilon_m \left[1 + \frac{\eta}{(1-\eta)A_c + \varepsilon_m / (\varepsilon_i - \varepsilon_m)} \right]. \tag{2}$$

In the absence or negligible dielectric loss, formula (2) assumes that it is experimentally confirmed that the DP grows with increasing inclusion concentration η. If we consider elongated metal ellipsoids, then the depolarization parameter A_k ($k = a, b, c$) will take the values $0 < A_c < 2$ and $0 < A_a < 1$. Moreover, the material of the ellipsoid can be either optically more dense (at $A_k < 1$), or optically less dense ($A_k > 1$) in comparison with the material of the environment. It is important to note that the use of the standard value of A_c leads to a decrease in the possibilities allowed according to formula (2).

It should be noted that the dielectric constant of microinclusions and the matrix ε_m in the general case are complex values:

$$\varepsilon_i = \varepsilon_i' + i\gamma_i \omega^{-1}, \tag{3}$$
$$\varepsilon_m = \varepsilon_m' + i\gamma_m \omega^{-1},$$

where γ_i, γ_m – are the specific conductivities of the components, respectively, and ω – is the circular frequency of the external electric field.

Therefore, for DP $\varepsilon(\omega)$ of semiconductor ceramic structures SiC-AlN, according to expression (3), we obtain:

$$\varepsilon = \varepsilon' + i\varepsilon'',$$
$$\varepsilon' = \varepsilon_m' + \eta a \frac{\delta^2 \Delta^2}{a^2 + b^2}, \quad \varepsilon'' = \varepsilon_m'' + \eta b \frac{\delta^2 \Delta^2}{a^2 + b^2}. \tag{4}$$

In the formula (4), the following notation is used:

$$a = (1-\eta)A_c \Delta^2 \varepsilon_m' + \delta^2 \Delta_{im}, \; b = (1-\eta)A_c \Delta^2 \Gamma_m + \delta^2 \Gamma_{im},$$
$$\Delta^2 = \Delta_{im}^2 + \Gamma_{im}^2 = (\varepsilon_i' - \varepsilon_m')^2 + (\gamma_i - \gamma_m)^2 / \omega^2,$$
$$\delta^2 = \varepsilon_m'^2 + \Gamma_m^2 = \varepsilon_m'^2 + \gamma_m^2 / \omega^2.$$

The dielectric loss tangent δ_1 is expressed as:

$$tg\delta_1 = \frac{\varepsilon''}{\varepsilon'} = \frac{\varepsilon_m''(a^2 + b^2) + \eta b \delta^2 \Delta^2}{\varepsilon_m'(a^2 + b^2) + \eta a \delta^2 \Delta^2}. \tag{5}$$

Formulas (5) for the dielectric loss tangent and (4) for permittivity $\varepsilon'(\omega)$ are obtained using the reference modeling method [4] and a number of assumptions about the geometry and shape of microinclusions, as well as the known polarization processes in heterosystems in accordance with the Maxwell-Garnett approach . Calculations showed that these expressions at low frequencies qualitatively describe the effect of colossal amplification of the DP $\varepsilon'(\omega)$ and the behavior of the dielectric loss tangent.

In fig. Figures 3 - 8 present, in comparison with experiment, the results of calculations and modeling the dielectric constant of semiconductor silicon carbide ceramics in accordance with formula (4), as well as the dielectric loss tangent by formula (5).

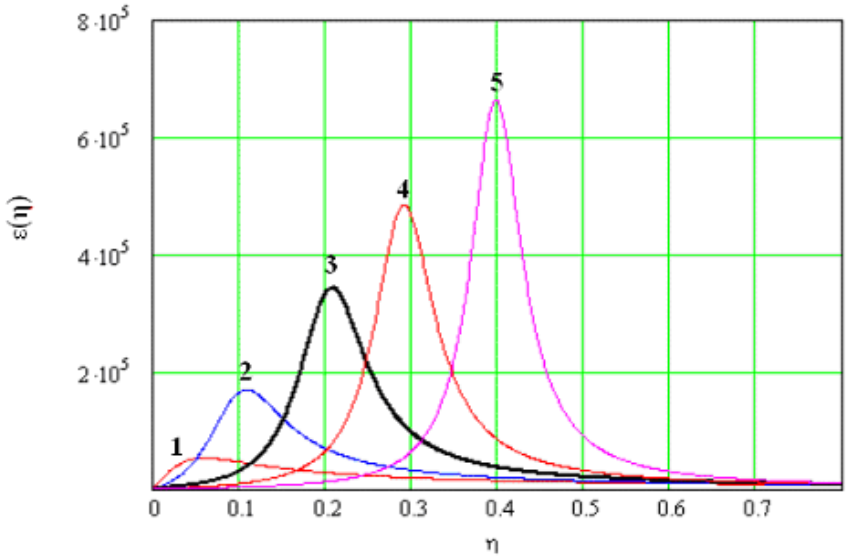

Fig. 3. The dependence of the dielectric constant on the concentration for SiC-AlN ceramics with an aspect ratio A_c: 1– 1,00; 2 – 1.10; 3 – 1.25; 4 –1.40; 5 –1,65 при $\varepsilon'_m = 1000$ и $\varepsilon'_i = 6000$; $\Gamma_m = 10^5$; $\Gamma_i = 0$.

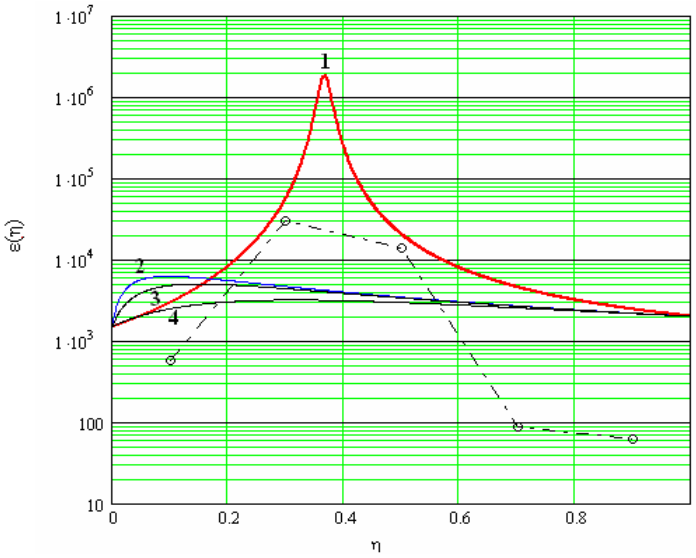

Fig. 4. The dependence of the dielectric constant on the concentration for SiC-AlN ceramics: : 1– A_c= 1,58, $\Gamma_m = 10^5$; 2 – A_c= 0,90, $\Gamma_m = 10^5$; 3 – $0.15 \cdot 10^5$; 4 – $5 \cdot 10^3$; $\varepsilon'_m = 1500$; $\varepsilon'_i = 2000$.
Solid lines - model, points - experience with frequency $\omega = 0.1$ kHz

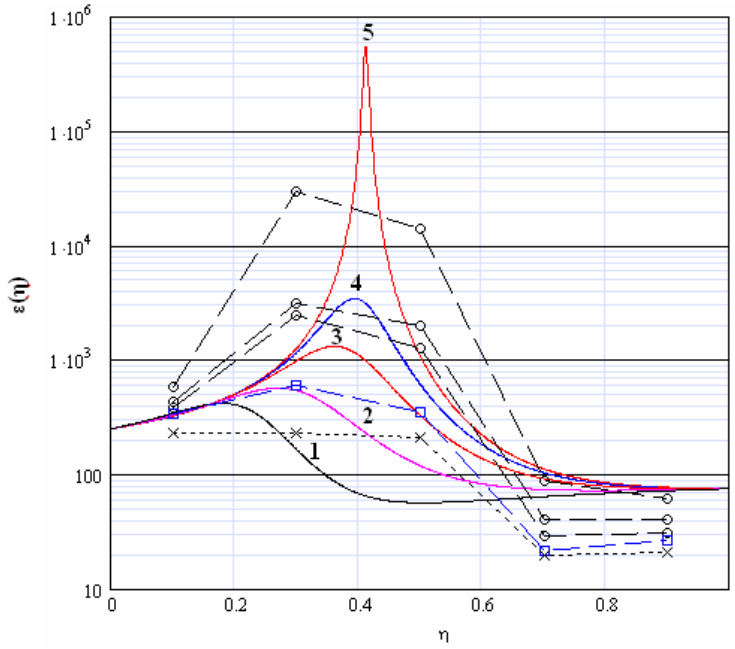

Fig. 5. DP dependence for SiC-AlN heterosystems for various values of the frequency ($\Gamma_m = \gamma_m / \omega$ and $\Gamma_i = 0$) of the electric field: 1 – $\Gamma_m = 100$; 2 – 200; 3 – 420; 4 – 750; 5 – 10^4; A_c=1,70; $\varepsilon'_m = 250$, $\varepsilon'_i = 75$. Solid lines - model curves; points are experimental at frequency values: $\omega = 1$ MHz; 10; 1; 0.5 and 0.1 kHz

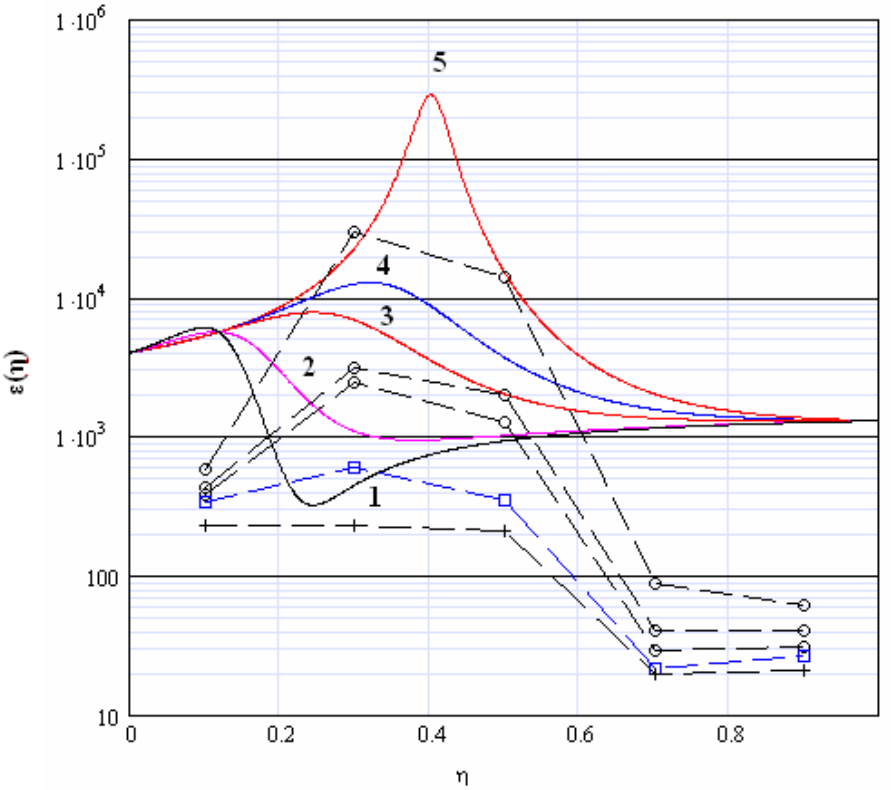

Fig. 6. Concentration dependence of DP for SiC-AlN heterosystems at: 1–5: $\Gamma_m = (0.6 - 1 - 3 - 5 - 30) \cdot 10^3$; A_c=1.70; $\varepsilon'_m = 4000$; $\varepsilon'_i = 1300$. Solid lines - model curves; points - experimental results [3], respectively, with frequency values: $\omega = 1$ MHz; 10; 1; 0.5 and 0.1 кHz

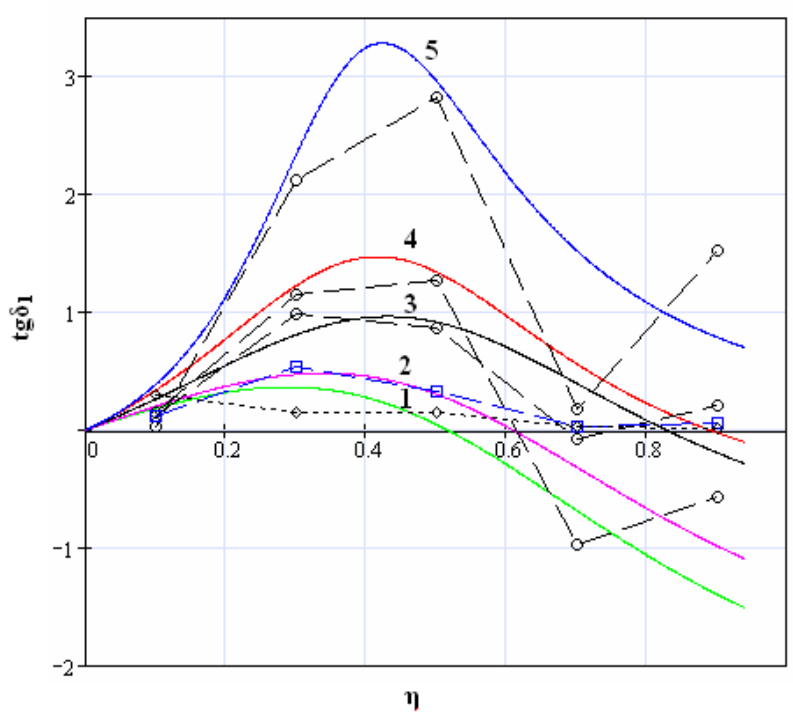

Fig. 7. The dielectric loss tangent in SiC-AlN heterosystems at: 1 – $\Gamma_m = 250$ ($\Gamma_i = 170$), 2 – 220, 3 – 140, 4 – 100, 5 – 30; A_c=1.35; $\varepsilon'_m = 320$; $\varepsilon'_i = 48$; $\varepsilon''_m = 0$. Solid lines - model curves; points - experimental data, respectively, at frequency values: $\omega = 1\,\text{MHz};\ 10;\ 1;\ 0.5$ and 0.1 кHz

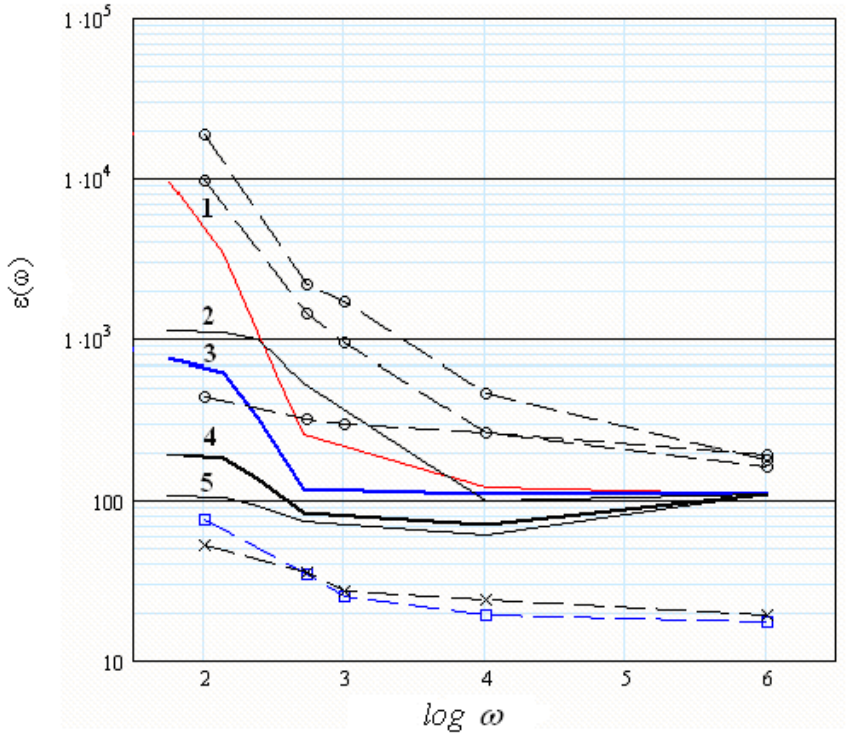

Fig. 8. Frequency dependence $\varepsilon'(\omega)$. Solid curves — model at microinclusion concentrations η: 1 – 0.4; 2 – 0.5; 3 – 0.3; 4 – 0.6; 5 – 0.7; - experimental data ($log\ \omega$), respectively, at concentrations: 0.3, 0.5, 0.1, 0.7, 0.9

Figures 3 and 4 show how it changes $\varepsilon'(\omega \to 0)$ for different values of the model parameters A_c и Γ_m. Lines 1 - 5 in Fig. 3 correspond to A_c ($0 < A_c < 2$) values from 1 to 1.65 at $\Gamma_m = 10^5$ and show how the line maximum ε' shifts depending on the concentration 0.02 to 0.40 with an increase in A_c. The value $\eta = 0.40$ is close enough to the corre-

sponding experimental values in terms of the position of the maximum of the curves of the giant enhancement effect of DP $\varepsilon(\omega)$ at small SiC-AlN-based ceramic structures in SiC. When $A_c < 1$, the position of the maximum $\varepsilon(\omega)$ does not exceed the values $\eta = 0.05 \div 0.15$, which corresponds to the calculated data for various quantities, Γ_m , when $A_c = 0.90$. Line 1 for the quantities $A_c = 1.58$, $\Gamma_m = 10^5$ and $\varepsilon'_m = 1500$, $\varepsilon'_i = 2000$, is selected in combination with the corresponding points of the largest experimental values $\varepsilon(\omega)$, but far from the maximum value ($\eta \sim 0.4$) at the maximum concentrations of microinclusions ($\eta \to 0$ and in particular $\eta \to 1$), the model curve differs quite a lot (by an order of magnitude or more) from the corresponding experimental data . A more detailed comparison with experimental data is shown in Fig. 8 for values; $A_c = 1.70$; $\varepsilon'_m = 4000$, and for different quantities Γ_m (γ_m / ω). Since the values ε'_m and ε'_i in this case are also far from the maximum, the calculated values also differ greatly from the experimental ones. The results of all calculations of the DP $\varepsilon'(\omega)$, shown in Fig. 6, they describe the behavior of the dielectric permittivity quite well, make it possible to correctly estimate the DP $\varepsilon'(\omega)$, at $\eta \to 0$ and $\eta \to 1$, but the maximum DP ε' calculated in the course of the calculations significantly exceeds the experimental data.

The results of calculations of the dielectric loss tangent $tg\delta_1$ (Fig. 7), in principle, are quite accurately consistent with the actual behavior $tg\delta_1$ in SiC-AlN ceramics, but the values Γ_m, corresponding to model lines 1 and 2 are opposite (with experience) and differ only by 3 – 4 times, while according to experimental data they differ by two to three orders of magnitude. In addition, qualitative agreement with the experimental data is observed at values $\Gamma_i = 170$, significantly different from the values of this parameter in Fig. 3 – 7. The experimental and model curves for a decrease in the effect of the enhancement of the DP $\varepsilon'(\omega)$ with increasing frequency are shown in Fig. 8. It should be noted that with an increase in the frequency at various values $\eta = 0.4,\ 0.5,\ 0.3,\ 0.6,\ 0.7$, model (Fig. 8) curves 1 – 5 generally adequately reflect a decrease in the DP $\varepsilon'(\omega)$ gain, but in the obtained model the range of permittivity $\varepsilon'(\omega)$ is narrower than in the corresponding experiment. As noted above, in our opinion, this is due to the fact that in the constructed model, the effect of giant enhancement of the DP occurs in a narrower range η (see Fig. 5).

We conclude that not all parameters of our model are consistent with experimental data for ceramics based on silicon carbide SiC. It is clear that expression (4) was obtained on the basis of the most general assumptions regarding the geometric shape of inclusions, the dielectric properties of the matrix, and of course, it would be difficult to assume that theoretical calculations correspond to experimental data only by changing the model parameters (3). However, shown in fig. 3 - 8, these theories do not exhaust all the possibilities of the model. Obviously, for comparison with experimental data on heterostructures and ceramics based on silicon carbide, a more careful choice of values of values is necessary ε'_m and ε'_i, the geometrical shape of microinclusions is specified and, depending on the aspect ratio ξ, it is necessary to clarify the values of the depolarization parameter A_c. In the task we posed, the limits of the values of the model parameters γ_i, γ_m, ω ($\Gamma_i = \gamma_i / \omega$). remained not completely determined. It should be noted that the lack of agreement between the experimental data and the simulation results is explained by the approximations and assumptions made in the analysis and development of the mathematical model. Therefore, in the model, the effect of colossal enhancement of the DP is manifested in a rather narrower range of concentrations of microinclusions η. At the same time, in the work, the authors managed to achieve a fairly good qualitative agreement between the experimental results and theoretical modeling of the DP heterosystems based on silicon carbide ceramics, which takes place for all the calculations (Figs. 3–8).

Conclusion. Thus, in this work, on the basis of the Kubo-Greenwood formula at various concentrations, we construct a mathematical model for calculating the electrical conductivity depending on temperature in structures based on solid solutions $(SiC)_{1-x}(AlN)_x$. For the semiconductor heterostructures based on silicon carbide $(SiC)_{1-x}(AlN)_x$, the logarithmic concentration dependences of the electrical conductivity ($\ln(\sigma)$) were obtained for various values of T ($10^4 / T$), which are consistent with experimental data. The analysis is carried out and the Mott phase transition and the localization of Anderson carriers in heterostructures of silicon carbide $SiC)_{1-x}(AlN)_x$. are considered. The results obtained by modeling a gigantic increase in permittivity at low frequencies are in good agreement with the data of the experiments.

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СИНТЕЗ МНОГОРЕЖИМНОЙ ИНТЕЛЛЕКТУАЛЬНОЙ СИСТЕМЫ УПРАВЛЕНИЯ СЛАБОФОРМАЛИЗУЕМЫМ ПРОЦЕССОМ

SYNTHESIS OF A MULTI-MODE INTELLECTUAL SYSTEM OF MANAGEMENT OF A WEAKLY FORMED PROCESS

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Аннотация. *Отмечены характерные особенности многих промышленных процессов биотехнических, биотехнологических, пищевых и других производств. К основным отнесены сложность получения математической модели вследствие неполноты знаний кинетических закономерностей, наличия нелинейностей различного вида в математической модели, нестационарность, а также значительная структурная и параметрическая неопределенность, проявляющаяся в процессе функционирования. Осуществлен синтез нейросетевой системы управления процессом с учетом многорежимности его функционирования в условиях неопределенности. Предложено режимы протекания процесса идентифицировать с помощью характерных изменений скорости изменения концентрации растворенного в среде культивирования автоматически контролируемого углекислого газа в отходящем из аппарата воздухе. На основе проведенного анализа результатов обучения нейронной сети различными методами установлена целесообразности применения алгоритма Левенберга-Марквардта, который обеспечивает большую точность и высокую скорость сходимости вблизи минимума, а, следовательно, позволяет существенно ускорить процедуру обучения. Используя алгоритм Левенберга-Марквардта, проведено обучение нейросетевых моделей объекта управления, каждая из которых на определенных режимах протекания процесса наиболее приближена к фактическому состоянию объекта. Это позволило реализовать основной принцип работы многорежимных систем управления, заключающийся в переключении алгоритмов управления с нейросетевыми моделями при смене режимов процесса, что позволяет обеспечить заданные показателей качества системы в каждом из режимов при изменяющихся условиях функционирования.*

Ключевые слова: многорежимная система управления, нейросетевая модель, неопределенность модели, объект управления, идентификация режимов, скорость изменения углекислого газа.

Abstract. *The characteristic features of many industrial processes of biotechnological, biotechnological, food and other industries are noted. The main ones are the difficulty of obtaining a mathematical model due to the incompleteness of knowledge of kinetic laws, the presence of various types of nonlinearities in the mathematical model, non-stationarity, as well as significant structural and parametric uncertainty that manifests itself in the process of functioning. The synthesis of a neural network process control system was carried out taking into account the multi-mode of its functioning in conditions of uncertainty. It is proposed that the process flow modes be identified using characteristic changes in the rate of change in the concentration of automatically controlled carbon dioxide dissolved in the culture medium in the air leaving the apparatus. Based on the analysis of the results of training the neural network by various methods, the feasibility of applying the Levenberg-Marquardt algorithm, which provides greater accuracy and high convergence rate near the minimum, and, therefore, can significantly accelerate the training procedure, has been established. Using the Levenberg-Marquardt algorithm, we trained neural network models of the control object, each of which, at certain modes of the process, is closest to the actual state of the object. This allowed us to implement the basic principle of multimode control systems, which consists in switching control algorithms with neural network models when changing process modes, which allows us to provide specified system quality indicators in each of the modes under changing operating conditions.*

Key words: multimode control system, neural network model, model uncertainty, control object, mode identification, carbon dioxide rate of change.

Introduction. Management of complex poorly formalized biotechnological and technological objects, as well as objects of heat supply systems, occurs, as a rule, under conditions of uncertainty, which is caused by the low reproducibility of the processes occurring in them and the action of uncontrolled disturbances. Such objects are characterized by the absence of a mathematical model due to the incomplete knowledge of kinetic laws, the presence of various types of nonlinear dependencies in the mathematical model, the multiplicity of model variables, as well as the significant uncertainty in the structure and parameters of the model that appears during operation. Such processes include various objects of heat supply systems, chemical, biotechnical and biotechnological, food and other processes of industrial production with their complex and not fully formalized models. Recently, when controlling processes in batch fermentation reactors, the principle of differentiating process modes has been introduced: different stages (modes) of the same process are carried out under different conditions in terms of temperature, pH, aeration, etc. Moreover, biologically valuable products are synthesized both in the exponential growth mode (nucleotides, many enzymes, vitamins, which are also called primary metabolites), and in the stationary growth mode (antibiotics, pigments, etc., which are called secondary metabolites), and the optimal conditions of these modes differ . Naturally, multi-mode determines new (additional) requirements for the synthesis of process and object control systems. The functioning of these systems should be carried out in transitional (unsteady) and steady-state modes and ensure the reproduction of a given trajectory of the optimum temperature, stabilization of the optimum temperature, or programmed control of the process temperature depending on the process mode. Currently, biotechnology is increasingly replacing chemical production: it is the production of drugs, vitamins, new fuels, and the solution of environmental problems. Biotechnological processes account for more than 40% of chemical-pharmaceutical production and this percentage is growing due to the creation of the latest generation of protein-based drugs [1]. In this regard, it seems relevant to synthesize an intelligent control system for poorly formalized processes, taking into account the capabilities of modern software tools and computing power of computers.

The purpose of the study is the implementation of the basic principle of constructing multi-mode control systems by switching control algorithms when changing process modes to provide specified indicators of the quality of the system in each of the modes under changing operating conditions.

Research method. One of the most effective methods for the synthesis of intelligent control systems of poorly formalized processes is a method based on the use of neural network (NS) technology [2,3,4]. However, despite the fact that the duration of the biomass and biosynthesis growth modes in real-time systems can be almost constant, the moments of the onset and end of each of the modes differ significantly. This leads to the need to identify the modes of cultivation and training of the neural network depending on the mode of operation. In this paper, it is proposed to use the parameters of the current state of the process [5] to determine the moments of transition from one mode to another. The rationale for this is as follows. The main modes of almost all biotechnological processes based on the microbiological synthesis of secondary metabolites are two modes: the first mode is the biomass accumulation mode, the second is the biosynthesis mode of the target product. In each of the modes, the ranges of values of the monitored parameters differ significantly, which makes it possible to consider these modes separately. This allows us to significantly simplify the calculations in the synthesis of the optimal control algorithm of the biotechnological process, on the one hand, and to solve the problem of operational switching of control algorithms when changing modes, on the other hand. Thus, the principle of multi-mode controlled biotechnological batch process leads to the need for rapid identification of the moments of the beginning and end of the modes during the operation of the system. We also note that with continuous cultivation there is no change in the regimes of culture development, as with periodic cultivation, and the process constantly proceeds in the regime with exponential growth of the population, therefore, it is not necessary to take into account the differentiation of cultivation regimes by regimes when controlling a continuous process. However, not in all cases a continuous process is preferable to a batch process. For example, at a low specific rate of biomass growth, a periodic process is not inferior to a continuous process in efficiency and is more profitable, since it is easier to implement. In addition, the intensive biosynthesis of many metabolic products occurs with a slow growth of biomass. In batch processes, the concentration of the target product in the culture fluid is usually higher than in continuous, which significantly increases the efficiency of the stages of isolation and purification of the product. All this indicates that periodic processes in the future will be applied and remain the main ones in many domestic productions of vitally important drugs and therefore their management is an urgent task in the context of import substitution.

The use of the flow time of the modes in order to differentiate them, as well as the change of control actions and parameters at predetermined predetermined time intervals, leads to the fact that, due to the low reproducibility of

the processes, the optimal flow conditions of one mode are superimposed on others. This leads to a decrease in the effect of the implementation of optimality conditions for each cultivation regimen separately. In this regard, the application of the principle of differentiation of modes necessitates the prompt determination of the time moments of switching modes, which can be done, for example, by means of a characteristic change in automatically controlled environmental parameters [5]. For an example in fig. Figure 1 shows the option when the cell growth rate is not limited by the concentration of the carbon substrate (it is in excess) and, therefore, the specific cell growth rate will be determined mainly by the content of dissolved oxygen (pO_2) in the medium [1]. However, it should be noted that to measure the composition of the medium, it is necessary to install pO_2 sensors, which are located in the device and are sterilized with it with hot steam, as a result of which their characteristics significantly affect the measurement accuracy. Thus, the difficult operating conditions of primary automation measuring instruments, due to the need for their thermal sterilization together with the apparatus on the one hand, and the lack of primary measuring transducers that can withstand steam sterilization, for monitoring and regulating dissolved oxygen, pH, redox potential, on the other parties are a serious obstacle to the control and management of bioprocesses.

A parameter well correlated with pO_2 is the carbon dioxide concentration automatically measured in the effluent from the apparatus. If the values of the concentration of oxygen and carbon dioxide in the exhaust air are multiplied by the value of the air flow through the apparatus, then you can get the respiration rate of microorganisms (CO_2 emissions) and the oxygen consumption rate of the microorganism culture [1]. Shown in fig. The 3 profiles of the "respiratory coefficient" and their practical coincidence for fermentation units of different volumes confirmed the similarity of the hydrodynamic situation at certain speeds of rotation of the mixer and air supply to aeration [1, 6] and the possibility of using the rate of change in the concentration of carbon dioxide to differentiate cultivation phases.

In fig. Figure 2 shows the operational conditional differentiation of the biomass growth and biosynthesis of the target product using characteristic changes in the sign of the rate of change of automatically controlled carbon dioxide. So, when controlling the process from the mode of adaptation of microorganisms to the mode of exponential growth of microorganisms, the rate of change is d (CO_2) / dt <0, and to the mode of slowing the growth of microorganisms d (CO_2) / dt> 0. From the above it follows that the information content of the CO_2 concentration is sufficient in order to use the concentration of CO_2 and its rate of change in various modes as inputs of a neural network system to support decision-making on the management of the process as a whole.

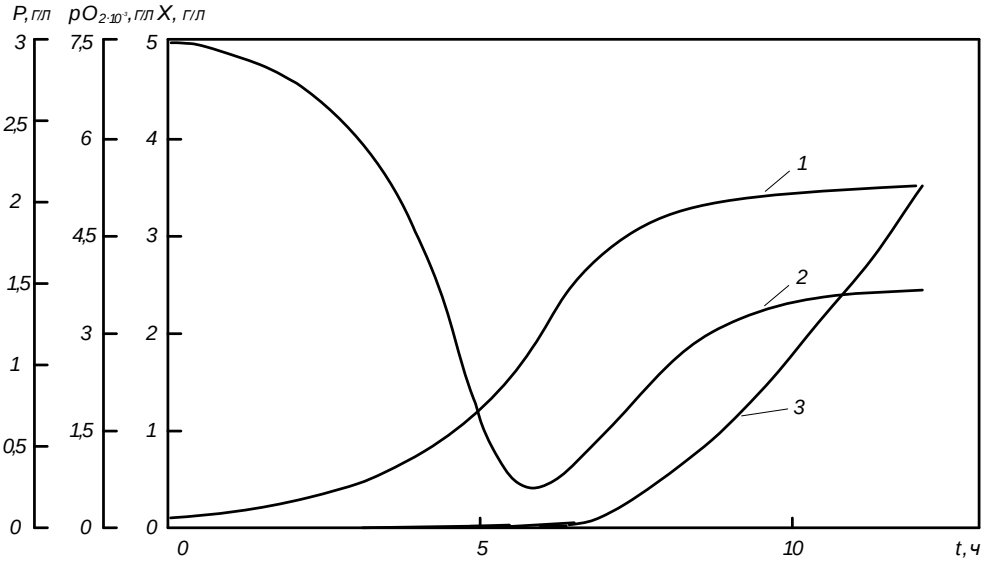


Fig. 1. Schedule of operational conditional differentiation of modes by speed changes in pO_2 concentration: 1 - cell growth curve (X); 2 - curve of dissolved oxygen (pO_2); 3 - concentration of accumulated protein by cells (P) [1]

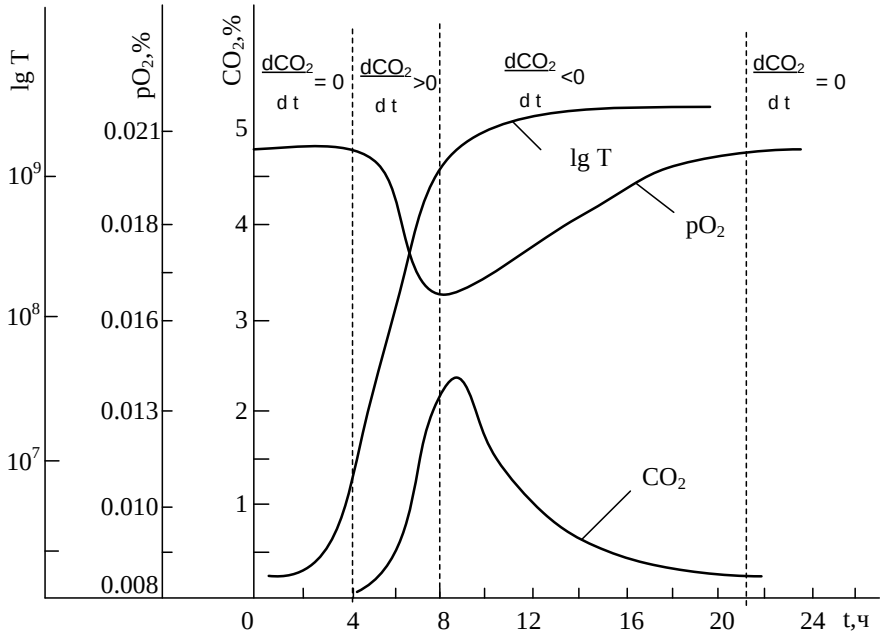


Fig. 2. Schedule operational identification of biomass growth regimes and biosynthesis of the target product by the rate of change of CO_2 in the air leaving the apparatus: log T is the logarithm of the spore titer; pO2 is the concentration of dissolved oxygen; CO_2- concentration of carbon dioxide in the exhaust air; d (pO_2) / dt - rate of change of pO_2

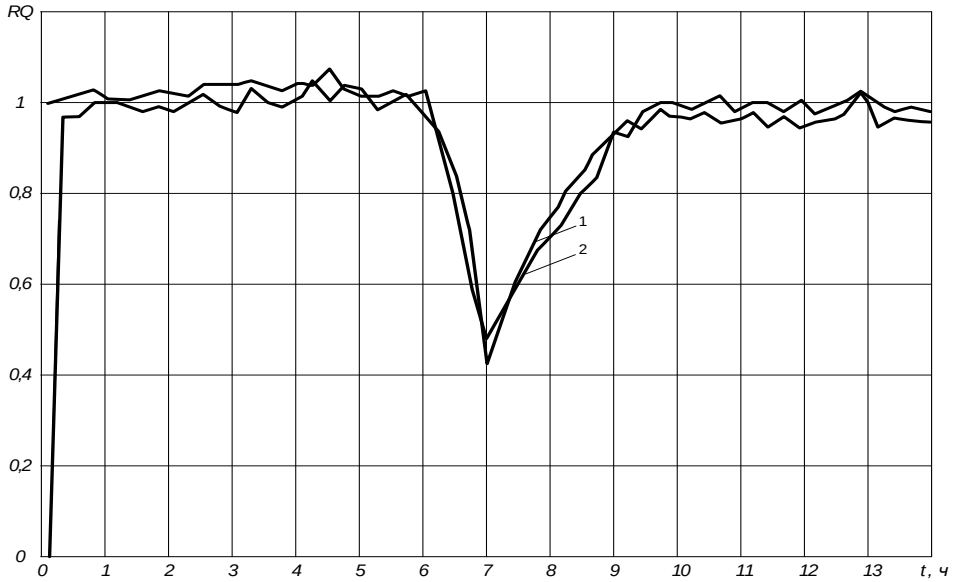


Fig. 3. The profile of the "respiratory coefficient" for units with a volume of 300 l (1) and a volume of 15 l (2) [1]

The learning process of the neural network model is carried out as a result of minimizing the objective function – some functional J characterizing the quality of training [8]. The functional is the standard error between the vectors of the desired (target) and real output of the NS:

$$J = \frac{1}{2}\sum_{q=1}^{Q}\sum_{i=1}^{S}\left(t_i^q - a_i^q\right)^2$$

where Q is the volume of the training sample; q is the number of the sample; S is the number of neurons in the output layer; a_i^q – is the signal vector element at the network output; t_i^q – is the vector element of the desired (target) signal values at the output of the network for sampling with number q.

To solve the problem in a neural network basis, a multilayer direct distribution neural network was used. The use of one or another learning algorithm allows us to determine the values of customizable parameters (weights and offsets) of the network that provide the minimum value of the error functional.

Research results and discussion. The results of a comparative analysis of the learning algorithms of the neural network model of a dynamic object are shown in table 1.

Table 1

The results of training a neural network by various methods

Name of training method	Maximum accuracy e = 10-5			The maximum number of training cycles N = 200		
	number of training cycles	training error	training time	number of training cycles	training error	training time
Fletcher-Reeves method	15 169	1,0 0,01	12,16 145,2	10 100	0,14 $5{,}77{\cdot}10^{-4}$	8,06 237,0
Polack-Ribeiro method	14 181	1,0 0,01	11,83 155,7	10 200	0,097 $4{,}9{\cdot}10^{-4}$	8,17 3,34
Bruden, Fletcher, Goldfarb and Shanno method	14 54 154	1,0 0,01 10^{-5}	10,67 41,43 116,3	10 200 –	0,96 0,04 –	4,31 82,81 –
Levenberg-Marquardt method	4 9 13	1,0 0,01 10^{-5}	5,1 10,63 14,27	10 90 –	$1{,}2{\cdot}10^{-4}$ $3{,}95{\cdot}10^{-8}$ –	9,98 112,4 –

The analysis of the results of training the neural network by various methods, taking into account the stopping criteria - maximum accuracy and maximum number of training cycles - indicates the appropriateness of the Levenberg-Marquardt algorithm, which provides greater accuracy and high convergence rate near the minimum, and, therefore, can significantly accelerate the training procedure . Using the Levenberg-Marquardt algorithm as a learning algorithm, we trained neural network models of the control object, each of which, at certain modes of the process, is closest to the actual state of the object, and the corresponding neural network controllers that were previously trained based on information about the model parameters object. To train the neural network, the following data were used: the size of the training sample - 8000; input signal values are random in the range [-6; 6]; the maximum learning error is 0.00001. The initial number of neurons in the hidden layer is previously assumed to be equal to three. The number of cycles (eras), during each of which all elements of the training sequence are successively fed to the input of the NS, and then its output values and learning quality indicators are calculated, are taken equal to 200. As a function of activation of the hidden network layer, a hyperbolic tangential function is selected, Belonging to the class of sigmoidal [9]. The function of activating the output layer is selected linear over the entire range of changes in the input argument, since the network outputs can take arbitrary values, if sigmoid functions were used in the last output layer of the network, then the output signals of the network would be limited by the range [-1 ; 1], ie when such a layer of signals with large positive and negative values arrives at the input, its output would tend to one of the indicated limits, which is undesirable. The number of neurons in the hidden layer of the neural network of the predictive model was chosen to be 9. The training of the neural network ended when the learning error of 1.12x10-8 was achieved, which is an indicator of the successful stage of the identification of a managed object.

A numerical simulation of a neural automatic control system was carried out when the set action was changed at four I-IV intervals with the following object parameters from the uncertainty interval [3]:

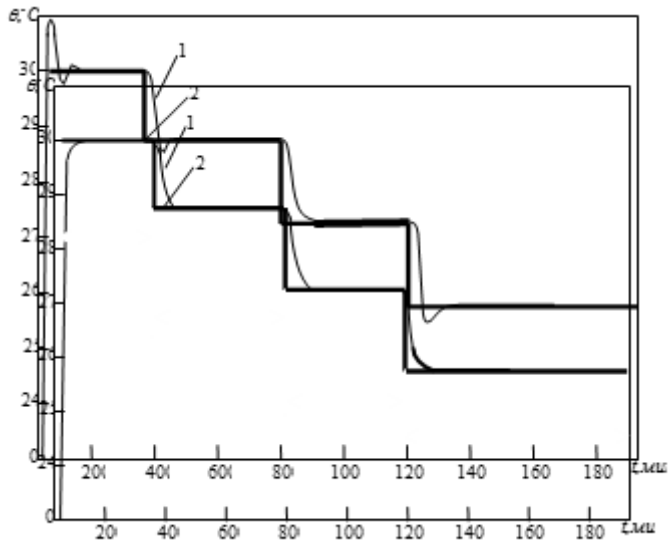
I interval: $K_{об}$ = 0.383 [^{0}C / m3 / h]; τ = 2.8 min; T1 = 14.35 min; T2 = 8.55 min;

II interval: $K_{об}$ = 0.1042 [^{0}C / m3 / h]; τ = 4 min; T1 = 27.26 min; T2 = 17.3 min;

III interval: $K_{об}$ = 0.1042 [^{0}C / m3 / h]; τ = 4 min; T1 = 41.56 min; T2 = 25.01 min;

IV interval: $K_{об}$ = 0,0766 [^{0}C / m3 / h]; τ = 2.2 min; T1 = 28.16 min; T2 = 16.83 min.

Figure 4 shows the transient processes in an automatic control system (ACS) using a multi-mode biotechnological process using neural network models obtained at various operating modes of the control object and the corresponding neural network regulators.



a) b)

Fig. 4. Simulation results of a multi-mode neural network ACS: 1 - transient for a controlled variable; 2 - stepwise setting action; a) ACS operating modes with one neural network model; b) ACS operating modes with four neural network models that are different for each section of the control program

As can be seen from fig. 4, the developed approach to the synthesis of a multi-mode neural network control system for an object allows substantiating a rational structure with switchable neural network models for various modes of a poorly formalized process.

Findings. The use of neural network models in industrial process control systems in combination with the identification of process modes and switchable control algorithms with models for each of the modes gives a positive result and can significantly improve the functioning of a controlled biotechnological system. Performance indicators are high performance in transition mode and increased accuracy of stabilization of operational parameters in steady state.

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ПРОГРАММНАЯ РЕАЛИЗАЦИЯ АЛГОРИТМОВ ОБРАБОТКИ ЗАШУМЛЕННЫХ ДАННЫХ

SOFTWARE IMPLEMENTATION OF NOISY DATA PROCESSING ALGORITHMS

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В настоящее время существует большое число программных пакетов для сглаживания данных (MatLab, Matematica, Statistica). Целью данного исследования является программная реализация набора наиболее эффективных алгоритмов для тестовых исследований быстро меняющихся данных.

Ключевые слова: сглаживание кривой, программное приложение, сигнал, данные.

Currently, there are a large number of software packages for data smoothing (MatLab, Matematica, Statistica). The purpose of this study is the software implementation of a set of the most effective algorithms for test studies of rapidly changing data.

Key words: curve smoothing, software application, signal, data.

Introduction. Modern information technology allows you to process and store virtually unlimited amounts of information. One type of such information is digital signals obtained, for example, as a result of experiments with video or audio equipment. Very often, these digital signals contain stepwise (spasmodic) changes that "clog" the information that is useful for analysis. Anti-aliasing is a technology used to eliminate the effect of "stepping" that occurs at the edges of a multitude of separate flat or three-dimensional images that are simultaneously displayed on the screen. Smoothing was invented in 1972 at the Massachusetts Institute of Technology in the Architecture Machine Group, which later became the main part of the Media Lab.

Curve smoothing algorithms are widely used in various studies. For example, Govindarajulu, Malloy, Ganguli, Spiegelman and Eisen [1] consider anti-aliasing techniques for modeling environmental epidemiological data. Astafiev, Shchedrin, and Yanusova in [2] proposed smoothing as a method that improves the process of convergence of curves with sharp changes in elevation. And Bocharov in [3] applied some smoothing algorithms to solve the problems of predicting the natural regime of the groundwater level. The analysis presented in the above works was carried out using various mathematical models. The construction of smoothed curves in these works was carried out using highly specialized software applications that are applicable only in these specific studies.

The purpose of this study is to develop and describe a software application that allows you to build a smoothed version of the measured data by some of the most relevant algorithms.

Methods. To develop the SCA software application (Smoothing Curve Application), the MS Visual Studio 2015 software application development environment was used (Figure 1).

Type of application - Windows Forms. Windows Forms allows you to implement a graphical user interface and is part of the Microsoft .NET Framework. It allows you to write traditional GUI applications with windows, forms. This approach simplifies access to Microsoft Windows interface elements by creating a wrapper for the Win32 API in managed code.

The main component used for plotting was the ZedGraph component. ZedGraph is a class library, user control, and web control for .NET written in C # to draw 2D line, line, and pie charts. It has full capabilities for detailed settings, but most options have default settings for ease of use [4].

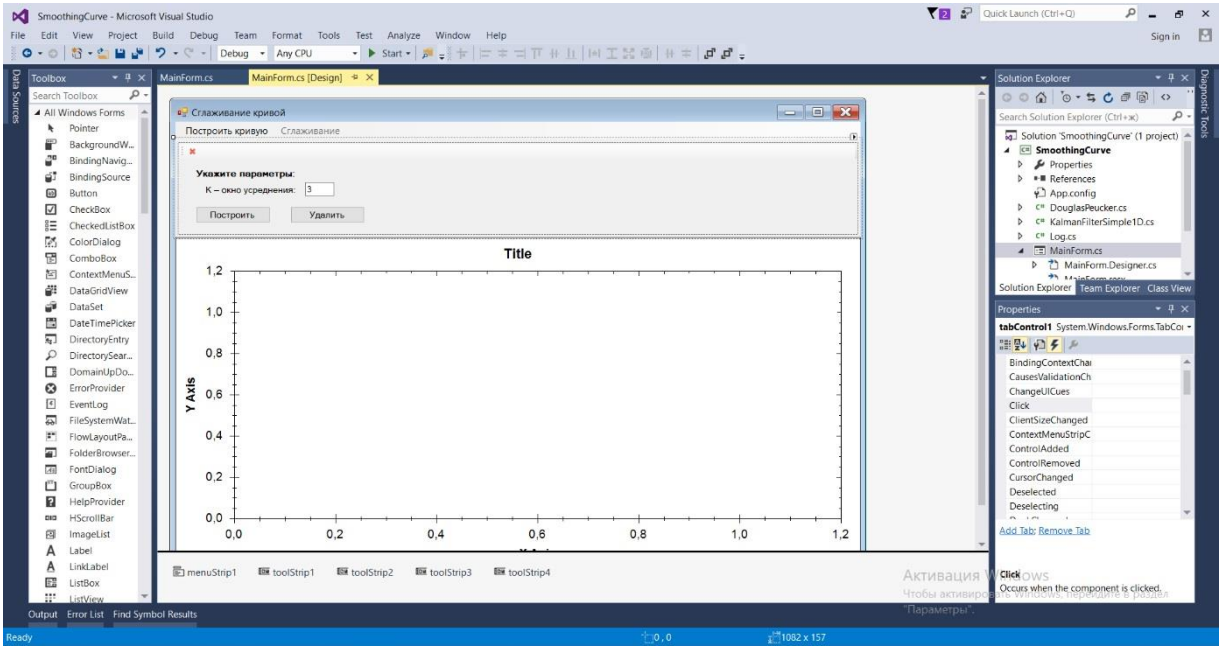

Fig. 1. MS Visual Studio 2015 interface

The programming language used to write the application code is C #. C # belongs to a family of languages with C-like syntax, of which its syntax is closest to C ++ and Java. The language has static typing, supports polymorphism, operator overloading (including explicit and implicit type conversion operators), delegates, attributes, events, properties, generalized types and methods, iterators, anonymous functions with support for closures, LINQ, exceptions, comments in the format XML [5].

Results. Figure 2 shows the main window of the developed SCA software application.

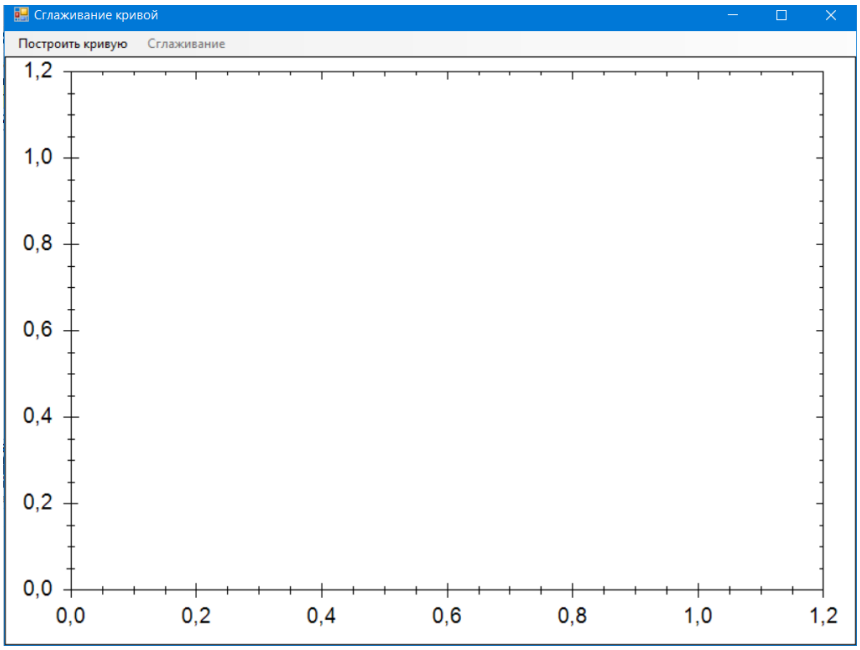

Fig. 2. SCA application interface

The main window contains the program menu and the workspace for graphing. The menu allows you to build a curve based on data obtained from a file or from a device (Figure 3).

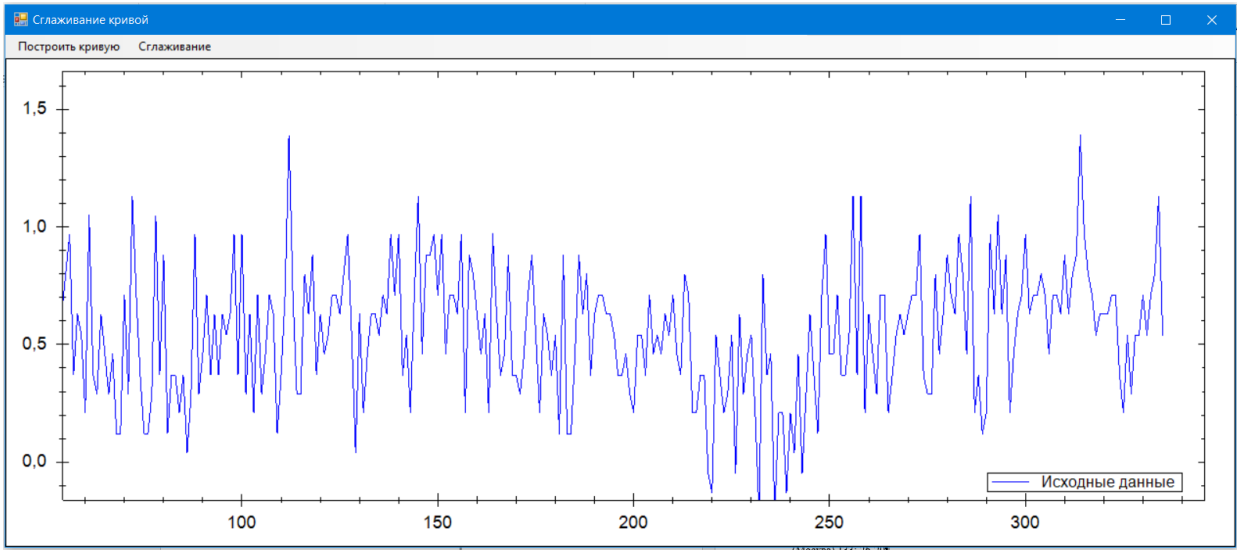

Fig. 3. Curve construction

After the graph is built, access to the Smoothing menu item is opened, which allows you to apply 4 types of smoothing:

1) according to Kalman;

2) low pass filter;

3) Douglas-Pecker algorithm;

4) moving average.

After specifying the necessary parameters on the graph, a curve is constructed that is obtained by the corresponding smoothing algorithm (Figure 4).

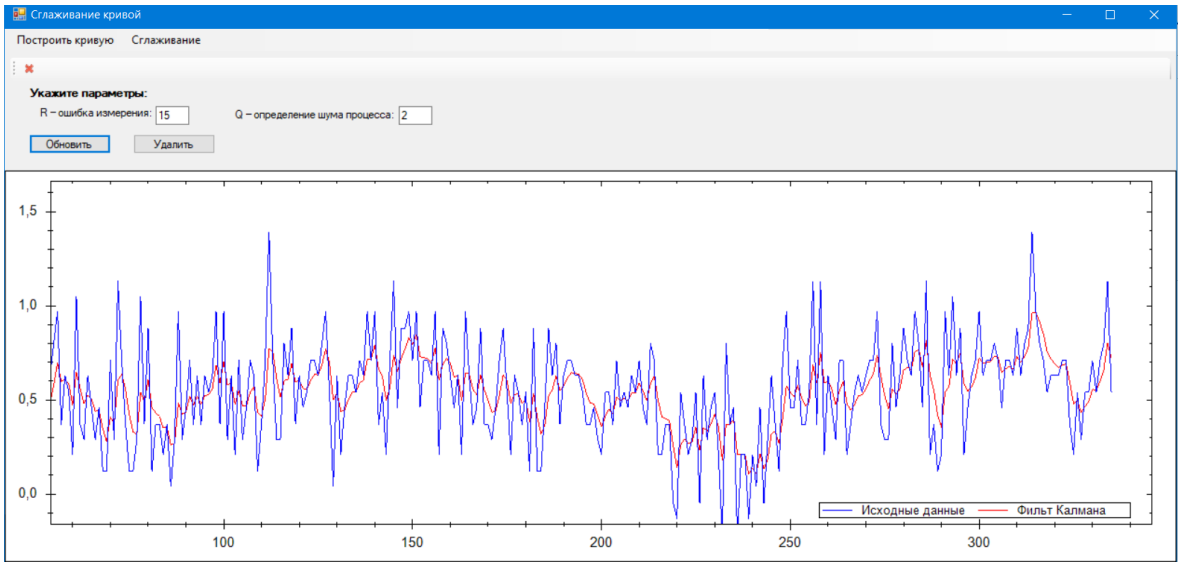

Fig. 4. Adding a smoothing curve

The SCA program allows you to simultaneously apply several types of smoothing for one curve, which in turn leads to the possibility of choosing the most optimal solution to the problem.

For a more detailed consideration of the curve, the program has a scaling function (Figure 5).

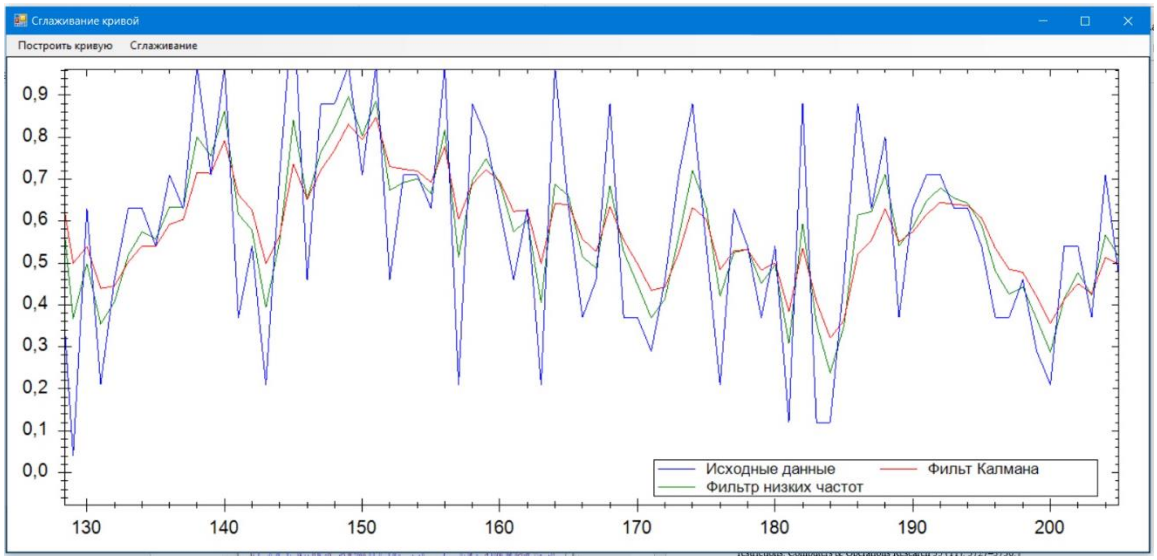

Fig. 5. Data scaling

If it is necessary to change the smoothing parameters, it is possible to update the smoothing curves or delete them.

Discussion and conclusions. The result of this work is the development of the SCA software application, which allows you to apply some algorithms for smoothing the curves obtained during the experiments. To develop a software application, the MS Visual Studio 2015 software application development environment and the C # programming language were used.

This software package uses the main existing types of data smoothing, has an intuitive interface and can be a good tool for conducting research in the field of mathematical processing of results.

For example, the use of averaging of GPS navigation data for unmanned systems by the Kalman algorithm made it possible to effectively control the course of a lethal object. The gusts of wind that had taken off the UAV course were detected by the system, analyzed and transferred to the control system for course correction. Whereas the short-term scatter of absolute altitude data according to GPS data associated with the measurement error (up to 4 meters with a duration of up to 100 milliseconds) was filtered and smoothed.

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ОЦЕНКА ДИНАМИКИ ГИДРОЛИТОСФЕРНОГО ПРОЦЕССА ПРИ ИЗМЕНЕНИИ РАДИУСА «КОЛОДЦА»

ASSESSMENT OF DYNAMICS OF HYDROLITHOSPHERIC PROCESS AT CHANGE OF RADIUS OF "WELL"

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В статье рассмотрена разработка метода адаптации параметров регулятора, зависящих от изменения радиуса «колодца», вызывающего изменение динамики процесса добычи гидроминеральных ресурсов.

Ключевые слова: радиус «колодца», гидроминеральная база, математические методы, метод адаптации, параметры регулятора.

The article discusses the development of a method for adapting the parameters of the regulator, depending on changes in the radius of the "well", causing a change in the dynamics of the process of producing hydro-mineral resources.

Key words: radius of "well", hydromineral base, mathematical methods, adaptation method, regulator parameters.

Introduction. Today, an important problem for mankind remains a negative impact on the environment, leading to environmental degradation. Polluting the environment, soil poisoning occurs, which entails pollution of the groundwater aquifer, which in the future can greatly affect the composition of water and our health. The annual increase in precipitation leads to a dilution of the mineral composition of narzan. The relevance of the study is to preserve the hydromineral resources of the KMV region. The use of modern mathematical methods, the introduction of water production process control systems will allow the rational use of the hydromineral base.

The purpose and objectives of the study. The aim of the study is to develop a method for adapting the parameters of the regulator when the radius of the "well" changes, causing a significant change in the dynamics of the production of hydro-mineral raw materials.

To achieve this goal, it is necessary to carry out:

1) Analysis of the mathematical model of mineral water deposits.

2) Synthesis of a field management system formed during
adaptation of the control system when changing the radius of the "well".

3) Investigate transients of a closed-loop control system.

The novelty of the results is determined by the fact that in the work:

1) The relationship of the radius of the "well" with the coefficient K.

2) The influence of the coefficient K (radius of the "well") on the parameters of the controller is investigated.

The practical significance of the results is determined by the possibility of improving methods for the synthesis of control systems for hydrolyte-sphere processes.

The paper studies the practical results of the synthesis of the KMV field management system. The task of synthesizing the control system of the Kislovodsk field is set. A model layer of the field is considered, a closed control system is built, taking into account the change in the radius of the "well".

The mathematical description of the control object

Ground water

$$\frac{\Delta H_1(x,y,z,\tau)}{\Delta\tau} = k_{1,x} * \frac{\Delta^2 h_1(x,y,z,\tau)}{\Delta x^2} + k_{1,y} * \frac{\Delta^2 h_1(x,y,z,\tau)}{\Delta y^2} + k_{1,z} * \frac{\Delta^2 h_1(x,y,z,\tau)}{\Delta {z_1}^2}) \quad (1)$$

$$0 < x < L_x; 0 < y < L_y; 0 < z < L_{z_1}$$

Пласт

$$\frac{\Delta H_2(x,y,z,\tau)}{\Delta\tau} = \frac{1}{\eta_2} * (k_{2,x} * \frac{\Delta^2 H_2(x,y,z,\tau)}{\Delta x^2} + k_{2,y} * \frac{\Delta^2 H_2(x,y,z,\tau)}{\Delta y^2} + k_{2,z} * \frac{\Delta^2 H_2(x,y,z,\tau)}{\Delta {z_2}^2}) + V(\tau) * \frac{\Delta H_2(x,y,z,\tau)}{\Delta x} \quad (2)$$

$$0 < x < L_x; 0 < y < L_y; 0 < z < L_{z_3}$$

where: h1 – pressure in the groundwater horizon;

H3 – pressure in the studied aquifer;

$k_{i,x}, k_{i,y}\ k_{i,z}$ – filtering coefficients according to the corresponding coordinates;

ηi = 0.00101 / m – is the elastic capacity of the layer;

V (τ) – pressure drop caused by the impact of the production well.

$$V(\tau) = Q^*K \quad (3)$$

where Q – is the production rate of the producing well;

K – is the gain;

δ (x0, y0, z0) is a function equal to unity if x = x0, y = y0, z = z0, and equal to zero in other cases;

x, y, z – spatial coordinates;

τ – time.

Boundary conditions (Darcy conditions) between the layers are set in the form:

Groundwater - Plast

$$h_1(x, y, L_{z_1}, \tau) = h_1(x, y, L_{z_1}, \tau) + b_1 \cdot (H_2(x, y, 0, \tau) - h_1(x, y, L_{z_1}, \tau)),$$

$$H_2(x, y, 0, \tau) = H_2(x, y, 0, \tau) - b_1 \cdot (H_2(x, y, 0, \tau) - h_1(x, y, L_{z_1}, \tau))$$

where b1 = 0.00003 days^{-1} is the overflow parameter.

Lower boundary of the reservoir

$$\partial H_3(x, y, L_z, \tau) / \partial z = 0$$

Side faces

$$h_1(0, y, z, \tau) = h_{1,0}; H_2(0, y, z, \tau) = H_{2,0},$$

$$\partial h_1(L_x, y, z, \tau) / \partial x = 0; \partial H_2(L_x, y, z, \tau) / \partial x = 0.$$

Forming the boundary conditions along the y coordinate, we assume that the thickness of the layers is such that disturbances from the intake wells do not affect the state of the formation at the boundary points:

$$h_1(x, 0, z, \tau) = h_1(x, L_y, z, \tau) = h_{1,0},$$

$$H_2(x, 0, z, \tau) = H_2(x, L_y, z, \tau) = H_{2,0}$$

We carry out a procedure for studying the static and dynamic characteristics of an object to determine static and dynamic coefficients, using different coefficients, depending on changes in the radius of the "well" [3]. Several options are to be considered, including different well radius, a study will be conducted for three different values of the well radius, with three different coefficients depending on the radius change.

Imagine there is one producing well [5]. The decrease in level (H_y) at the location of the production well, at a given flow rate (Q), is described by the dependence:

$$H_y = \frac{Q}{4\pi km} Ln\left(\frac{2{,}25 \cdot a^*}{r^2}\right) + \frac{Q}{4\pi km} Ln(t_{\text{пр}}) \quad (4)$$

where $Ln(t_{\text{пр}}) = Ln(\tau) - Ln(1+1{,}78 \cdot b \cdot \tau/\mu^*) = Ln(t) - (Ln(\tau) + Ln(1/\tau + 1{,}78 \cdot b^*/\mu^*))$

or $Ln(t_{\text{пр}}) = -Ln(1/\tau + 1{,}78 \cdot b^*/\mu^*)$

where τ – is the current time from the start of the well disturbance (0 << τ);

a * – is the reservoir conductivity;

km – reservoir conductivity;

b * – is the overflow parameter;

r – is the radius of the "well" (Fig. 1);

μ * – reservoir fluid loss.

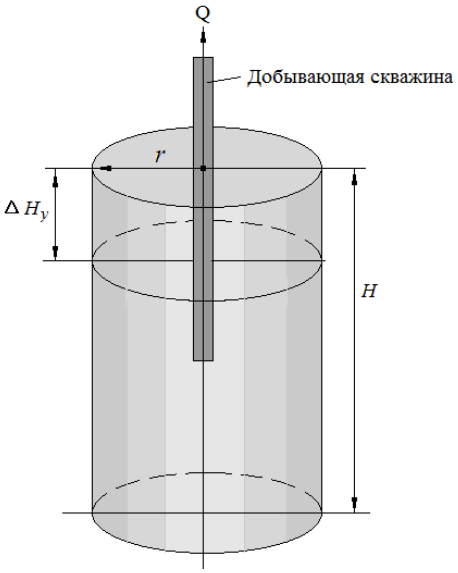

Fig. 1. Well scheme

With a sufficiently large τ, the dependence is converted to the form:

$$H_y = K_y \cdot Q,\ K_y = \frac{1}{4\pi km}\left(Ln\left(\frac{2{,}25 \cdot a*}{r^2}\right) - Ln(1{,}78 \cdot b^*/\mu^*)\right) \quad (5)$$

Assuming km = 201,33 m2 / day;

a^*/r^2 = 110 day^{-1};

μ^* = 0,00008;

b^* = 0,000059 day^{-1},

We get K_{r1} =0,001914, K_{r10} =0,0011613, K_{r30} =0,0003871.

If in the time Δτ the flow rate changed by ΔQ, then in the stationary mode the pressure drop caused by the action of the j-th production well (V4 (yj, τ)) can be written in the form $V_4(y_j) = \Delta H_y = K_y \cdot \Delta Q$ [1]. For the above physical properties of the aquifer (ΔHy = 2 m), in the steady state flow rate

$$\Delta Q = \Delta H_y / K_y = 2/0.001914 = 2612.33 \text{ m3 / day}$$

Consider the first case with a transmission coefficient depending on the value of the radius of the "well" equal to unity [6]. At this stage, we conduct research in a static mode, setting a constant flow rate of 100 m3. We carry out verification by accepting a coefficient equal to 0.001914827 (Fig. 2).

Fig. 2. Determining the value of lowering the level of a real well

The resulting value is 0.7, the accepted value is 0.6. It is necessary to determine how many times it is required to increase (decrease) the coefficient. The coefficient value is 0.857. During verification, we increase the correction factor at 0.857.

We will re-verify to confirm the correct calculation of the coefficients (Fig. 3).

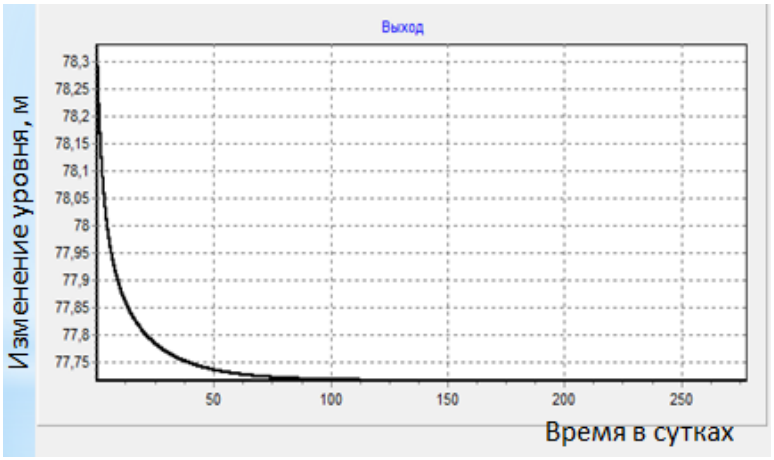

Fig. 3. Verification of verification results

From here we determine the value of K1 for the first well, equal to 605.013.

Next, we examine the dynamic system. For this, it is necessary to add a sinusoidal effect (Fig. 4) [7].

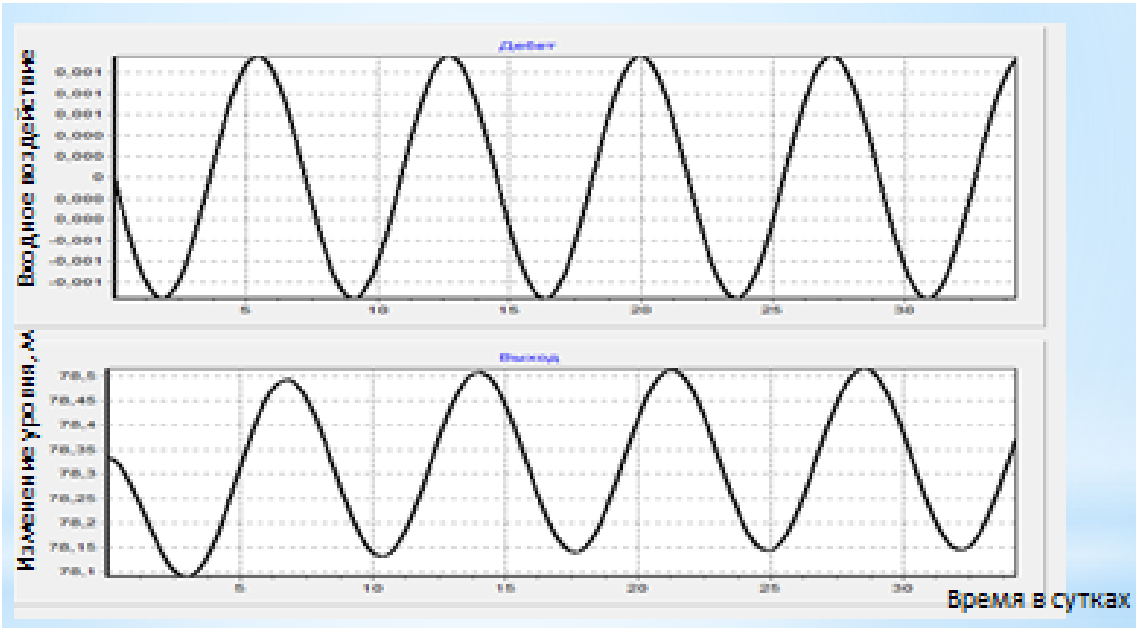

Fig. 4. Determination of the phase value

Consider the second case with a transmission coefficient that depends on the value of the radius of the "well" equal to ten. At this stage, we conduct research in static mode, setting a constant flow rate of 100 m3. We carry out verification by accepting a coefficient equal to 0.0011613.

The resulting value is 0.45, the accepted value is 0.6. It is necessary to determine how many times it is required to increase (decrease) the coefficient. The coefficient value is 1.333. During verification, we increase the correction factor in 1.333.

We will re-verify to confirm the correct calculation of the coefficients.

From here we determine the value of K1 for the first well, equal to 388.937.

Consider the third case with a transmission coefficient depending on the value of the radius of the "well" equal to thirty. At this stage, we conduct research in a static mode, setting a constant flow rate of 100 m3. We carry out verification by accepting a coefficient equal to 0,0003871.

The resulting value is 0.14, the accepted value is 0.6. It is necessary to determine how many times it is required to increase (decrease) the coefficient. The value of the coefficient is 4.2857. During verification, we increase the correction factor in 4.2857.

We will re-verify to confirm the correct calculation of the coefficients [4].

So, we determine the value of K1 for the first well, equal to 361.664.

Next, we examine the dynamic system. For this, a sinusoidal effect must be added.

During verification and determining the response of the system to the selected spatial modes, the following values of the coefficients K1 and phase Δφ, are obtained, which are presented in Table. 1 and the following graph is constructed, which determines the nonlinear dependence of K (R) on R_0.

Table 1

The resulting values of the coefficients

Static Mode			Dynamic Mode		
Coefficient value 0.001914 with R = 1	Coefficient value 0.0011613 with R = 10	Coefficient value 0,0003871 with R = 30	Coefficient value 0,001914 with R = 1	Coefficient value 0,0011613 with R = 10	Coefficient value 0,0003871 with R = 30
K_1	K_1	K_1	φ	φ	φ
605,013	388,937	361,664	-1,102	-1,102	-1,102

To plot the dependence, we apply the Lagrange interpolation polynomial [2] in the form of Newton:

$$K_1(R) = K_0 + (R - R_0) * \frac{K_1 - K_0}{R_1 - R_0} + (R - R_0) * (R - R_1) * \frac{\frac{K_2 - K_1}{R_2 - R_1} - \frac{K_1 - K_0}{R_1 - R_0}}{R_2 - R_1} \quad (6)$$

$$K_1(R) = 1{,}1322R^2 - 36{,}463R + 640{,}3434$$

when $R_0 = 1$; R1 = 10; R2 = 30;

K0 = 605.013; K1 = 388.937; K2 = 361.664.

In fig. 6, the following graph is constructed, which determines the nonlinear dependence of $K(R_n)$ on R_0.

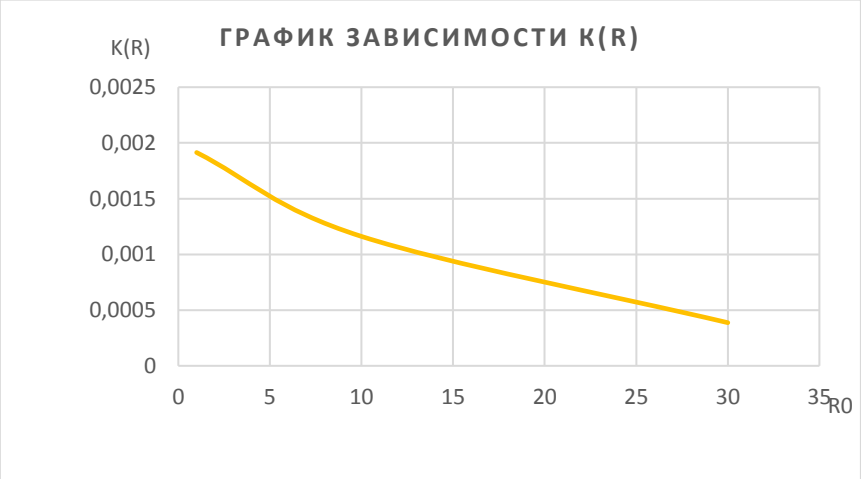

Fig. 6. Nonlinear dependence of K (R_n) от R_n

Conclusion. The description of the reaction of the system to a change in the radius of the well is considered. Applying the Lagrange interpolation polynomial in Newton's form, we obtain a graph of the nonlinear dependence of K (Rn) on Rn.

The obtained dependences allow us to develop an adaptive procedure for determining the parameters of the controller depending on changes in the radius of the "well".

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СИСТЕМА ОЦЕНКИ ЭНЕРГОЭФЕКТИВНОСТИ СИНХРОНИЗИРОВАННОГО ДОСТУПА В ИМИТАЦИОННОЙ МОДЕЛИ БЕСПРОВОДНОЙ СЕНСОРНОЙ СЕТИ

SYSTEM FOR EVALUATING THE ENERGY EFFICIENCY OF SYNCHRONIZED ACCESS IN A SIMULATION MODEL OF A WIRELESS SENSOR NETWORK

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Аннотация. *В статье исследуются энергоэффективность узлов в структуре имитационной модели синхронизированного доступа беспроводной сенсорной сети, приводятся обоснования и доказательства применения имитационного моделирования на основе метода Time Division Multiple Access (TDMA), для оценки надежности используется алгоритм определения пути f узла к базовой станции в нижней границе оценки стабильности. Основной задачей исследуемого синхронизированного доступа канального уровня является настройка временных параметров протокола. Предложенная имитационная модель исправляет дефекты спецификации сети и производит оценку объема в момент передачи и за единицу времени на раннем этапе настройки архитектуры сети. Основное преимущество имитационной модели заключается в высокой энергоэффективности беспроводных сенсорных узлов при развертывании беспроводной сенсорной сети.*

Ключевые слова: алгоритм, автономность работы, бесперебойность, беспроводная сенсорная сеть, синхронизированная сеть, сетевой протокол, маршрутизация, simulation model.

Abstract. *The article examines the energy efficiency of nodes in the structure of a simulated model of synchronized access of a wireless sensor network, provides rationale and evidence for the use of simulation based on the Time Division Multiple Access (TDMA) method, to evaluate reliability, an algorithm is used to determine the f path of a node to a base station at the lower boundary of stability assessment . The main task of the investigated synchronized access of the data link layer is to configure the protocol temporal parameters. The proposed simulation model corrects defects in the network specification and estimates the volume at the time of transmission and per unit of time at an early stage of network architecture setup. The main advantage of the simulation model is the high energy efficiency of the wireless sensor nodes when deploying a wireless sensor network.*

Key words: algorithm, autonomy, continuity, wireless sensor network, synchronized and asynchronous network, network protocol, routing, channel layer.

Introduction. The functioning of E-Governance, which implements the tasks of the electronic state, is organized in the form of Internet portals, i.e. integrated electronic tools are being created to ensure the implementation of a number of government functions. There is a problem of the quality and reliability of technical means of information and communication services: reliability and quality of database servers, quality of communication channels, reliability of network equipment, etc. This problem, of course, should be solved taking into account the “factor of geographical scales”, i.e. the increase in the coverage area of electronic services is accompanied by an increase in the fleet of technical equipment and the number of services for organizing the functioning of communication networks. [1]

One of the promising solutions for sparsely populated regions of Russia is a self-organizing distributed network, which consists of sensor nodes (wireless sensor network). It has reliability, fault tolerance and long battery life, and its purpose is in the collection and transmission of information.

High energy consumption and, as a consequence, a decrease in the autonomy of the wireless sensor network nodes is associated with the use of asynchronous access. The time synchronization schedule of nodes can increase the availability of information reception and transmission while maintaining energy reserves at the time of active operation of the network. Reducing the discharge of the battery pack and increasing the speed of transmitted packets occurs due to the process of data aggregation.

The article discusses the issues of substantiation and evidence using simulation based on the TDMA method (Time Division Multiple Access - time division multiple access) [2]. The primary task of which is the modeling of the data link layer and the classification of the upper level, and the secondary task is the model of the physical layer. With such a formalization of the model, it is possible to adjust the level of complexity of the physical level. Make settings for the model and debug the channel, network levels, this is necessary to detail the wireless network model.

Materials and methods. Simulation of a wireless sensor network

The process of introducing a physical layer model into a network model is a feature of modeling a sensor network. In the protocol stack of the TinyOS network operating system (Fig. 1), data is transmitted between nodes at the physical level and checked for collisions in the channel to calculate the probability of packet delivery [3]. A lightweight access model with preliminary verification in the channel is used. Simulation of the transmission of individual bits in the channel, taking into account the signal power between nodes located in the reach zone, is necessary when implementing a complicated model.

To route packets in the user-level application interface, channel-level capabilities are applied at the network level. The amount of network-level load depends heavily on the level of network performance and the tasks performed by the router.

The presented structure in TinyOS demonstrates the possibility of use in the communication space. Changing add-ons of levels smoothly is possible due to a clear distinction between the interface and the level structure [4]. Particular attention is paid to the direct transfer of applications from the simulation model to the real system. In practice, difficulties may arise at the network and channel levels, and this affects the work of the application level [5].

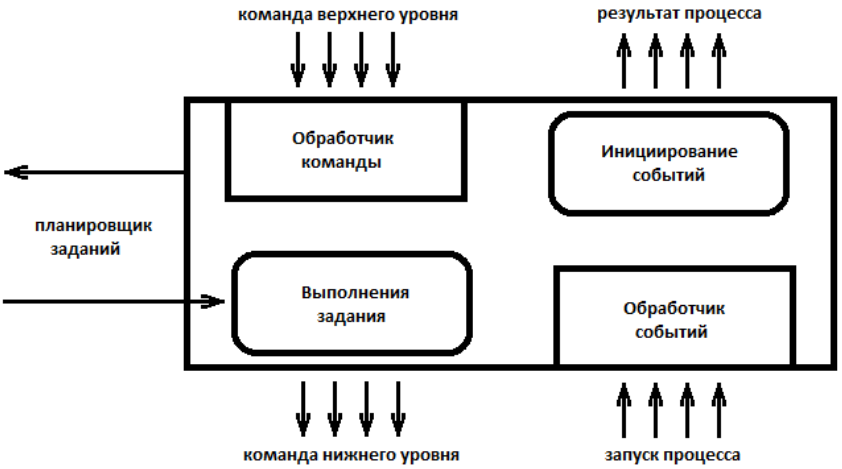

Fig. 1. The structure of the operating platform TinyOS

Software and hardware components are considered the foundation of a wireless sensor network. The software component supports the process of transmitting information to base stations. When new nodes appear on the network or when the node fails, the transfer is carried out taking into account changes in the network configuration. This is the principle of self-organization of the network, i.e. there is a redistribution of the flow direction in the nodes towards the base station (Fig. 2).

Time sharing of access in channels using the TDMA scheme increases energy efficiency up to 10 times. When using a synchronized approach when modeling a wireless network, a shift in emphasis occurs. When listening to the network, the energy consumption is reduced and the transmission time increases, which should not exceed the fixed interval for which the receiving node scans the network [6].

When servicing terminal nodes, it is appropriate to use no more than one router node, in which case the scheme will be effective. Using TDMA reduces power consumption, which reduces battery capacity and cost. A factor that increases energy consumption is collisions. But in wireless sensor networks with a high density of nodes, the network stops working.

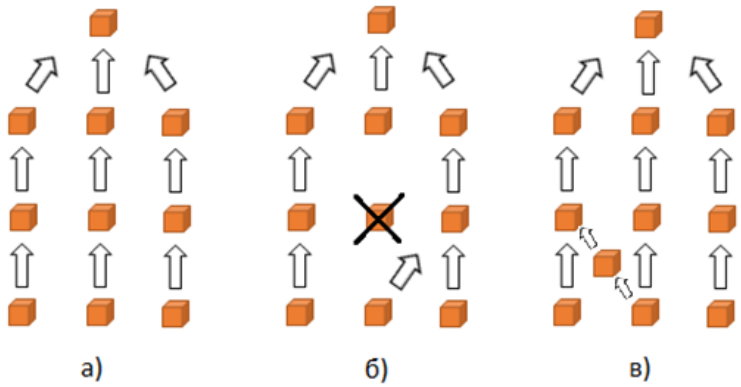

Fig. 2. Options for redistributing a wireless network configuration:
a) the organization of a wireless sensor network, b) rebuilding the network at the time of a node failure,
c) building up a wireless network

For a number of applications, router and application levels can be simplified, but this affects the accuracy of the model. OPERATING SYSTEM TinyOS was specially developed to reconfigure the wireless sensor network and it is possible to introduce new nodes, move and delete nodes.

Wireless sensor networks do not require network configuration changes, so there is no breakdown and the base router works with an immutable route table. The method of changing routes is used in territorial routing due to a geographical factor. In real conditions, in the algorithm, the task of routes, taking into account the factor of geographical scale, is specified as a universal data transmission route.

TinyOS was created for wireless sensor networks based on the concept of distributed offers, adapted for system services. No complex logic decisions and specifications for network management. In the IMPLEMENTED model, the access protocol is DEVELOPED in the channel level of the model, and the model is optimized without changing the interfaces between the levels of the protocol stack.

Results and discussions. Evaluation of fault tolerant structure in a simulation model of a wireless sensor network. Assessing network deployment for functional requirements is called fault tolerance of a wireless network. We apply the approach of accounting for uncertain actions to assess the parameters of the sensor network.

The algorithm of the method is laid down for automated routes:

- determination of the model and verification of the wireless channel of the network;
- requirements for reliability, uninterrupted operation of the network;
- the procedure for calculating the parameters of functions and the location of the sensor network;
- unloading the wireless network and avoiding collisions by identifying transit nodes;
- step-by-step removal of unnecessary nodes during the formation of network structure calculations.

To assess the reliability $P'_{fs}$of the contact of nodes with the base station, an algorithm is used to determine the path f of the node to the base station at the lower boundary of the Litvak-Ushakov stability assessment. The lower bound for the likelihood F_c of a node connecting a node to a base station is determined [7]:

$$P'_{fs} = \left(1 - Q_{fs}\right),$$

Q_{fs} – the likelihood that all independent paths from this node F_s to the base station are disabled.

$$Q_{fs} = \prod_{\mu^k_{fs} \in M_{fs}} q^k_{fs}$$

Q_{fs}t – the probability that this independent path μ^k_{fs}between the f – node and the base station is faulty.

In a wireless sensor network, information is transmitted according to a given schedule, the number of routes corresponds to the number of paths for transmitting information through T and f nodes to the base station and correspond to the number of cycles performed by T nodes during the information collection period. The collection of information by the end nodes depends on the time T and periods of breakdowns, T nodes use constant power, which increases operating time, E_{all} battery capacity, E_{dis} loss of power charge. T node operates in two positions, this is the discharge of the power source, or in relay mode [8].

To calculate the current consumption time in sleep mode, the average relay current mode is needed, in this case, the current consumption during sleep is less than the average value.

We calculate the probability that the battery will not be discharged on the node for K the number of relayings.

$$P_E = \frac{1}{2}\left(1 + erf\left(\frac{E_{MU} - K\,\mu}{\sqrt{2\,K\,\delta^2}}\right)\right) \quad (1)$$

The reliability level of the wireless network structure P'_{fs} is determined (1).

The main task of synchronized access of the data link layer is to configure the protocol temporal parameters [9]. With certain accuracy parameters, the nodes should be synchronized in one frame. The TDMA access scheme implemented on the TinyOS platform did not show a complete view of network scalability. However, it was possible to increase the transmission speed of information in a smaller channel. In the implemented scheme, a short period of time is allocated at the beginning of the frame, which determines the states of the nodes.

At the base station, throughput is optimized for information transfer and for autonomy. In the simulation model, the synchronization of the channel level of the wireless network is performed without the use of special equipment. The simulation model uses a four-level wireless network protocol stack. The physical and network layers with fault tracking functionality and a static routing table are used. The application layer consists of rules with a fixed time interval.

To perform specialized tasks and adjust the structure, the health intervals of network segments are estimated. The model corrects defects in the network specification and estimates volume at the time of transmission and per unit of time at an early stage of network architecture configuration. When modeling a protocol with a variable frame length, the throughput increases.

Comparing this simulation model with a previously developed model that uses the adaptive route selection method taking into account the signal-to-noise ratio in the data channel for solving the data transfer problem in the electronic state, it was found that the standard deviation of the calculation results does not differ by more than 7%. The probability of failure of nodes in the models is practically the same. The main advantage of the latest simulation model is the gain in electricity.

Conclusion. The article considers a simulated model of synchronized access - as a prototype for creating a wireless sensor network using energy-efficient nodes. The intensity of the use of the information transmission channel uses a 20Ah battery resource for one year, the functioning of router nodes for 5 years.

In the course of the studies, a time-division channel access scheme was used for the channel level model of the wireless sensor network. The model was tested in real conditions, which confirmed the adequacy of the simulation model. Such a solution can be applied to solve the problems of automation of electronic state processes in sparsely populated areas of Siberia and the Far North.

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ТЕХНОЛОГИЯ ПРОДОВОЛЬСТВЕННЫХ ПРОДУКТОВ | FOOD TECHNOLOGY PRODUCTS

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ОПТИМИЗАЦИЯ ПАРАМЕТРОВ ОПЕРАЦИИ ОБЕЗЗАРАЖИВАНИЯ СТОЧНЫХ ВОД ПИЩЕВЫХ ПРОИЗВОДСТВ

OPTIMIZATION OF PARAMETERS OF OPERATIONS OF DISINFECTION OF WASTE WATER OF FOOD PRODUCTION

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Аннотация. *Обеспечение продовольственной безопасности страны напрямую зависит от эффективности технологий пищевых производств и утилизации их отходов. К сожалению, безопасное использование отходов большинства пищевых производств невозможно без их обеззараживания.*

Материалы и методы. *В данной работе оптимизированы параметры операции обеззараживания сточных вод пищевых производств, при комплексном физико-химическом воздействии в активаторе, вращающимся электромагнитным полем с перемещающимися внутри него ферромагнитными частицами и активного хлора.*

Результаты и обсуждения. *Результатом оптимизации является снижение удельной энергоёмкости процесса при соблюдении требований к эпидемиологической безопасности. Параметры оптимизированной системы имеют следующие значения: заполненность ферромагнитными стержнями рабочей зоны активатора $\rho_{зп}$ = 5,18 %; магнитная индукция B = 40 мТл; отношение длины ферромагнитных стержней к их диаметру l/d = 25; концентрация активного хлора ω = 15,60 мг/л; продолжительность воздействия t = 2,81 с; при этом удельные затраты электроэнергии составляют $N_{уэ}$=3,09 Вт·с/мл, а показатели эпидемиологической безопасности не превышают допустимых нормативными документами. Результаты оптимизации параметров системы, выполненны в среде программного комплекса Matlab Simulink.*

Заключение. *В ходе проведённого исследования были получены следующие параметры операции обеззараживания сточных вод пищевых производств в активаторе: $\rho_{зп}$ = 5,18 %; l/d=25; B=40 мТл; ω =15,60 мг/л; t =2,81 с; критерий оптимальности (удельная энергоёмкость процесса обеззараживания) равен $N_{уэ}$=3,09 Вт·с/мл; предельно допустимое число КОЕ ОКБ 100 шт; расчётное значение числа составило КОЕ ОКБ 98 шт.*

Ключевые слова: пищевые производства, утилизация, сточные воды, оптимизация параметров операции обеззараживания.

Abstract. *Ensuring food security of the country directly depends on the effectiveness of food production technologies and the disposal of their waste. Unfortunately, the safe use of waste from most food industries is not possible without disinfection.*

Materials and methods. *In this work, the parameters of the operation of disinfecting wastewater from food production are optimized, with a complex physico-chemical effect in the activator, a rotating electromagnetic field with ferromagnetic particles moving inside it and active chlorine.*

Results and discussions. *The result of optimization is a reduction in the specific energy consumption of the process, while observing the requirements for epidemiological safety. The parameters of the optimized system have the following meanings: occupancy of the activator's working area with ferromagnetic rods $\rho_{зп}$ = 5,18 %; magnetic induction B = 40 mT; the ratio of the length of the ferromagnetic rods to their diameter l/d = 25; concentration of active chlorine ω = 15,60 mg / l; exposure time t = 2.81 s; in this case, the specific energy costs are $N_{уэ}$=3,09 W · s / ml, and the indicators of epidemiological safety do not exceed the permissible normative documents. The results of optimizing the system parameters were performed in the environment of the Matlab Simulink software package.*

Conclusion. *In the course of the study, the following parameters of the wastewater disinfection of food production in the activator were obtained: $\rho_{зп}$= 5,18 %; l/d=25; B = 40 mT; ω =15,60 mg / l; t = 2.81 s; the optimality criterion (specific energy intensity of the disinfection process) is $N_{уэ}$=3,09 = 3.09 W · s / ml; the maximum permissible number of CFU CCB is 100 pcs; the calculated value of the number was CFU CCB 98 pcs.*

Key words: food production, recycling, wastewater, optimization of parameters of disinfection operation.

Introduction. Food safety is the main factor in socio-economic stability, the provision of which directly depends on the efficiency of technological processes in food production. In the Southern Federal District of the Russian Federation, livestock makes a significant contribution to the development and maintenance of this economic cluster. About 65 ... 70% of heads are concentrated in small farms numbering up to 1,500 heads. An important problem with this approach to animal husbandry is the issue of environmentally sound waste management and the development of maximum resource conservation.

According to the set of regulatory documents GOST 26074-84, GOST R 51769-2001 and MU 2.1.5.800-99, waste from livestock farms are solid and liquid fractions, the disposal of which must be carried out separately after separation. One of the main disposal operations of which is their disinfection. In the framework of this study, the issue of optimizing the operation of disinfection of wastewater (hereinafter effluents) was considered. Unfortunately, the methods used today for disinfecting livestock stocks do not allow taking into account all the specifics of this material, which significantly reduces the effectiveness of the development of technological approaches to their disposal. Due to the high content of nutrients, the most rational option for disposal is the use of effluents for irrigation of agricultural fields. The advantages of this approach are: rational use of natural resources, an increase in the content of humus in the soil and, as a consequence, increased fertility. Accordingly, the task of optimizing the technological process for the disinfection of wastewater from livestock enterprises is urgent.

The aim of this study. The aim of this study is to optimize the parameters of the wastewater disinfection operation implemented by the activator.

As an analysis of information sources and the results of preliminary studies [1–9] showed, the most preferred solution to this problem is the physicochemical effect of a rotating electromagnetic field with ferromagnetic particles moving inside it and active chlorine, which is realized in the disinfection activator.

The advantages of this exposure are:

- the presence of a prolonged bactericidal effect;
- the absence of dependence of the effect of disinfection on turbidity, rigidity and pH of the medium;
- minimization of negative by-products.

The most promising device for implementing the selected impact is an activator, consisting of a housing 1, a pipe of the working zone 2, an inductor 3, ferromagnetic rods 4. A schematic diagram of the activator is shown in Figure 1.

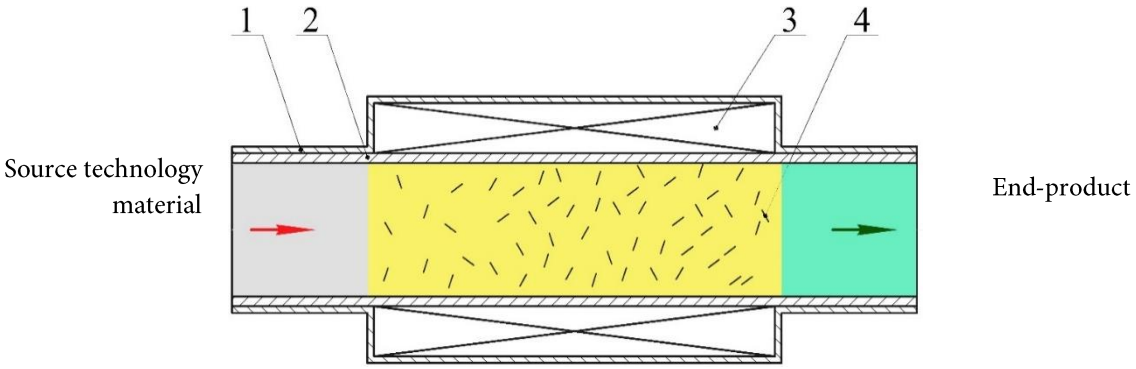

Fig. 1. Schematic diagram of the activator for disinfection of wastewater from livestock enterprises

Materials and methods. Based on the factor analysis and the results of preliminary studies carried out in [10–13], the 5 most significant factors were selected that could influence the effluent disinfection operation in the activator. The names and areas of variation of the selected factors are presented in [10, 11] and in Figure 2.

Based on the experimental studies [10–13], mathematical models were obtained that allow us to describe the relationship of the selected factors with parameters characterizing the quality of the disinfection process in the activator.

The epidemiological status of the runoff, according to GOST R 51769-2001 and MU 2.1.5.800-99, was characterized by the number of colony forming units of common coliform bacteria (CFU CCB), representing the most typical bioindicator [12]:

$$y_{КОЕ\,ОКБ} = 71{,}72 - 9{,}13x_1 + 1{,}32x_2 - 20{,}15x_3 - 31{,}74x_4 - 14{,}02x_5 + 5{,}81x_2^2 + 4{,}31x_3^2 + \\ + 7{,}98x_4^2 + 3{,}14x_5^2 - 18{,}92x_3x_4. \quad (1)$$

The energy component of the technological process for disinfecting wastewater from livestock enterprises was characterized by specific energy intensity and is described by the equation [13]:

$$y_{уэ} = 5{,}59 - 2{,}14x_1 - 0{,}44x_2 + 2{,}24x_3 + 1{,}14x_5 + 1{,}52x_1^2 - 1{,}48x_2^2 \quad (2)$$

As an optimality criterion, the costs of specific electric energy for the disinfection operation were selected. And the maximum allowable value of the number of CFU CCB according to MU 2.1.5.800-99 equal to 100 units became a limitation on the epidemiological safety of the operation.

The selected optimality criterion corresponds to the objective function (2) in the form of a quadratic regression equation in canonical form, which is the dependence of the optimality criterion on factors influencing it. Figure 2 shows a block diagram of an optimization problem.

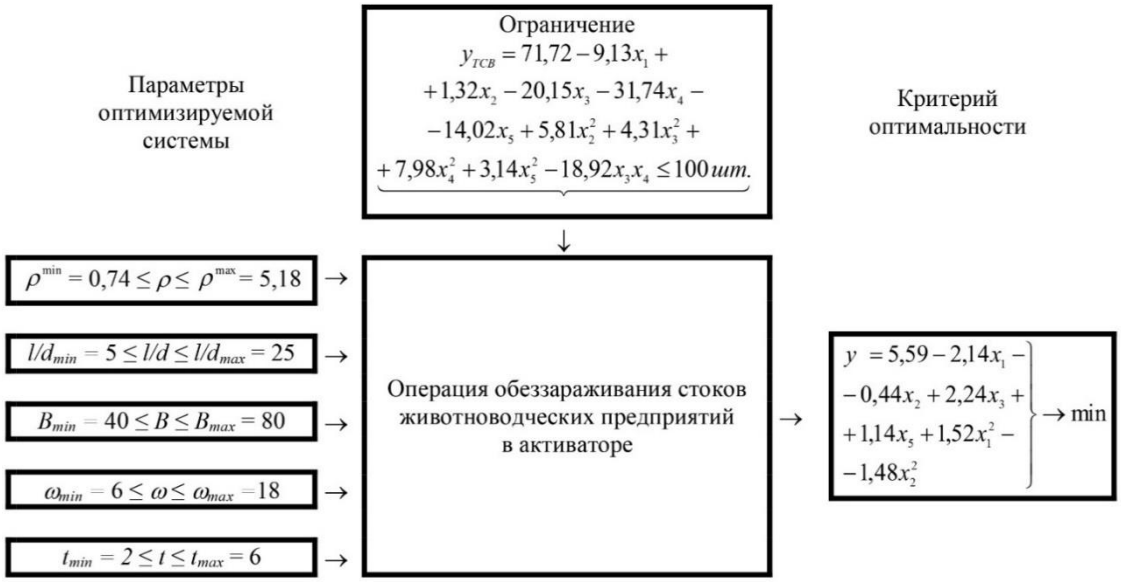

Fig. 2. The block diagram of the optimization problem

The most promising methods were selected: exhaustive search and steep ascent (or descent, depending on the task of achieving maximum or minimum).

As technological material wastewater of the farm premises was used. Evaluation of the bacteriological properties of the starting material was carried out in laboratory conditions, by fermentation, by seeding it on Endo nutrient medium.

Results and discussions. The results of optimizing the parameters of the system executed in the environment of the Matlab Simulink software package are presented in Table 1.

Table 1

Parameters of the optimized system

№ п/п	Optimized System Settings	Optimization method	
		steep climb	full sorting
1	Optimality criterion: Specific energy consumption $N_{уэ}$, W · s / ml	3,10111	3,09751
2	Limitation: The number of colony forming units of bacteria CFU CCB (not more than 100), pcs	98,13057	98,13417
3	Parameters:		
	The occupancy of the working zone of the activator with ferromagnetic rods $\rho_{зп}$ in%	5,18097	5,18457
4	The ratio of the length of the ferromagnetic rods to their diameter l / d	25,08413	25,08753
5	Magnetic induction B in mT	40,04792	40,05152
6	The concentration of active chlorine ω in mg / l	15,64570	15,64960
7	Duration of exposure t in s	2,81349	2,81709

Based on the foregoing, the following conclusions were made:

– the discrepancy between the results, with the considered calculation methods, does not exceed 0.36%, which is insignificant;

– the time spent on the calculation by the steep ascent method was 3 s., And by the exhaustive search method of 15 s., Which is equally acceptable.

– the method of exhaustive search allows you to get the most reliable result, by minimizing the possibility of taking the local extremum of the function as global, however, it is necessary to carry out an additional check of the function for monotony.

It was established that when choosing a method for solving most technical optimization problems of a similar class, it is necessary to be guided by the reliability of the result and the simplicity of the method, and not by the time spent on the calculations.

Conclusion. In the course of the study, the following parameters of the wastewater disinfection of food production in the activator were obtained: $\rho_{эп}$ = 5.18%; l / d = 25; B = 40 mT; ω= 15.60 mg / l; t = 2.81 s; the optimality criterion (specific energy intensity of the disinfection process) is $N_{уэ}$ = 3.09 W · s / ml; the maximum permissible number of CFU CCB is 100 pcs; the estimated value of the number of CFU CCB - 98 pcs.

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РАЗРАБОТКА ОТДЕЛЬНЫХ ДОКУМЕНТИРОВАННЫХ ПРОЦЕДУР ХАССП В ОПТИМИЗАЦИИ ЛОГИСТИЧЕСКИХ ПРОЦЕССОВ ОБЕСПЕЧЕНИЯ КАЧЕСТВА ПРОДУКЦИИ И ПОДТВЕРЖДЕНИЯ ЕГО СООТВЕТСТВИЯ ТРЕБОВАНИЯМ РЫНКА

DEVELOPMENT OF SEPARATE DOCUMENTED HACCP PROCEDURES FOR OPTIMIZING LOGISTICS PROCESSES ENSURING PRODUCT QUALITY AND CONFIRMING ITS COMPLIANCE WITH MARKET REQUIREMENTS

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***Аннотация**. Внедрение системы управления качеством пищевой продукции на основе принципов ХАССП, являющееся не только обязательным требованием технического регламента Таможенного союза ТР/ТС 021/2011 «О безопасности пищевой продукции», но и стратегическим решением для организаций пищевой индустрии, направлено на улучшение результатов их деятельности. При этом надлежащим образом оформленная система управления качеством обеспечивает основу для планирования, выполнения, мониторинга и улучшения результатов деятельности. Именно поэтому одним из обязательных требований системы ХАССП является документирование процедур и ведение записей по результатам мониторинга контрольных операций.*

***Материалы и методы.** Для достижения целей, поставленных в работе, применялся иерархический метод классификации, а также метод «Дерево принятия решений».*

***Результаты.** Руководствуясь требованиями стандарта ГОСТ Р 51705.1-2001 и Методическими рекомендациями Федеральной службы по надзору в сфере защиты прав потребителей и благополучия человека, разработана структура документированной информации системы ХАССП.*

***Обсуждение.** Эксперимент, составляющий эмпирическую базу представленного авторами в статье исследования, предполагал определенное документирование по процедурам, подверженным анализу на предприятии – производителе продовольственной продукции.*

В соответствии с Планом ХАССП определены критические контрольные точки по отдельным производственным процессам, по результатам мониторинга (контроля) разработан план корректирующих действий для устранения причин несоответствия в случае возникновения отклонений параметров процесса от критических пределов.

***Заключение.** Предлагаемые в настоящем исследовании способы оптимизации структуры документированной информации системы ХАССП позволяют решать задачу по созданию нормативной и организационно-методической основы для разработки, внедрения и нормального функционирования в организации системы управления качеством, которая бы в полной мере соответствовала требованиям нормативных документов.*

Ключевые слова: безопасность, документированная информация, качество, логистический процесс, пищевая продукция, стандарт, ХАССП.

***Abstract.** The introduction of a food quality management system based on the HACCP principles, which is not only a mandatory requirement of the technical regulation of the Customs Union TR/CU 021/2011 "on food safety", but also a strategic decision for food industry organizations, is aimed at improving the results of their activities. At the same time, a properly designed quality management system provides the basis for planning, implementing, monitoring, and improving performance. That is why one of the mandatory requirements of the HACCP system is to document procedures and keep records of the results of monitoring control operations.*

***Materials and methods.** To achieve the goals set in the work, a hierarchical classification method was used, as well as the "decision Tree" method.*

***Results.** Guided by the requirements of GOST R 51705.1-2001 and the Guidelines of the Federal service for supervision of consumer protection and human well-being, the structure of documented information of the HACCP system was developed.*

***Discussion.** The experiment, which forms the empirical basis of the study presented by the authors in the article, assumed certain documentation on the procedures that are subject to analysis at the food production enterprise.*

In accordance with the HACCP Plan, critical control points are defined for individual production processes, and a plan of corrective actions is developed based on the results of monitoring (control) to eliminate the causes of non-compliance in case of deviations of process parameters from critical limits.

Conclusion. *The methods proposed in this study to optimize the structure of the documented information of the HACCP system allow us to solve the problem of creating a regulatory and organizational-methodological basis for the development, implementation and normal functioning of a quality management system in the organization that would fully meet the requirements of regulatory documents.*

Key words: safety, documented information, quality, logistics process, food products, standard, HACCP.

Introduction. Organizations are facing today, and will face tomorrow, fierce global competition, market and law requirements, reduced response times and product life spans. In this situation, the introduction of a food quality management system based on the principles of HACCP (in the English transcription of HACCP - Hazard Analysis and Critical Control Points) [1], which is not only a mandatory requirement of the technical regulation of the Customs Union "On Food Safety" [2], but and a strategic decision for food industry organizations, aimed at improving the results of their activities and providing a solid foundation for sustainable development initiatives [3].

In addition, the implementation of quality management standards is one way or another aimed at creating an effective management system in the supply chain, providing a synergistic effect from the interaction of all market participants [4]. And in this case, the regulation and unification of the requirements and procedures for assessing quality and safety at all stages of product promotion on the market in one way or another will require mechanisms for optimizing the logistics system and all the flows accompanying this movement, aimed at achieving maximum approximation of the aggregate characteristics of the products, considered as material logistics flow, documentation / documentation of quality management procedures - as information and service logistics flows to end-user requirements. And in this regard, the construction of the optimal interaction of participants in the supply chain seems to be the most popular for the authors, and as a tool for this kind of adjustment of the quality management of food products / food products, it reveals the need to implement the principles of HACCP.

Potential benefits from the introduction of a food quality management system based on the principles of HACCP are the following:

– the ability of organizations to stably produce food products and / or provide catering services that meet the requirements of consumers, as well as legislative and regulatory requirements [5, 6, 7];

– the opportunity to demonstrate compliance of the organization in the field of quality and safety with the requirements set above [8].

This system provides control at all stages of food production, at any point in the process of production, storage and sale of food products, where dangerous situations may arise. When introducing the HACCP system, special attention is paid to critical control points at which, as a result of targeted control measures, all conditions must be created to prevent, eliminate or reduce all types of risks of hazardous factors to an acceptable level.

To implement the HACCP system, manufacturers must not only research their own product and production methods, but also apply this system and its requirements to suppliers of raw materials, auxiliary materials, as well as to the wholesale and retail trade system, i.e. internal and external logistics flows of the considered system of the manufacturer at the level of macro- and mesological system.

A properly designed quality management system provides the basis for planning, implementing, monitoring and improving the results of activities in the provision of food products and food products at the level of micro-, macro- and mesological systems. That is why one of the mandatory requirements of the standard GOST R 51705.1-2001 is the documentation of procedures and maintaining records based on the results of monitoring technological operations. The creation and management of documents creates a solid foundation for the organization's processes, while ensuring accountability, risk management and business continuity aimed at optimizing the logistics of material, information, financial, service and work flows.

The purpose of documented information management is to create documents and to manage them in a controlled manner for the efficient implementation of the production activities of the logistics system; ensuring compliance of products with regulatory requirements; decision making optimization; providing protection during litigation related to the presence or lack of evidence of the organization.

Logistic information flows in the form of documents in the quality management system are also designed to provide the necessary information to structural units at the level of the micro-logistics system; mutual understanding between staff; establishing the order of the work; providing the basis for the training of newly hired employees and the necessary retraining of all personnel of the organization; creating the basis for the audit of the HACCP system [9].

Requirements for documenting all procedures, forms and methods of recording data related to the HACCP system are established in paragraph 3 of the standard [1], and provide a structured approach to document management.

Materials and Methods. To achieve the goals set in the work, a hierarchical classification method was used [10], as well as the "decision Tree" method [1].

Results. The volume and composition of the documented information of the logistics systems of various organizations may differ depending on the size of the organization and the type of its activity, the range of products and / or services provided, the complexity of the processes, and, of course, the competence of employees. At the same time, guided by the requirements of the standards GOST R 51705.1-2001 [1], GOST R 56671-2015 [11] and the Methodological recommendations of the Federal Service for Supervision of Consumer Rights Protection and Human Well-being [12], in organizing the creation and functioning of the management system quality based on the principles of HACCP must necessarily be developed and managed information presented in table 1.

Table 1

Elements of a quality management system based on the principles of HACCP to be documented
[Compiled by the authors]

Clause of GOST R 51705.1-2001 standard	**Name of the document (example)**
4.1.2	Policy in the field of quality and safety of food products; organizational structure of the enterprise
4.1.3	An assortment of products with an indication of the document in accordance with which it is produced
4.1.4	Order on the establishment of the HACCP group
4.1.4.1	Documents confirming the competence of employees (documents on education and work experience); staff training plan
4.1.4.4	HACCP Group Minutes
4.2.1	Regulatory documents for products, raw materials, food additives and packaging (GOST, GOST R, STO, TU); assortment list of products
4.2.2.1	Flowchart of the production process; technological instructions; technical and technological maps; layout of production facilities with the location of equipment; flow route diagrams; cross-pollution management instructions; technology magazines
4.2.2.2	Production control program; instructions on cleaning, disinfection and deaeration procedures, staff hygiene; instructions for handling allergens, genetically modified organisms (GMOs), the use of food additives; an input control journal or acceptance sheets with a mandatory assessment of the conditions of transportation and delivery of raw materials; regulatory documents for raw materials, ingredients, packaging materials; documents confirming the safety of raw materials, packaging and auxiliary materials; instructions or documented procedures for the incoming inspection of raw materials, ingredients, packaging materials; documented procedure “Management of non-conforming products”; temperature and humidity control log; personal medical book of the forwarding driver; list of specialized vehicles; agreements for the washing and disinfection of vehicles with acts of delivery of acceptance of work performed; contract for the provision of transport services in the case of the use of hired vehicles
4.2.3	HACCP Compliance Monitoring Protocol
4.3.1	Normative documents regulating product safety; HACCP plan; laboratory research protocols; health and examination logs; instructions for observing the rules of personal hygiene; instructions for accessing third-party visitors to the enterprise; contract for medical examination of employees and other documents
4.3.2	HACCP Plan; laboratory research protocols; Complaints, claims, complaints and incidents related to violation of product safety requirements
4.3.3	Preventive action plan
4.4.4	HACCP Plan; laboratory research protocols
4.5.1 – 4.5.4	HACCP Plan
4.6.1	HACCP plan, production control program
4.6.3	HACCP Plan; technology magazine
4.7.1 – 4.7.5	Procedure “Management of non-conforming products”; HACCP worksheet; preventive action plan; approved lists of test equipment and measuring instruments; schedule of verification and certification of equipment and measuring instruments, verification certificate; equipment maintenance contracts; instruction "Requirements for measuring and control devices"; schedule of preventive maintenance, instructions for preventive and maintenance; technical passports, documents confirming permission to use equipment for contact with food; equipment technical inspection log
4.7.4	Potentially hazardous product recall procedure
4.8.1 – 4.8.3	Procedure for internal audits (inspections) of the HACCP system; program of internal audits (inspections); report on internal audits (inspections)
4.9.1, 4.9.2	The list of registration documentation of the quality management system based on the principles of HACCP
4.9.3	Procedure “HACCP System Documentation Management”

The structure of the interaction of documents of the quality management system of the logistics system based on the principles of HACCP, according to the authors, can be composed in the form of a hierarchy in which each subsequent level clarifies but does not duplicate the previous one, optimizing information and service logistics flows. Such a construction contributes to the implementation, maintenance and better understanding of documentation requirements by the staff, as well as the formation of a knowledge base, as one of the competitive advantages of the organization [13]. In general, the structure of the external and internal documented information of the organization can be represented in the form of a diagram (Fig. 1). The structure shows the importance of documents when moving from the upper level to the lower. This means that when developing documents, you should adhere to the rules:

– the document of the lower level should not contradict the requirements of documents occupying the top positions;

– documents of the lower level should not duplicate the information contained in the documents occupying the top positions, but should contain links to them.

In turn, the organization's use of external regulatory documentation at the stages of the product life cycle (communication with the consumer, development, preparation of production, procurement, production and sale) is carried out in order to increase the level of safety; ensuring competitiveness, rational use of resources and customer requirements; confirmation of product conformity; court decisions; fulfillment of deliveries. Therefore, if necessary, and in order to limit the number of internal documentation, its development and updating should include links to existing external regulatory documents.

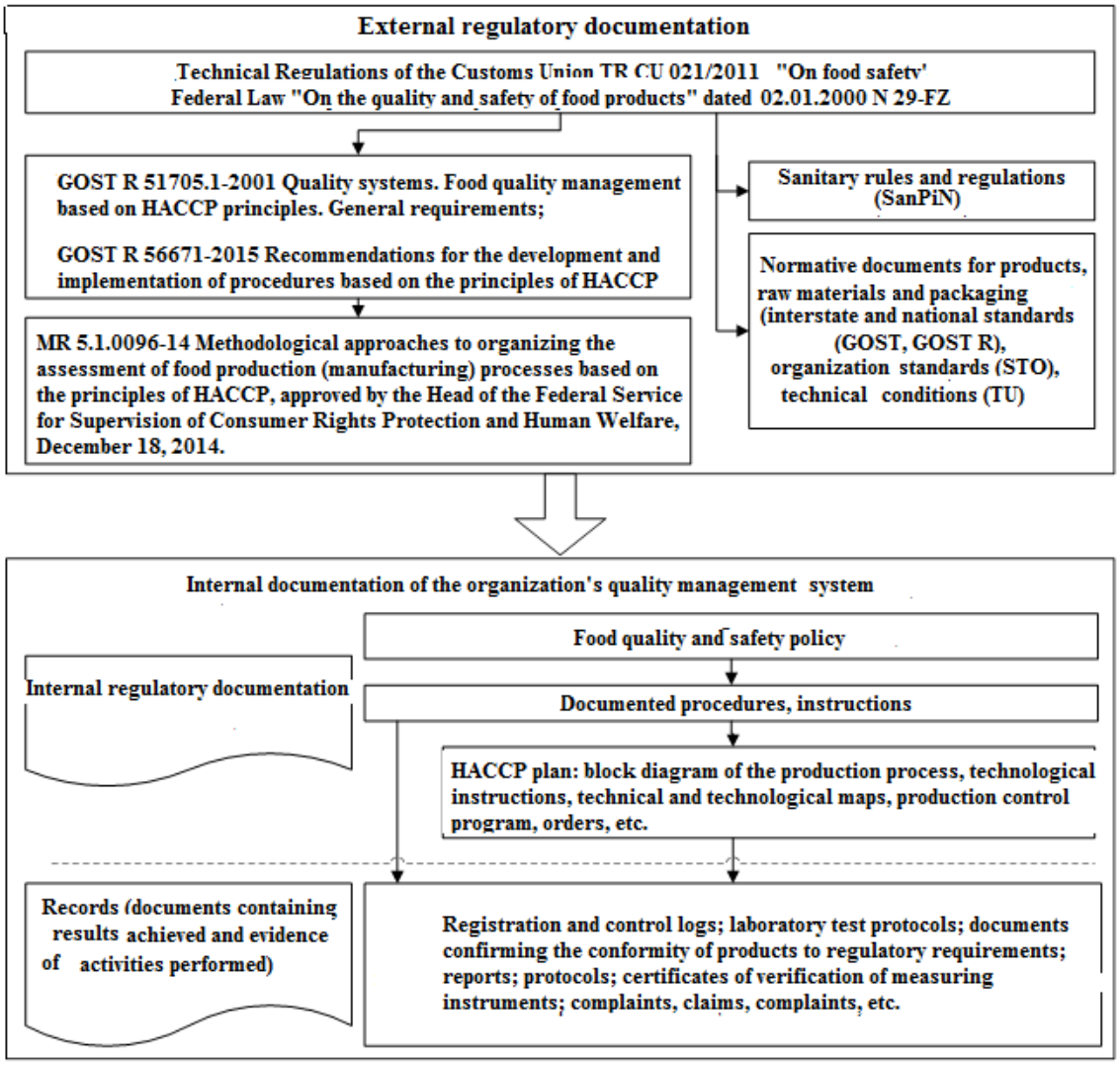

Fig. 1. Structure of the external and internal documented information of the HACCP system [Compiled by the authors]

Documented information recorded and stored as evidence of conformity (records), for example, test reports, control logs, etc., must be protected from unintentional changes. As for the term "record" referred to in ISO 9001: 2008 [14] and used to indicate the documents necessary for recording the results of an organization's activities and present evidence of its compliance with established requirements, the requirement "register" is used in version ISO 9001: 2015 [11] and keep documented information".

However, the use in the organization of the terms "document" and "record" habitual for it is not excluded and can be implemented depending on the rules for identifying documents established by the organization.

A record is a document containing the results achieved or evidence of activities undertaken. The presence and preservation of them in the organization is evidence of the functioning of the HACCP system both for the management of the organization and for external auditors.

The main task of managing records is to ensure the safety and convenience of finding the necessary information about the results of processes. Records are kept and maintained in working order to obtain evidence of product compliance with established requirements and the effectiveness of the HACCP system at all stages of the product life cycle.

The forms of document forms for maintaining quality records, the procedure for filling them out and the responsibility for filling out should be established in the HACCP system documentation management procedure.

The authenticity and reliability of all quality data should be certified by a signature with a transcript of the name of the person responsible for entering the quality data.

Quality records are kept in the units where they are collected. Storage conditions for documents in the unit should ensure their safety, absence of damage and prevention of damage during the entire storage period. Recovery of quality data in the event of loss of paper copies can be made from an electronic database.

Access to records is granted with the permission of the heads of departments responsible for their storage. Granting access to consumers and suppliers to documents containing quality records is carried out in accordance with the requirements of the agreement (contract).

The main stages of record management are presented in table 2.

Table 2

Stages and means of record management [Compiled by the authors according to the methodology of developing a quality management system: Business Studio help system. URL: http://www.businessstudio.ru [15]

N п/п	Management stage	Management tools
1	Formation	
1.1	Determining which records, when and how should be generated	
1.1.1	Identification of information needs	All operational, reporting data on the organization's processes should be systematically identified and documented.
1.1.2	Definition of requirements	Requirements for the formation, generalization and accounting of records should be determined on the basis of legislative and other requirements
1.1.3	Creation of reliable records	Records should be formed at the time (or shortly after) of the operation to which they relate
1.1.4	Determination of shelf life	A guidance document should be developed establishing the procedure for determining the retention periods of records as required
2	Control	
2.1	Determining what information should be generated from the records and how it will be managed over time	
2.1.1	Registration	For processes requiring evidence of data collection, a guidance document should be developed that establishes the procedure for registering records by assigning them an individual number and date of creation
2.2	Establishing Terms and Conditions for Using Records Over Time	
2.2.1	Development of Access Rules	Record Access Rules must be defined.
2.2.2	Implementing Access Rules	Access Rules must be implemented in record systems by assigning access status to both records and performers
2.3	Keeping records usable over time	
2.3.1	Maintaining integrity	A procedure must be established to ensure the integrity and protection of records and to prevent unauthorized use, amendment, removal, concealment and (or) destruction
2.3.2	Ensuring accessibility and usefulness	The procedure for ensuring the availability and usefulness of digital recordings over time should be defined.
2.4	Implementation of authorized removal of records from circulation	
2.4.1	Withdrawal from circulation	The procedure for analysis, authorization and implementation of decisions regarding the preservation and removal of entries from circulation for each work process should be defined
2.4.2	Broadcast	The procedure for authorized and controlled transfer of records to another organization

N п/п	Management stage	Management tools
		should be established.
2.4.4	Saving information about destroyed records	In cases where the nature and complexity of the activity and official record keeping require this, information (registration, identification and chronological metadata) about records that have been destroyed must be preserved

Discussion. The experiment, which constitutes the empirical basis of the study presented by the authors in the article, suggested some documentation on the procedures that are subject to analysis at the enterprise manufacturing food products.

Initially, the authors need, in accordance with the main document, the HACCP Plan, to determine the critical control points (hereinafter – CCP) for individual production processes (Table 3).

Table 3

Critical Control Points for Procedures under the HACCP Plan of a Food Producer [Compiled by the authors]

Stages	KKT	Hazard / risk	Preventive actions / management activities	Critical limits
1. Weighing ingredients	KKT 1	Excessive Vitamin Premix	Formulation Compliance	According to the recipe
2. Filtration of feedstock	KKT 2	Physical: foreign matter due to inappropriate filter cell size or filter integrity	1. Compliance with the frequency of inspection of mechanical filters.	1. Appropriate filter cell size.
3. Sterilization	KKT 3	Microbiological: survival of extraneous microflora (pathogenic, conditionally pathogenic microorganisms). Due to insufficient sterilization temperature	2. Removal of possible foreign particles from the filter.	2. The integrity of the filter.
4. Sterilization	KKT 4	Microbiological: survival of extraneous microflora (pathogenic, conditionally pathogenic microorganisms) due to insufficient exposure time	3. Conducting scheduled preventive repairs (hereinafter - PPR) and maintenance (hereinafter - MOT) of equipment.	Temperature in the set parameters

As a result of audits, surveys, and expert evaluations of both the actual and estimated state of the enterprise's logistics system, one way or another, inconsistencies with plans, programs, and other documentations may arise. Depending on the nature of these inconsistencies and on whether they are potential or already detected, either preventive or corrective actions are applied to them. The developed system of corrective actions based on the results of monitoring (control) during technological operations, reflected in table 4, is presented in table 5.

Table 4

Monitoring of procedures under the HACCP plan [Compiled by the authors]

Stage	Monitoring (control)			
	Subject / place of control	Method / Procedure	Periodicity	Data logging
1. Weighing ingredients	Vitamin Premix Weight	1. The working calibration of the scales, calibrated according to the inspection schedule.	During each weighing	Ingredient Sheet
2. Filtration of feedstock	Mechanical filter	2. Weight control premix vitamin.	Visual inspection at the end of the process, immediately before the automatic washing of the heat exchanger, but at least once a day	Journal of registration and inspection and washing of mechanical filters
3. Sterilization	Sterilization temperature	Visual inspection	During each sterilization cycle (beginning, middle, end)	Thermogram (automatically)
4. Sterilization	Installation performance	1. Visually by the temperature sensor on the monitor.	During each sterilization cycle (beginning, middle, end)	Log book of equipment operating mode

Table 5

Corrective actions based on monitoring results on procedures under the HACCP plan [Compiled by the authors]

Stage	Correction and Corrective Action			Verification (confirmation)
	Method / Procedure	**Responsible person**	**Data logging**	
1. Weighing ingredients	1. Recalibrate the balance.	Process Engineer	Ingredient Sheet	Checking the ingredient sheet after each production process, by internal auditors during the internal audit
2. Filtration of feedstock	Correction			Review of records on the control of mechanical filters by members of the HACCP group during weekly walks, by internal auditors during the internal audit
	1. Clean and rinse the filter.	Process Engineer	Log of inspection and cleaning of mechanical filters	
	2. Notify the site master (within 5 minutes after detecting a discrepancy).	Process Engineer	Orally	
	3. Block products developed since the last positive control of the filter.	Quality Control Engineer	Signal sheet	
	4. Make a decision on blocked products.	Head of Technical Control Department, Production Manager	Act of destruction	
	5. Make a record of the departure of the CCP beyond the limits and a record of the correction (within 30 minutes after detecting a discrepancy).	Process Engineer	1. Journal of inspection and cleaning of mechanical filters.	
	6. Replace the filter (until the next batch of product is released).	Service Engineer	2. An e-mail addressed to the master of the site about the exit of the CCP beyond.	
	Corrective action: 1. Investigate the causes of non-compliance. 2. Take measures to eliminate the cause of non-compliance (based on the results of the investigation).	Service Engineer	Application for work	
	3. Inform the representative of the HACCP group.	Shift Supervisor		
	4. Make a record based on the results of corrective actions.			
3. Sterilization (CCP 3)	Correction:			1. Verification of thermograms after each sterilization by an input control engineer. 2. Verification of thermograms and records of correction and corrective actions by members of the HACCP group during weekly walks, by internal audits during the internal audit
	1. Return to reprocessing in production. 2. Notify the site master (within 5 minutes after detecting a discrepancy). 3. Make a record of the departure of the CCP beyond the limits and a record of the correction (within 30 minutes after detecting a discrepancy).	Process Engineer	1. Thermogram (automatically). 2. Report on the operation of the equipment. 3. E-mail in the name of the master of the site about the exit of the CCP beyond.	
	Corrective action:			
	1. Identify the causes of the temperature drop. 2. Develop and implement measures to eliminate the cause of non-compliance.	Service Engineer, Process Engineer	Application for work	
	3. Inform the representative of the HACCP group. 4. Make a record based on the results of corrective actions.	Shift Supervisor	E-mail	
4. Sterilization (KKT 4)	Correction:			Verification of correction records by members of the HACCP group during weekly walks, by internal audits during the internal audit
	1. Return to reprocessing in production. 2. Notify the site master (within 5 minutes after detecting a discrepancy). 3. Make a record of the departure of the CCP beyond the limits and a record of correction (within 30 minutes after the detection of a discrepancy)	Process Engineer	1. Report on the operation of the equipment. 2. An e-mail addressed to the master of the site about the exit of the CCP beyond.	

Conclusion. Detailed documentation of the quality management system should be carried out so that the system remains understandable not only for those who developed it, but also for employees of the organization itself, as well as third-party organizations: suppliers, consumers, control bodies, thus ensuring optimization of the flows of all participants in the logistics supply chain [16].

The methods of optimizing the structure of the documented information of the HACCP system proposed in this study allow us to solve the problem of creating a regulatory and organizational-methodological basis for the development, implementation and normal functioning of a quality management system in an organization that would fully comply with the requirements of regulatory documents.

In view of the presence of sufficient advantages of documenting the procedures of the HACCP system, one should not forget about their information support based on modern procedures for optimizing the logistics system of enterprises in terms of their information subsystem. And this implies the widespread use of information technology of the decision support class, which includes interactive informatization systems for the implementation of support, covering the main stages of document management. According to the authors, it is advisable to consider further research into the issues of ensuring quality management procedures as optimization of the logistics information system, including (in the definitions of logistics) various information flows circulating inside and between elements of the logistics system, between the logistics system and the external environment [17]. Thus, the effectiveness of the logistics system is achieved only if the HACCP principles are integrated into existing production processes, including by creating the optimal information base for the quality management system [18].

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РАЗРАБОТКА РЕЦЕПТУРЫ И ТЕХНОЛОГИЯ ПРИГОТОВЛЕНИЯ МЯГКОГО СЫРА С ПРИМЕНЕНИЕМ ОВОЩНОГО СЫРЬЯ

RECIPE DEVELOPMENT AND TECHNOLOGY FOR PREPARING SOFT CHEESE WITH APPLICATION OF VEGETABLE RAW MATERIALS

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Аннотация. *В связи с большим содержанием жиров, влаги и довольно интенсивным распадом белков мягкие сыры имеют нежно-сливочную или творожистую консистенцию. Производство таких сыров с применением различных овощных добавок позволяет сделать продукт более пикантным и обладающим повышенной пищевой ценностью.*

Материалы и методы. *В качестве овощного сырья были выбраны морковь, свекла и хрен. Данные овощи исследовались по следующим показателям: содержание сухих веществ, витамина С, клетчатки, также было проведено определение кислотности и флавоноидов.*

Результаты. *По полученным результатам исследований было выявлено, что наиболее целесообразной и перспективной овощной добавкой при производстве мягких сыров будет выступать хрен и продукты его переработки, так как он обладает наилучшими химическими и физико-химическими показателями по сравнению с морковью и свеклой.*

Заключение. *Добавление овощного сырья в сыр при его производстве позволяет обогатить получаемый продукт витамином С, клетчаткой, а также флавоноидами, повышая таким образом не только пищевую ценность сыра, но и делая его более усвояемым и полезным для организма человека.*

Ключевые слова: сыр, мягкий сыр, овощное сырье, сыропроизводство.

Abstract. *Due to the high content of fats, moisture and fairly intense breakdown of proteins, soft cheeses have a creamy or curdled consistency. The production of such cheeses with the use of various vegetable additives allows you to make the product more piquant and possessing high nutritional value.*

Materials and methods. *As vegetable raw materials were chosen carrots, beets and horseradish. These vegetables were investigated by the following indicators: solids content, vitamin C, fiber, and acidity and flavonoids were also determined.*

Results. *According to the research results, it was found that the most appropriate and promising vegetable supplement in the production of soft cheeses will be horseradish and its processed products, since it has the best chemical and physico-chemical characteristics compared to carrots and beets.*

Conclusion. *Adding vegetable raw materials to cheese during its production allows to enrich the resulting product with vitamin C, fiber, and flavonoids, thus increasing not only the nutritional value of cheese, but also making it more digestible and useful for the human body.*

Key words: cheese, soft cheese, vegetable raw materials, cheese production.

Introduction. The problem of maintaining health by improving the quality of one's nutrition is becoming more and more urgent every year. Especially recently, in view of the constantly growing trend for healthy eating all over the world and, in particular, in our country, as a whole, increased attention of people to what they eat. One of the most common ways to improve your diet is to consume functional foods.

According to GOST R 52349-2005: “A functional food product is a special food product intended for systematic use in the composition of food diets by all age groups of a healthy population, which has scientifically substantiated and confirmed properties, reduces the risk of developing nutrition-related diseases, prevents deficiency or "replenishing the deficiency of nutrients in the human body, preserving and improving health due to the presence of physiologically functional food ingredients in its composition." From this definition, we can conclude that the systematic consumption

of these products can not only support or make up for the missing amount of substances useful to the body and, as a result, the general level of human health, but also improve it.

Functional food products are created by reducing unhealthy components in traditional products as a result of their enrichment with functional food ingredients. Functional products can be natural, natural food sources (first category) or specially created products (second category). Of these two categories, the products from the first category are most trusted by consumers. the mere fact of natural origin is more credible. By analogy with functional products, functional food ingredients introduced into the product are divided into the first and second categories [1].

At the end of September 2019, the Prime Minister of the Russian Federation signed an order on the preparation of the transition of the population of the Russian Federation in 2021 to a new consumer basket. This bill was introduced at the beginning of 2018. According to him, in the new consumer basket there will be more meat (instead of 58, 73 kg are planned), dairy products (instead of 290, 325 kg are planned) and less cereals and flour products (96 kg is planned instead of 126) [2–4].

Having studied the new consumer basket, we came to the conclusion that, taking into account future changes, it is necessary to develop a new functional product based on dairy products, in view of the fact that their consumption by the population, as described in the previous paragraph, should increase much more than meat products groups.

As a result, it was decided to develop a functional dairy product, namely a soft cheese with the addition of a natural functional ingredient. The choice of this dairy product is not accidental. This is primarily due to the fact that cheeses occupy a special place in the diet of a healthy diet, since they are a valuable source of complete digestible proteins, fats, products of their fermentation, as well as minerals, organic acids, and certain groups of vitamins. The world nutrition science recognizes cheese as a highly nutritious, biologically complete, easily digestible product. It is an indispensable and indispensable component of the human diet. The high biological value of soft cheeses is due to the fact that they are distinguished by a high content of soluble protein and amino acids, which gives them the properties of dietary products and allows you to satisfy the needs of the body.

Soft cheeses are extremely diverse both in organoleptic evaluations and physico-chemical parameters, and in the way of production. A wide range of different functional, aromatic and flavoring ingredients can be used in the production of soft cheeses. It is in the technology of soft cheeses that there is a huge selection of technological operations and introduced components aimed at obtaining new functional cheeses enriched with useful substances [5–8].

In addition, a large group of cheeses are the so-called “soft” cheeses. Among the wide variety of cheeses produced in the world, soft cheeses occupy a special place. Their production is widespread in many countries with developed cheese making (France, Italy, Germany, the USA, etc.), accounting for up to 25–35% of the total cheese production. It is known that soft cheeses are in steady demand among Russians, their preparation is cost-effective and, therefore, very attractive for the dairy industry. The advantage of soft cheeses is the most efficient use of raw materials in production, the possibility of faster implementation, since they have a shorter ripening time compared to hard cheeses, as well as high nutritional and biological value of the product. Also, some types of these cheeses can be realized without ripening at all [9–12].

The functional ingredient, it was decided to choose from three products of the vegetable group - carrots, beets and horseradish root. The following briefly describes the beneficial properties of the above vegetables, which determine their functional use.

Carrots. The main vitamin of carrots is β-carotene, which is contained in it in large quantities. β-carotene normalizes metabolism, affects the physical and mental development of the body, increases its resistance to infections, normalizes the functions of the organs of vision. In addition, it contains vitamins B4 and C in sufficient quantities. These vitamins improve appetite, increase the body's resistance to infections, ulcers and cancers, and effectively improve the functioning of the pancreas. For example, mashed baked carrots are used to produce a functional curd product. There are several reasons for this:

– mashed baked carrots is a source of vitamin A;

– this type of raw material is affordable, as carrots are grown in almost all regions of the Russian Federation, which allows purchasing it in the immediate vicinity of production, and the cost of the selected raw material is much lower than foreign vegetable fillers;

– in addition to the availability of carrots as a raw material for the filler, mashed baked carrots has a relatively low energy value, therefore, it is possible to reduce the calorie content of a new functional product [10].

In addition, powder compositions from carrots and pumpkins have found their application in the production of functional biscuits. In addition to saturation of the product with β-carotene, this composition saturated the product with pectin almost 2 times in comparison with the control sample. Fiber content increased by 75%, and the content of β-carotene is more than 30% of the daily needs of the human body, which justified recommending these biscuits for functional nutrition. When a 7% mixture of finely divided pumpkin and carrot powders is added, the content of macronutrients such as calcium increases in biscuits. Based on the studies, a significant effect of the composition of finely divided pumpkin and carrot powders on the organoleptic and physico-chemical parameters of biscuits was found. Significantly increased their nutritional value. All this made it possible to recommend this product as functional [11].

Beet. It is useful as a prophylactic against the appearance of heart and vascular diseases, participates in the process of hematopoiesis, and prevents leukemia and anemia. Magnesium and iodine, found in abundance in beets, contribute to the treatment of atherosclerosis and hypertension, and also have an anti-inflammatory effect. Among beet vitamins in terms of quantitative content, vitamins C and B4 stand out, first of all. Just like carrots, beets found their application in the production of functional products.

Known technology for the use of finely divided carrot and beetroot powders to expand the range and increase the nutritional value of structured fish products (fish sticks). To this end, it was proposed to add regional vegetables (carrots and red beets) rich in biologically active substances to the minced Baltic bream obtained. The finished products were distinguished by high external and taste advantages - an analysis of the chemical composition of the fish-growing sticks showed that they are a high-protein natural product, functional in the content of 7 types of physiologically necessary ingredients: beta-carotene, vitamin A, vitamin PP, sodium, phosphorus, potassium and sulfur. When using beets as a herbal supplement, the color of the surface of the stick on the surface had a beetroot hue, and a light violet hue in the section. The taste of the finished products had no extraneous flavors and aromas, was enriched with characteristic shades of added vegetables, and a moderate level of salinity [12].

There is also a technology for using beets, pumpkins and Jerusalem artichoke in the formulation of multicomponent caramel toppings. Beet pectin and inulin from Jerusalem artichoke root crops have a beneficial effect on the digestive system, increase immunity and have therapeutic and prophylactic properties. As a result of studies, it was found that the optimal ratio in a multicomponent filling consists of 70% beetroot and 30% pumpkin puree with an additional addition of 15% Jerusalem artichoke. The resulting product favorably affects the digestive system, enhances immunity and has therapeutic and prophylactic properties [13].

Horseradish root. It is called a natural antibiotic. This is one of the best sources of bactericidal phytoncides. It is useful in the treatment of colds, cough, runny nose, bronchitis, asthma and tuberculosis. Vitamin C is the main vitamin in horseradish. Like β-carotene in carrots, it is found in horseradish in large quantities. Vitamin C prevents damage to tissues and organs caused by oxidative stress. Vitamin B6 and B9 present in the plant help to lower blood homocysteine levels. A high concentration of this amino acid negatively affects the production of serotonin. Also in sufficient quantities in horseradish contains vitamin B4 contributing to the improvement of memory and central nervous system.

As a functional ingredient, horseradish root puree has found its application in the development of new recipes for sauces and dressings (low-calorie dressings on a berry, vegetable or milk basis with the addition of vegetable oil). Due to the content of natural antioxidants in horseradish, the shelf life of these dishes is increased, as well as enrich them with dietary fiber, minerals, vitamins, phenolic compounds and antioxidants, practically without increasing their energy value [14].

In addition, it is possible to use infusion from horseradish root as a spicy-aromatic raw material for the production of soft drinks, to enhance their aroma. As a result of the experiment, we obtained a drink with a more pronounced aromatic tone and with the manifestation of freshness and brightness of the citrus flavor perception in the organoleptic of the drink compared to a similar drink without infusion. This product is capable of exerting a positive influence both on the psychoemotional state of the consumer, and enriching his body with the necessary biologically active substances, and helping to maintain an equilibrium state in the body [15].

In accordance with the foregoing, the aim of this work is to develop the formulation of a functional dairy product, namely soft cheese with the addition of one of the three products of the vegetable group as a functional ingredient - carrots, beets, horseradish root. From these vegetables, one product that is most suitable for the role of a functional ingredient will be selected. The selection will be carried out according to several criteria: the content of the mass fraction of solids, the content of fiber, vitamin C and flavonoids, as well as titratable acidity (in terms of malic acid). The result of the work will be a discussion of the results and a conclusion on the work done.

Materials and methods. The objects of research of this work: carrots, beets, horseradish root and soft cheese.

The determination of solids in the selected vegetable samples was carried out by the thermogravimetric method according to GOST 28561-90, the essence of which is to dry a product sample that is loosened or distributed over the absorbing surface at elevated temperature and atmospheric or reduced pressure.

The mass fraction of moisture (X) in the studied vegetables was calculated by the formula:

$$X = \frac{m_1 - m_2}{m_1 - m_3} \cdot K \cdot 100, \quad (1)$$

where m_1 – is the mass of the cup with a lid, a stick and sand or filter paper (or without them) and a sample before drying, g;

m_2 – the mass of the cup with a lid, a stick, sand or filter paper (or without them) and a sample after drying, g;

K – is the correction factor;

m_3 - the mass of the cup with a lid, a stick, sand or filter paper (or without them), g,

The mass fraction of solids (X_1) was calculated by the formula:

$$X_1 = 100 - X, \quad (2)$$

Vitamin C was determined by the titrometric method according to GOST 24556-89, based on the extraction of vitamin C with an acid solution (hydrochloric, metaphosphoric, or a mixture of acetic and metaphosphoric), followed by visual or potentiometric titration with a solution of sodium 2,6-dichlorophenolindophenolate until a light pink color was established.

Mass fraction of ascorbic acid (X) was calculated by the formula:

$$X = \frac{(V_1 - V_2) \cdot T \cdot V_3 \cdot 100}{V_4 \cdot m}, \quad (3)$$

where V_1 – is the volume of the solution of sodium 2,6-dichlorophenolindophenolate used for titration of the sample extract, cm^3;

T – titer of a solution of sodium 2,6-dichlorophenolindophenolate, g / cm^3;

V_3 – the volume of extract obtained by extraction of vitamin C from a sample of the product, cm^3;

V_4 – volume of extract used for titration, cm^3;

m – is the mass of the sample, g

To determine the content of crude fiber, the method of Genneberg and Shtoman was chosen, described in GOST 31675-2012, the essence of which is the sequential processing of a sample of the test sample with solutions of acid and alkali, ashing and quantitative determination of the organic residue by the weight method.

The mass fraction of crude fiber in the dry matter of the test samples (y) was calculated by the formula:

$$y = \frac{(m_1 - m_2)}{m_3} \cdot 100 \cdot \frac{100}{100 - m_4}, \quad (4)$$

where m_1 – is the mass of the nutsche filter with fiber after drying, g;

m_2 – mass of the nutsche filter after ashing, g;

m_3 – mass of sample;

m_4 – mass fraction of hygroscopic moisture,%;

$(100 - m_4)$ – mass fraction of dry matter,%.

The percentage of flavonoids in carrots, beets and horseradish was determined by the photometric method according to GOST R 55312-2012, by measuring the optical densities of the complexes formed by the interaction of flavonoids that are part of the studied vegetables with aluminum chloride at a wavelength of 408-420 nm.

The mass fraction of flavonoid compounds (in terms of catechin) (X_1) is calculated by the formula:

$$X_1 = C \cdot 100 \cdot 100 \cdot m \cdot 5, \quad (5)$$

where C – is the amount of catechin in 25 cm3, found from the calibration graph, mg;

100 – extract volume, cm^3;

100 – recalculation in percent,%;

m – is the mass of a sample of vegetables taken for analysis, g;

5 – volume of extract taken for analysis, cm^3.

The acidity was determined by potentiometric method according to GOST ISO 750-2013 by titration of the analyzed solution with sodium hydroxide solution in the presence of phenolphthalein indicator [1].

In the manufacture of soft cheese such as "Slavyansky" was used cow's milk, with a mass fraction of fat of 3.2%. At the initial stage, milk was pasteurized at a temperature of 70 ° C for 10 minutes and then cooled to 34 ° C. In order to enrich milk with calcium during cooling, a solution of calcium chloride was added to milk at the rate of 30 g per 100 l of milk. A starter culture containing *Lactococcus lactis subsp. Was used in the production. Cremoris, L. lactis subsp. Diacetilactis, Streptococcus thermophilus, Bifidobacterim bifidum, B. longum, B. adolescentis* with an active acidity of 5.2 units. pH in an amount of 1% by volume of milk. The enzyme preparation Rennet, which promotes coagulation of milk, was introduced into the milk mixture after establishing a pH value of 6.42 units. pH Coagulation of the resulting milk mixture was carried out for 30 minutes while maintaining a constant temperature of 34 ° C. After the formation of a dense clot, the cheese grain was mixed until a dense elastic consistency was achieved, salting was carried out and its further self-pressing. In the process of cheese production, a preliminary heat treatment of horseradish and the production of vegetable puree were carried out. The resulting puree was introduced into the cheese in two ways: in whey and directly in the cheese grain itself.

Results and its discussion. According to literature data, most vegetables have a rather low percentage of solids. Typically, this indicator varies between 18-20%, but in certain types of vegetables may not exceed 3-5%. It is worth noting that the amount of solids is determined by physiologically active and nutrient elements - mineral salts, vitamins, carbohydrates, nitrogenous and aromatic substances [16].

As a result of physical and chemical studies, it was found that carrots, beets and horseradish have almost the same dry matter content in their composition: carrots - 14%, beets - 15%, horseradish - 16%. According to the results obtained, it can be concluded that horseradish, in contrast to beets and carrots, is richest in nutrients, minerals and trace elements.

As for fiber, this polysaccharide is one of the main components of the cell walls of fruits and vegetables. Carrots, beets and horseradish mainly contain insoluble fiber that does not interact with water and other substrates [17]. In these types of raw materials, dietary fiber is represented by hemicellulose, cellulose, pectin, and lignin. Fiber-rich foods are extremely beneficial for the digestive system, as well as significantly improve the body's metabolism. As the analysis showed, the percentage of fiber in horseradish is much higher than in beets and carrots: horseradish - 7%, beets - 3%, carrots - 2%. The increased content of dietary fiber in horseradish is due to the high content of cellulose microfibrils in cell membranes.

We also conducted a series of tests to determine vitamin C in the studied vegetables. Vitamin C, also known as ascorbic acid, is the most abundant vitamin in nature. This vitamin is actively involved in redox reactions that occur in the body. The insufficient intake of vitamin C with food contributes to the active development of vitamin deficiency. Ascorbic acid is necessary for the functional integration of sulfhydryl groups of enzymes, for the formation of collagen and intracellular structural substance, which is important for the formation of cartilage, bones, teeth and wound healing. It affects the formation of hemoglobin and the maturation of red blood cells [18].

According to various studies, horseradish contains five times more vitamin C than lemons and oranges. According to the content of ascorbic acid, this root crop is not inferior to red pepper and blackcurrant berries. This is confirmed by the results of chemical analysis that we obtained. So the percentage of ascorbic acid in horseradish was 45%, in carrots - 23%, and beets - 20%. According to the results, it is clear that the content of vitamin C in horseradish is several times greater than in beets and carrots. The flavonoid content in the studied vegetables was not determined randomly, since these compounds have powerful antioxidant activity and are not inferior to vitamins C and E, as well as β-carotene [19].

According to the reference data, horseradish contains the largest number of flavonoids, unlike other vegetables and root crops. According to our results, it is also seen that the mass fraction of flavonoids in horseradish is several times higher than their content in carrots and beets: carrots - 55%, beets - 51%, horseradish - 71%. All obtained research results are given in table. 1.

According to the results of chemical and physico-chemical tests, it was revealed that the most appropriate and promising vegetable additive in the production of soft cheese will be horseradish and its processed products.

Table 1

The results of studies of the chemical and physico-chemical parameters of vegetables

The determined indicator	Test vegetable		
	Carrot	Beetroot	Horseradish
Mass fraction of solids,%	14	15	16
Cellulose, %	2	3	7
Vitamin C, %	23	20	45
Flavonoids,%	55	51	70
Acidity (in terms of malic acid), ^{0}T	0,15	0,15	0,38

In the process of cheese production were carried out: preliminary heat treatment of horseradish and making mashed potatoes from it. The resulting puree was introduced into the cheese in two ways:

1. In the milk mixture before making the enzyme, in dosage:

Sample No. 1 - 8 g;

2. Directly in cheese grain, in dosage:

Sample No. 2 - 4 g;

Sample No. 3 - 8 g;

Sample No. 4 - 12 g.

The optimal dosage of added puree to the milk mixture was calculated on the basis that in one portion of the functional product (50 grams) should contain 15% of the functional ingredient, as a result of which the following calculations were obtained:

$$\begin{matrix} m_{\text{функц–го прод–та}} - 100\ \% \\ m_{\text{функц–го ингред–та}} - 15\ \%, \end{matrix} \quad (6)$$

where $m_{\text{функц–го прод–та}}$ – is the mass of one portion of the functional product, 50 g;

$m_{\text{функц–го ингред–та}}$ - weight of the applied dosage of the functional ingredient, g.

Since the mass of one portion was 50 g, the mass of the applied dosage was:

$$m_{\text{функц–го ингред–та}} = \frac{50 \cdot 15}{100} = 7{,}5 \approx 8\ \text{г} \quad (7)$$

According to the formula (6), in addition to the optimal one, the minimum and maximum dosages were calculated to introduce the functional ingredient into the cheese grain.

The minimum weight of the applied dosage was calculated from the ratio:

$$\begin{matrix} m_{\text{функц–го прод–та}} - 100\ \% \\ m_{\text{функц–го ингред–та}} - 7{,}5\ \%, \end{matrix} \quad (8)$$

where $m_{\text{функц–го прод–та}}$ – is the mass of one portion of the functional product, 50 g;

$m_{\text{функц–го ингред–та}}$ - weight of the applied dosage of the functional ingredient, g.

Similar to the calculations by formula (7), we obtain the minimum weight of the applied dosage:

$$m_{\text{функц–го ингред–та}} = \frac{50 \cdot 7{,}5}{100} = 3{,}75 \approx 4\ \text{г} \quad (9)$$

The maximum weight of the applied dosage was calculated from the ratio:

$$\begin{matrix} m_{\text{функц–го прод–та}} - 100\ \% \\ m_{\text{функц–го ингред–та}} - 23\ \%, \end{matrix} \quad (10)$$

where $m_{\text{функц–го прод–та}}$ – is the mass of one portion of the functional product, 50 g;

$m_{\text{функц–го ингред–та}}$ - weight of the applied dosage of the functional ingredient, g.

Similar to the calculations according to formula (7), we obtain the maximum weight of the applied dosage:

$$m_{\text{функц–го ингред–та}} = \frac{50 \cdot 23}{100} = 11{,}5 \approx 12\ \text{г} \quad (11)$$

The test for assessing organoleptic indicators was carried out on a 5-point scale, where 1 point meant the lowest level of acceptance and 5 points - the highest. In total, 4 tasters participated in the test. According to the results of the study, each taster filled out a tasting card. The arithmetic mean values of points for each indicator and the total amount of points for each sample were summarized in table 2.

Table 2

The results of organoleptic evaluation of soft cheese with horseradish puree

Index	Sample № 1	Sample № 2	Sample № 3	Sample № 4
Consistency	5,0	4,0	4,0	5,0
Taste	4,8	3,3	3,5	3,8
Smell	4,8	3,5	3,8	4,0
Colour	5,0	4,0	4,0	4,0
Total points	19,6	14,8	15,3	16,8

As can be seen from the data in Table 2, the cheese sample No. 1 scored the highest score, during the production of which 8 grams of horseradish puree was added to the whey (Figure 1).

a *b*

Fig. 1. An outer view of sample 1: *a* – top view; *b* – cross section

This sample has a good coherent and soft consistency, for which I received 5 points from tasters. In addition, three of the four tasters noted he had a pleasant pungent flavor of horseradish, complementing the milk taste of cheese, which is felt throughout the mass of the product and the same uniform aroma. One of the tasters felt that the taste and aroma of horseradish were not felt enough, for which he set 4 points for both indicators. In terms of color, all experts agreed that this is the most accurate and aesthetically pleasing pattern, because the surface of this sample was uniformly cream-colored without coarse large inclusions of horseradish on the surface, for which he received 5 points from everyone.

In second place was sample No. 4 (Figure 2).

a *b*

Fig. 2. An outer view of sample 4: *a* – top view; *b* – cross section

All tasters noted that he had a good consistency, like that of sample No. 1, and set 5 points. According to the "taste" indicator, opinions were divided - one of the tasters noted a too strong and harsh taste of horseradish, which did not allow to feel the milky taste of cheese, as a result of which they gave it 3 points. Three others did not find the horseradish taste too strong, but put 4 points for its unevenness throughout the product. According to the "smell" indicator, all tasters agreed that it is felt unevenly, for which the product received 4 points from all. In terms of color, all experts

gave 4 points, considering that large inclusions of horseradish in places sharply contrast with the uniform cream color of the product.

The third place was taken by sample No. 3. According to the "consistency" indicator, the tasters put 4 points each, noting in places the insufficient density of the product, its excessive friability (Figure 3).

a *b*

Fig. 3. An outer view of sample 3: *a* – top view; *b* – cross section

According to the "taste" indicator, opinions were divided again - two tasters unanimously gave 4 points, considering the taste of the product as good as that of sample No. 1, but lowered the score for its unevenness, the other two put 3 points, considering the horseradish taste not strong enough, as well as uneven. The smell of this sample was also heterogeneous, for which he received 4 points from three experts and 3 points from one of the tasters, who considered the smell to be too weak and heterogeneous. The experts gave the indicator "color" 4 points each as well as sample No. 4, noting the unpleasant contrast between the uniform cream color of the product and the large inclusions of horseradish.

Outsider of this test was sample No. 2, which received the least points in comparison with other samples (Fig. 4).

a *b*

Fig. 4. An outer view of sample 2: *a* – top view; *b* – cross section

Tasters noted insufficient consistency, as in sample No. 3, and set this parameter to 4 points. The main disadvantages of this sample were taste and smell. According to the "taste" indicator, two tasters put 4 points each, noting its unevenness. Another expert put 3 points, considering that the taste of horseradish is not very pronounced, as well as uneven. The last taster gave 2 points, noting the minimal signs of horseradish taste in this sample, which, in addition to being weakly expressed, was also uneven, which in some places made him feel like there was no horseradish at all. The "smell" indicator also received different estimates: two tasters gave 4 points each, two more tasters gave 3 points each, lowering two points for the same reason as the "taste" indicator - a mild horseradish smell, which was present only in places and accordingly was uneven. The color of this sample received 4 points from all tasters, for the same reason as for samples No. 3 and No. 4 - large inclusions of horseradish sharply contrast with the uniform cream color of the product.

Conclusion. According to the results of the studies, it can be concluded that the use of horseradish as a vegetable additive in the production of cheese not only contributes to its enrichment with vitamins, flavonoids and dietary fiber, but also improves its taste, giving the product an interesting piquant taste.

Also, having carried out an organoleptic and visual assessment of the cheeses obtained, it was found that the most appropriate would be the addition of horseradish directly to whey, and not to cheese grain.

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МЕТОДИКА ОЦЕНКИ КОНКУРЕНТОСПОСОБНОСТИ ПРЕДПРИЯТИЙ ОБЩЕСТВЕННОГО ПИТАНИЯ

THE METHODOLOGY FOR ASSESSING THE COMPETITIVENESS OF PUBLIC CATERING ENTERPRISES

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Аннотация. *Изучение конкретных конкурирующих предприятий, и в частности, предприятий общественного питания, сводится к анализу сегодняшней политики и потенциальных шагов ближайших конкурентов. Определив, таким образом, сильные и слабые стороны своих конкурентов, предприятие имеет возможность разработать стратегию для превосходства над ними.*

В статье рассмотрено использование методов экспертных оценок, парных сравнений и модифицированных рангов для определения безразмерного показателя эффективности и оценки конкурентоспособности предприятий общественного питания.

При оценке требований, обеспечивающих конкурентоспособность заведения, качество продукции является более важным требованием, чем цена, уровень обслуживания, интерьер, реклама, маркетинговые исследования сегментации рынка, место расположения, наличие парковочной стоянки.

Положительным преимуществом метода экспертных оценок считается возможность получить реальные для практического применения результаты в тех случаях, когда строго математическое решение получить не удается. Отрицательными характеристиками метода является наличие субъективизма в оценках, а также зависимость результатов оценки от квалификации и количества экспертов в экспертной группе.

Ключевые слова: конкурентоспособность, предприятия общественного питания, экспертные оценки, парные сравнения и модифицированные ранги.

Abstract*. The study of specific competing enterprises, and in particular, public catering enterprises, comes down to an analysis of today's policies and potential steps of the closest competitors. Having thus determined the strengths and weaknesses of its competitors, the enterprise has the opportunity to develop a strategy for superiority over them.*

The article discusses the use of expert assessment methods, paired comparisons and modified ranks to determine the dimensionless performance indicator and assess the competitiveness of public catering enterprises.

When assessing the requirements that ensure the institution's competitiveness, product quality is a more important requirement than price, level of service, interior design, advertising, marketing research, market segmentation, location, availability of parking space.

A positive advantage of the method of expert assessments is the ability to obtain real results for practical use in those cases where a strictly mathematical solution cannot be obtained. The negative characteristics of the method are the presence of subjectivity in the assessments, as well as the dependence of the assessment results on the qualifications and number of experts in the expert group.

Key words: competitiveness, catering, expert assessments, paired comparisons and modified ranks.

Introduction. Assessing the competitiveness of public catering enterprises as a service sector is a rather difficult and complex job.

The competitiveness of an individual enterprise will largely depend on the correct accounting of the current and future needs of the population, which makes it possible to determine the product profile of a catering enterprise, its capacity, product range and quality, service level and a number of other factors [1, 2, 9].

The study of specific competing enterprises comes down to an analysis of today's policies and the potential steps of the closest competitors. Having thus determined the strengths and weaknesses of its competitors, the company has the opportunity to develop a strategy for superiority over them [3, 4].

According to experts, when assessing the competitiveness of public catering establishments, it is necessary to use (take as a basis) some initial provisions - principles that improve the accuracy of the assessment, take into account the interests of market entities and, first of all, their potential and loyal customers [5].

Along with the well-known (and at the same time different) methods for assessing the competitiveness of catering establishments, it is possible to use a method based on expert judgment.

The essence of the expert method lies in the quantitative assessment of processes and phenomena that do not have a quantitative measurement. This method is based on the use of experts' opinions, reflects the individuality of their judgment and requires professional experience and intuition [6, 7, 8].

A positive advantage of the method of expert assessments is considered the ability to obtain results that are real for practical application in cases where a strictly mathematical solution cannot be obtained. The negative characteristics of the method are the presence of subjectivity in the assessments, as well as the dependence of the assessment results on the qualifications and the number of experts in the expert group.

In the study of catering enterprises, the method of expert assessments is often used to assign ranks to factors that affect the result of analysis (assessment), according to the level of significance. As a rule, for this purpose, the factors under consideration are assigned corresponding values, which are called significance coefficients. This allows in the future to identify more significant (important) and, accordingly, less significant indicators of competitiveness.

In the practice of developing and searching for options, decisions to optimize those were made without having any specific grounds, and using only experience and on the basis of it - scientific and professional intuition. Nevertheless, the complicated system of requirements excluded the possibility of making and accepting tentative decisions. From here it becomes obvious and the most significant is the use of special methods, which, in our opinion, will make it possible to assess the advantages and disadvantages of each option.

Having considered many possible options in order to select the optimal one, particular initial indicators of known options are singled out, demonstrating the requirements for the competitiveness of the enterprise, which are unequal in their "weight" or importance (Ci). In addition, different options satisfy the requirements to an unequal extent, therefore, a weight factor bij is introduced, which determines the degree of compliance of the j-th option with the i-th requirement. The complex weight of a particular criterion is the product of two weights.

The method of modified pairwise comparisons is used to determine the coefficients Ci by conducting an examination in order to identify the relative importance of the requirements (Table 1).

Table 1

An example of filling out an expert card for assessing the importance of requirements

Requirements, *i*	Product quality	Price	Service level	Interior	Advertising	Marketing research of market segmentation	Location	Availability of parking
Product quality	1	2	2	2	2	2	2	2
Prices	0	1	2	2	2	2	2	2
Service level	0	0	1	2	2	2	2	2
Interior	0	0	0	1	1	1	1	2
Advertising	0	0	0	1	1	1	1	2
Market Segmentation Research	0	0	0	1	1	1	1	2
Location	0	0	0	1	1	1	1	2
Parking for cars	0	0	0	0	0	0	0	1

The essence of filling in the cells (cells) of the expert card is as follows: if the requirement contained in the horizontal line, according to the expert, is the most important requirement entered in the vertical column with which the comparison is being made, then “2” is set in the corresponding cell of the expert card, in case of lesser significance - "0".

When assessing the requirements that ensure the competitiveness of an establishment (Table 1), product quality is a more important requirement than price, service level, interior, advertising, market segmentation, location, parking lot availability, and therefore the number "2". To assess the comparison of options for public catering establishments, we construct a decision matrix (Table 2).

Table 2

Assessment of compliance of options with the requirements

Name of the enterprise	Requirements, *i*																							
	Product quality			Price			Service level			Interior			Advertising			Marketing research of market segmentation			Location			Availability of parking		
	Rating																							
	perfectly	well	satisfied	perfectly	well	satisfied	perfectly	well	satisfied	perfectly	well	satisfied	perfectly	well	satisfied	perfectly	well	satisfied	perfectly	well	satisfied	perfectly	well	satisfied
Slavyanovskiy (1)		+		+			+				+		+					+	+					+
Kolyba (2)	+			+			+				+		+					+	+					+
Izba (3)	+			+			+				+		+					+	+					+
New Rome (4)		+		+			+			+			+					+	+					+
IL Patio (5)		+		+			+			+			+					+	+					+
Acropolis (6)	+			+				+				+		+			+		+					+
Las Vegas (7)		+		+				+				+		+			+		+					+
Intourist (8)		+		+				+				+		+			+		+					+
Chavignol (9)		+		+				+				+		+			+		+					+
LLC "Montazh SSP" (10)		+			+				+			+			+	+					+		+	
Takeshi (11)			+			+			+			+			+	+					+	+		
T-Bone (12)			+		+				+	+				+		+				+			+	
Forest glade (13)			+		+			+			+			+		+			+				+	
Steakhouse (14)			+			+			+			+			+	+					+	+		
Skiff (15)		+				+			+			+			+	+					+	+		
Casanova (16)			+		+			+			+			+		+			+				+	
Vosvoyasi (17)		+				+			+			+			+	+					+	+		

Table 2 the top line contains the private criteria entered in any order - the requirements for catering establishments. To determine the number of points corresponding to each variant of the requirements, a modified ranking method is used.

To assess the comparison of options for public catering establishments, a matrix of decisions is built (Table 3).

The method of expert assessments allows you to determine the compliance of the j-th option with the i-th requirement. The weighting factors Ci of the requirement importance ranking fit into the row of compared and matching requirements.

Thus, the considered method of expert assessments makes it possible to determine the compliance of the j-th option with the i-th requirement. The assessment of the compliance of the options with the regulated requirements was carried out using the following ranking (ranks): excellent - 3, good - 2, satisfactory - 1.

Table 3

Calculation of the integral criterion for evaluating the compared options*

Variants, *j*		Requirements, *i*								Dimensionless efficiency indicator $(\sum_{i=1}^{n} c_i \times b_{ij})$
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	
		Weighting factors								
		C_1= 15	C_2= 13	C_3= 11	C_4= 6	C_5= 6	C_6=6	C_7= 6	C_8=1	
1	Points b_{i1}	6,7	10,0	10,0	6,7	10,0	3,3	10,0	3,3	523,8
	$c_i \times b_{i1}$	100,5	130,0	110,0	40,2	60,0	19,8	60,0	3,3	
2	Points b_{i2}	10,0	10,0	10,0	6,7	10,0	3,3	10,0	3,3	573,3
	$c_i \times b_{i2}$	150,0	130,0	110,0	40,2	60,0	19,8	60,0	3,3	
3	Points Points b_{i3}	10,0	10,0	10,0	6,7	10,0	3,3	10,0	3,3	573,3
	$c_i \times b_{i3}$	150,0	130,0	110,0	40,2	60,0	19,8	60,0	3,3	
4	Points b_{i4}	6,7	10,0	10,0	10,0	10,0	3,3	10,0	3,3	543,6
	$c_i \times b_{i4}$	100,5	130,0	110,0	60,0	60,0	19,8	60,0	3,3	
5	Points b_{i5}	6,7	10,0	10,0	10,0	10,0	3,3	10,0	3,3	543,6
	$c_i \times b_{i5}$	100,5	130,0	110,0	60,0	60,0	19,8	60,0	3,3	
6	Points b_{i6}	10,0	10,0	6,7	3,3	6,7	6,7	10,0	3,3	517,2
	$c_i \times b_{i6}$	150,0	130,0	73,7	19,8	40,2	40,2	60,0	3,3	
7	Points b_{i7}	6,7	10,0	6,7	3,3	6,7	6,7	10,0	3,3	467,7
	$c_i \times b_{i7}$	100,5	130,0	73,7	19,8	40,2	40,2	60,0	3,3	
8	Points b_{i8}	6,7	10,0	6,7	3,3	6,7	6,7	10,0	3,3	467,7
	$c_i \times b_{i8}$	100,5	130,0	73,7	19,8	40,2	40,2	60,0	3,3	
9	Points b_{i9}	6,7	10,0	6,7	3,3	6,7	6,7	10,0	3,3	467,7
	$c_i \times b_{i9}$	100,5	130,0	73,7	19,8	40,2	40,2	60,0	3,3	
10	Points b_{i10}	6,7	6,7	3,3	3,3	3,3	10,0	3,3	6,7	350,0
	$c_i \times b_{i10}$	100,5	87,1	36,3	19,8	19,8	60,0	19,8	6,7	
11	Points b_{i11}	3,3	3,3	3,3	3,3	3,3	10,0	3,3	10,0	258,1
	$c_i \times b_{i11}$	49,5	42,9	36,3	19,8	19,8	60,0	19,8	10,0	
12	Points b_{i12}	3,3	6,7	3,3	10,0	6,7	10,0	6,7	6,7	380,0
	$c_i \times b_{i12}$	49,5	87,1	36,3	60,0	40,2	60,0	40,2	6,7	
13	Points b_{i13}	3,3	6,7	6,7	6,7	6,7	10,0	10,0	6,7	417,4
	$c_i \times b_{i13}$	49,5	87,1	73,7	40,2	40,2	60,0	60,0	6,7	
14	Points b_{i14}	3,3	3,3	3,3	3,3	3,3	10,0	3,3	10,0	258,1
	$c_i \times b_{i14}$	49,5	42,9	36,3	19,8	19,8	60,0	19,8	10,0	
15	Points b_{i15}	6,7	3,3	3,3	3,3	3,3	10,0	3,3	10,0	309,1
	$c_i \times b_{i15}$	100,5	42,9	36,3	19,8	19,8	60,0	19,8	10,0	
16	Points b_{i16}	3,3	6,7	6,7	6,7	6,7	10,0	10,0	3,3	414,0
	$c_i \times b_{i16}$	49,5	87,1	73,7	40,2	40,2	60,0	60,0	3,3	
17	Points b_{i17}	6,7	3,3	3,3	3,3	3,3	10,0	3,3	10,0	309,1
	$c_i \times b_{i17}$	100,5	42,9	36,3	19,8	19,8	60,0	19,8	10,0	

It should be noted that different developers of expert charts can obtain dissimilar systems, and moreover, using the same method, it is possible to obtain incommensurable results. To prevent such a situation, the ranks should be transferred to a ten-point system in various cases. Hence, it is necessary to issue the coefficients, converted to a ten-point system, as a quotient from dividing 10 by the highest rank. In our case, the highest rank corresponds to the taxation "excellent" - 3, then $K_n = \frac{10}{3} = 3{,}33$.

In order to calculate the integral criterion for assessing comparable options $F2 = \sum_{i=1}^{n} c_i \times b_{ij}$ it was necessary to calculate by summing all the products $c_i \times b_{ij}$ each of the j rows of the decision matrix. The final results of this calculation (summation) are entered in the corresponding cells "performance indicator".

Acceptable - optimized, based on the values of the proposed set of 8 requirements, the option is obtained for which the efficiency indicator will be maximum. The calculations presented in table. 3, allowed us to conclude that enterprises # 2 and # 3 have the highest efficiency indicator - 573.3.

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ВЫЯВЛЕНИЕ КИНЕТИЧЕСКИХ ЗАКОНОМЕРНОСТЕЙ РАЗДЕЛЕНИЯ ВОДОЭМУЛЬСИОННОЙ ШПИНАТНОЙ СУСПЕНЗИИ В ПОЛЕ ГРАВИТАЦИОННЫХ И ЦЕНТРОБЕЖНЫХ СИЛ

THE DETERMINATION OF KINETIC REGULARITIES OF SEPARATION OF WATER-EMULSION SPINACH SUSPENSION IN THE FIELD OF GRAVITATIONAL AND CENTRIFUGAL FORCES

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Аннотация. *Пищевая натуральная добавка хлорофилл – это зелёный пигмент растений, хорошо растворимый в жирах. Эту пигментную субстанцию, имеющую название пищевой краситель хлорофилл и относящуюся к пищевым премиксам, получают различными физико-химическими способами из сырья, как правило, растительного происхождения. Данный пищевой краситель разрешен практически во всех странах мира и считается безвредным для здоровья. В известных способах получения хлорофилла применяется неэффективная с точки зрения энергосбережения подготовка растительного материала к экстракции путем его термической сушки, поэтому предложено часть свободной влаги удалять из измельченного сырья механическим способом. Для решения поставленной задачи наиболее полного извлечения хлорофилла из измельченных листьев шпината, их целесообразно подвергнуть предварительному кратковременному замачиванию в эмульсии вода/органический реагент при ультразвуковом воздействии, и далее удалить часть влаги, например, фильтрующим центрифугированием. После реализации процесса механического отделения эмульсии от измельченных листьев шпината и их отжима, полученный осадок, имеющий пониженную влажность, является подготовленным материалом для экстрагирования из него хлорофиллов. Для рационализации процесса фильтрации необходимо оценить структурно-механические свойства осаждаемых материалов с целью определения сопротивления осадка, выбора материала и сопротивления фильтрующей перегородки в зависимости от движущей силы процесса путем решения кинетического дифференциального уравнения фильтрации. В данной статье рассмотрен важный этап подготовки растительного сырья к экстрагированию хлорофилла, а именно механическое удаление влаги из осадка, состоящего из тонко измельченных листьев шпината, который образуется в результате частичного отделения эмульсии после этапа замачивания. Используя опытные данные и зависимости от скорости вращения рабочего органа центрифуги, после проведения серии экспериментов получены обобщенные уравнения для расчета удельного сопротивления осадка в зависимости от угловой скорости или от соответствующего ей перепада давления для использования в инженерных расчетах фильтрующих центрифуг.*

Ключевые слова: Шпинат, хлорофилл, интенсивность фильтрации, кинетика, отжим, сопротивление осадка, центрифугирование.

Abstract. *Chlorophyll is a green plant pigment that is highly soluble in fats. This pigment substance, called the food dye chlorophyll and related to food premixes, is obtained by various physicochemical methods from raw materials, usually of plant origin. This food coloring is allowed in almost all countries of the world and is considered harmless to health. In known methods for producing chlorophyll, preparation of plant material that is inefficient from the point of view of energy conservation is used for extraction by thermal drying, therefore, it is proposed to remove part of the free moisture from the crushed material by mechanical means. To solve the problem of the most complete extraction of chlorophyll from crushed spinach leaves, it is advisable to subject them to preliminary short-term soaking in water / organic reagent emulsion under ultrasonic treatment, and then remove part of the moisture, for example, by filtering centrifugation. After implementing the process of mechanical separation of the emulsion from the crushed spinach leaves and their extraction, the obtained precipitate having reduced moisture is a prepared material for extracting chlorophyll from it. To rationalize the filtration process, it is necessary to evaluate the structural and mechanical properties of the deposited materials in order to determine the sediment resistance, the choice of material and the resistance of the filtering partition depending on the driving force of the process by solving the kinetic differential filtration equation. This article discusses an important stage in the preparation of plant materials for the extraction of chlorophyll, namely, the mechanical removal of moisture from a precipitate consisting of finely ground spinach leaves, which is formed as a result of partial separation of the emulsion after the soaking step. Using experimental data and the dependence on the speed of rotation of the working body of the centrifuge, after a series of experiments, generalized equations were obtained for calculat-*

ing the specific resistance of the sediment depending on the angular velocity or the corresponding pressure drop for use in engineering calculations of filtering centrifuges.

Key words: spinach, chlorophyll, filtration rate, kinetics, spin, sludge resistance, centrifugation.

Introduction. The choice of rational technological solutions for the preparation of spinach leaves for the extraction of chlorophyll from them is due to the analysis of existing methods for producing chlorophyll extracts from plant materials. In some of the above methods, preparation of the plant material for extraction, which is ineffective from the point of view of energy saving, is used [8, 14]; here, the process of drying is meant, therefore it is desirable to exclude thermal moisture removal from the technology, and remove part of the free moisture from the crushed raw material by mechanical means [12].

To solve the problem of more complete extraction of chlorophyll from crushed spinach leaves, it is advisable to subject them to preliminary short-term soaking in water / organic reagent emulsion under ultrasonic treatment. After the soaking procedure, it is necessary to remove part of the moisture from the spinach with a lower energy intensity compared to thermal processes, for example, centrifugation, after which the material can be considered ready for extraction.

Figure 1 shows an operator model of the proposed technology for preparing plant materials (spinach leaves) for subsequent extraction of green pigment readily soluble in fats from it.

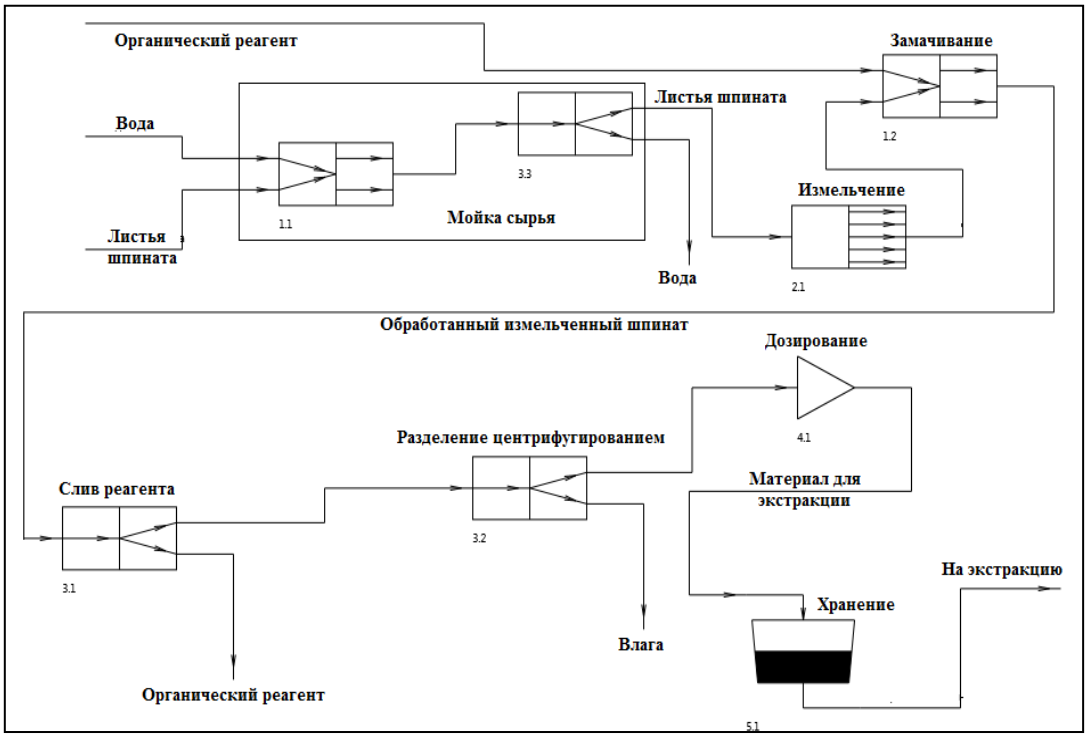


Fig. 1. Operator model of spinach leaf preparation technology to extraction

As already noted, an important stage in the preparation of plant materials is the mechanical removal of moisture from the sediment, consisting of finely chopped spinach leaves, which is formed as a result of partial separation of the emulsion after the soaking step. According to the proposed technology, the process of moisture removal must be carried out under the action of centrifugal forces in special filtering centrifuges to dewater the sludge. Great productivity with a simple design, a continuous sequence of operations and minimal labor costs leads to the widespread use of filtering centrifuges in various industrial fields.

These aggregates are used for clarification of suspensions with a concentration of a dispersed phase of about 50%, rapidly losing their fluidity, as well as for centrifugal extraction. This equipment is an aggregate, including three main nodes:

– a perforated drum located on a horizontal or vertical rapidly rotating shaft, in which the process of filtering the suspension and washing the precipitate;

– a casing in which the filtrate is collected and from which it is removed;

– a drive for rotating the drum with a braking device.

To implement the process of mechanical separation of the emulsion from the crushed spinach leaves and their extraction (processor 3.2 in Fig. 1), continuous filtering centrifuges with a screw device for unloading sludge can be recommended, which are used to dehydrate difficultly transported materials with a high content of fine particles in suspension. The use of devices of this type will allow to obtain products with minimal humidity.

These devices with a conical rotor filter assembly, inside of which a coaxial screw is located, are of vertical (Fig. 2) or horizontal (Fig. 3) design. The screw rotates in the direction of rotation of the rotor with a different frequency and is designed to discharge sediment.

The device diagram shown in Figure 2 is considered standard for vertical machines. Such centrifuges are manufactured with rotor diameters of 200–800 mm and, as a rule, from 3 to 5 sizes are contained in the parametric row [3, 10].

Horizontal filtering screw centrifuges (Fig. 3) were created in the 50s of the last century, and towards the end of the century their production exceeded the production of vertical centrifuges. Today, around the world, about 30 standard sizes of such centrifuges are manufactured, and their priority over vertical ones is explained by higher operational reliability. Experience shows that horizontal centrifuges are more promising than vertical ones, despite the fact that they occupy a large area and have slightly worse dynamic characteristics (the center of mass of the rotor is located behind the main supports) [3, 10].

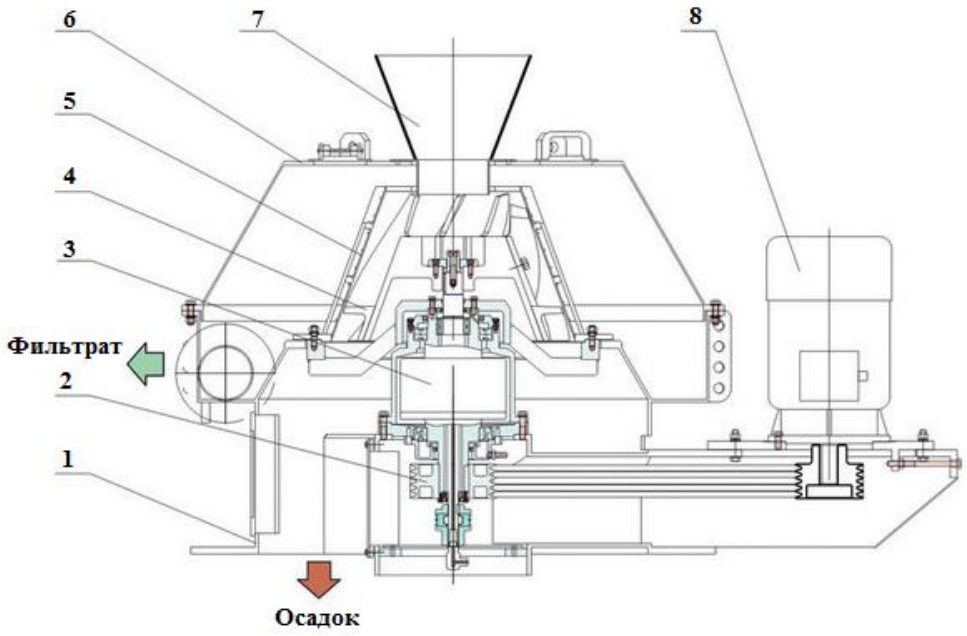


Fig. 2. Diagram of a vertical filtering centrifuge with screw discharge of sediment: 1 - frame; 2 - drive; 3 - gearbox; 4 - spiral scraper; 5 - filtering surface; 6 - case; 7 - loading hopper; 8 - electric motor

After implementing the process of mechanical separation of the emulsion from the crushed spinach leaves and their extraction, the obtained precipitate having reduced moisture is a prepared material for extracting chlorophyll from it.

The preparatory operation for the mechanical removal of moisture from plant materials in the field of centrifugal forces is subject to special attention, because to streamline the filtration process, it is necessary to evaluate the structural and mechanical properties of the deposited materials in order to determine the sediment resistance, the choice of material and the resistance of the filtering partition depending on the driving force of the process by solving kinetic differential equation of filtration.

Goals and objectives. The aim of the study is to determine the specific parameters of the filtration and spin spinach suspension during centrifugation for the selection and calculation of industrial centrifuges.

To achieve this goal it is necessary to solve the following tasks:

1. To analyze the existing methods for producing extracts of chlorophyll from plant materials and the operations of its preparation for extraction.

2. To propose a rational technological and apparatus scheme for preparing raw materials for ekstragirovanie.

3. Theoretically and empirically substantiate the mechanical removal of moisture from the precipitate, consisting of finely chopped spinach leaves, which is formed as a result of partial separation of the emulsion after the soaking step.

4. Using the experimental data and the dependence on the speed of rotation of the working body of the centrifuge, after a series of experiments, obtain generalized equations for calculating the specific resistance of the sediment depending on the angular velocity or the corresponding pressure drop for use in engineering calculations of filtering centrifuges.

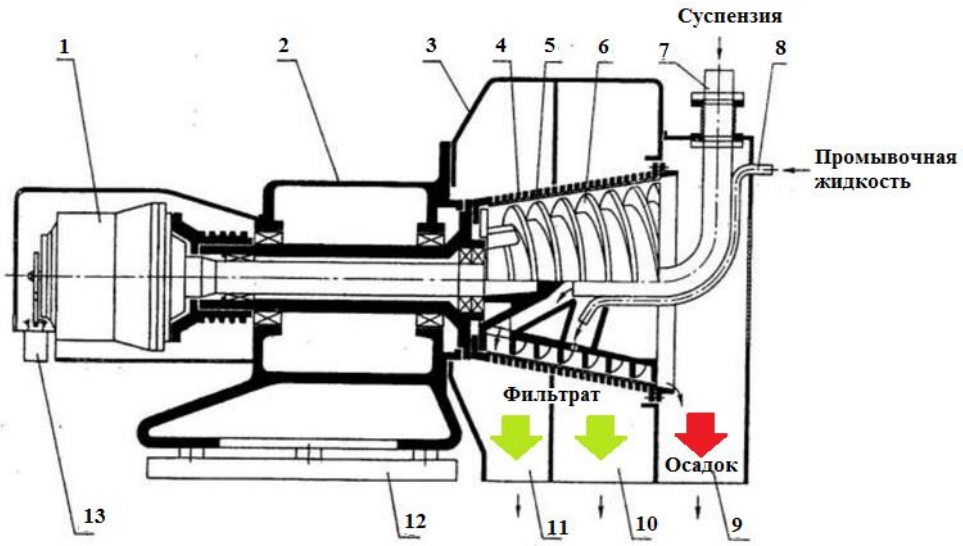
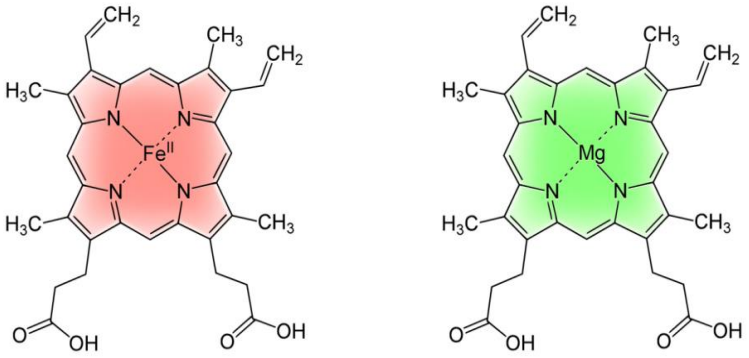


Fig. 3. Scheme of a horizontal filtering centrifuge with auger discharge of sediment: 1 - gearbox; 2 - bed; 3 - a casing; 4 - rotor; 5 - filtering surface; 6 - auger conveyor; 7 - supply pipe; 8 - pipe for entering the washing liquid; 9 - sediment discharge chamber; 10 - chamber drainage of washing fluid; 11 - a chamber for removing the filtrate; 12 - vibration isolating device; 13 - safety device

Methods and Models. Chlorophyll food supplement is a green pigment of plants, highly soluble in fats, plays a key role in photosynthesis, and is vital for the existence of plants. By its structure and structure, chlorophyll is similar to heme (Fig. 4), a non-protein coloring matter of the blood, to which oxygen molecules are attached [2, 7]. In the central part of the porphyrin cycle (Fig. 4 (b)), a magnesium ion is located in chlorophyll, which contacts in the usual interaction with 2 nitrogen atoms, and with other atoms - a coordination bond.

This pigment substance, called food color Chlorophyll (E-140) and related to food premixes, is obtained by various physicochemical methods from raw materials, usually of plant origin. There are also derivative dyes, copper complexes of chlorophylls and chlorophyllins, which are soluble in water and are classified as E-141 by the classification of food additives. As for plant materials, the natural food coloring Chlorophyll is extracted from many of its species, from seaweed to nettles and broccoli, although it is also present in some protozoa and bacteria.



а *б*

Fig. 4. The structure of the porphyrated core of chlorophyll (b) and heme (a)

Food coloring E-140 is allowed in almost all countries of the world and is considered harmless to health, although a scientific discussion on this issue is still relevant. Some consider chlorophyll to be a panacea for all diseases, including oncology and diabetes of both types, while others are of the opinion that chlorophyll can only act as an "air freshener" [9], but the most skeptical researchers still believe that chlorophyll is only a component plants involved in its photosynthesis. As noted above, the structure of chlorophyll is similar to the structure of heme, which forms hemoglobin in conjunction with iron, but there are still structural differences between them, therefore, according to some scientists, chlorophyll is not able to perform the functions of heme, and, therefore, it affects human health slightly [11].

If we are talking about natural chlorophyll, which is in the sap of plants, which can be squeezed out of any edible grass using a conventional mechanical press, then the opinion here is unequivocal - there is no doubt in its healing properties. The absence of this doubt is confirmed by long-term observations of people who consumed medicinal wheat juice, green smoothies and similar drinks for medicinal purposes, and as a result achieved the desired effect, and this includes oncology, and allergies, and immunity, and regeneration, and hormonal levels, etc. As for modern dietary supplements with chlorophyll, the situation here is not unambiguous, associated with the procedures for their preparation, therefore, when using a PC, the effect may not be, in the best case, if chlorophyll is natural, there is a chance to get the necessary treatment, and in the worst, to throw money away wind and lose time.

In general, it should be noted that the use of synthetic chlorophyll in the food industry does not lead to negative consequences for the finished product, because chlorophyll is one of the safest and sometimes useful food additives used in the industry today.

The choice of spinach leaves as a starting material for obtaining a natural dye based on chlorophylls, in particular, types a and b (Fig. 5, 6), is due to the fact that this vegetable is a food raw material rich in this pigment and, in addition,
a good source of various its functional properties, biologically active substances [4, 13].

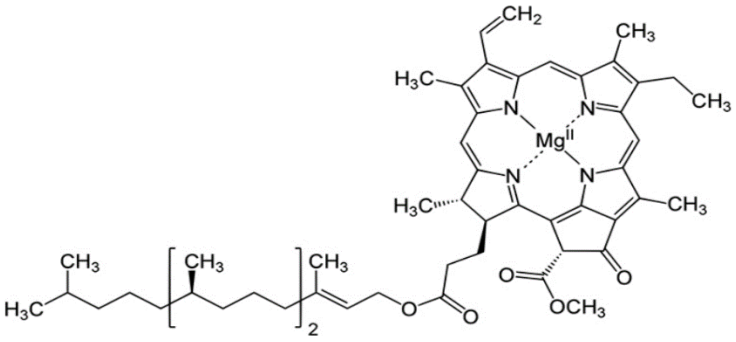


Fig. 5. Chlorophyll of type a

Both chlorophylls in spinach foliage are combined with proteins, and such a common plant complex is called chlorohybin. Both species are soluble in organic solvents, but their solutions are unstable, therefore, after distillation of the extractant, chlorophyll should be dissolved in fats, solutions of which can already be stored.

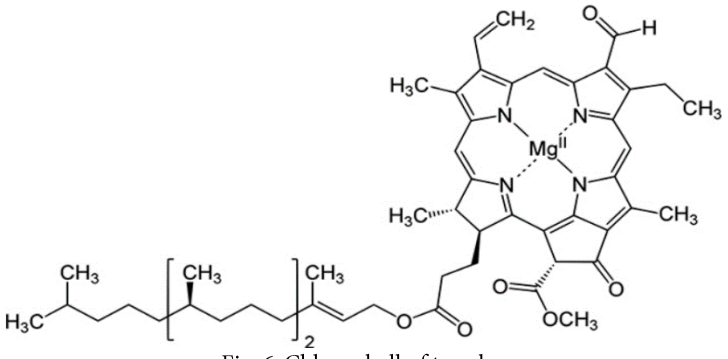


Fig. 6. Chlorophyll of type b

Spinach stands out among the rest of the plant material with a high content of chlorophylls, ascorbic acid, β-carotene, phenolic compounds, which have an immunomodulating and antioxidant effect. As for chlorophylls, their mass fraction in spinach leaves, according to various sources, ranges from 185 mg to 620 mg per 100 g of product [5, 6]. Table 1 below provides information on the chemical composition, nutritional value and nutritional balance of fresh spinach.

On the other hand, the choice in favor of spinach is also associated with its large yield with economic suitability after sowing after 25 ÷ 35 days with varying varieties. Currently, in the Russian Federation, spinach has not found proper use, although its vegetation interval allows for the supply of fresh vegetable products to the northern regions.

Garden spinach (Spinaciaoleracea) is a 1-year-old dioecious plant that is part of the family of quinoa. It is grown in almost all zones of the Russian Federation, given its early maturity, yield and cold resistance. It is grown at 4 ° C, and its shoots and mature plants do not die up to -6 ° C. However, a comfortable temperature for its cultivation is in the region of 15 ° C. Harvesting this culture is carried out when sowing in 2 ÷ 3 summer period [1].

Table 1

Chemical composition, nutritional value of spinach leaves in 100g of product

Serving Size, g		**100**	
Protein fraction, g	2,9	Vitamin K, phylloquinone, mcg	483
Lipid fraction, g	0,3	Vitamin PP, NE, mg	1,2
Carbohydrate fraction, g	2	Niacin, mg	0,6
Acid-organic fraction, g	0,1	**The presence of macronutrients**	
Food fibers, g	1,3	K mg	774
Water component, g	91,6	Ca, mg	106
Ash component, g	1,8	Si, mg	51,2
Calorie value, kcal	23	Mg mg	82
The presence of vitamins		Na, mg	24
A, RE, mcg	750	S mg	28,6
Beta Carotene, mg	4,5	Ph mg	83
B1, thiamine, mg	0,1	Cl mg	43,5
B2, riboflavin, mg	0,25	**The presence of digestible carbohydrates**	
B4, choline, mg	18	Starch and dextrins, g	0,1
B5, pantothenic, mg	0,3	Mono- and disaccharides (sugars), g	1,9
B6, pyridoxine, mg	0,1	**Saturated Fatty Acids**	
B9, folate, mcg	80	Saturated Fatty Acids, g	0,1
C, ascorbic, mg	55	**Polyunsaturated Fatty Acids**	
E mg	2,5	Omega-3 fatty acids, g	0,138
N, biotin, mcg	0,1	Omega-6 fatty acids, g	0,026

Harvested when the plants appear a small stem and a rosette of 5 ÷ 8 leaves is formed. Cleaning is more often disposable, less often selective. The spinach leaves are tender and quickly fade, so when manually harvested, the plants are pulled out with the root and laid down in the lower boxes or baskets. In large areas for cleaning use harvesting machines equipped with a transport trolley.

This vegetable is suitable for use, both raw and after processing. It is used as a salad supplement, pasta, mashed potatoes, various dishes are prepared from it, as well as juice, which is industrially used for tinting green peas when canning it.

Thus, the use of spinach premix for the enrichment of food products with dietary, specialized and therapeutic properties with a high content of biologically active materials leads to significant social effectiveness.

The necessary experimental study of filtering a water emulsion spinach suspension in a centrifugal force field to determine the functional dependence of the filtrate volume on the duration of the process was carried out on a MLW-T51 laboratory centrifuge at three speed modes: $\omega_1 = 41{,}8c^{-1}$; $\omega_2 = 104{,}6c^{-1}$; $\omega_3 = 209{,}3c^{-1}$ (рис. 7).

To find the resistance of the sediment R_{OC} during filtration according to dependence 5, it is necessary to conduct an additional empirical study on finding the resistance of the filtering partition R_ϕ, which can be determined from relation 1, where the values included in it are detected empirically.

$$R_\phi = \frac{\rho g h \pi d^2 \tau}{4V\mu}, \tag{1}$$

Here ρ – is the density of the liquid phase, kg / m^3; g – acceleration of gravity, m / s2; h – the height of the liquid column, m; d – diameter of the filter partition, m; τ – duration of the experiment, s; V – volume of the obtained filtrate, m3; μ – coefficient of dynamic viscosity of the liquid, Pa · s.

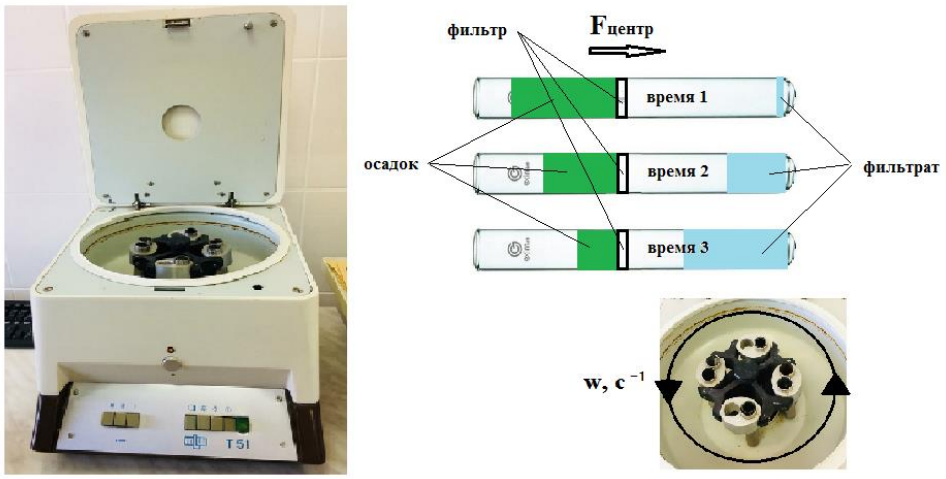


Fig. 7. An experimental study of the filtration of an aqueous emulsion suspension in a centrifugal force field

The essence of the experiment is to determine the obtained filtrate volume with a fixed column of liquid above the filter and for a given duration of the experiment. The experimental setup is shown in Figure 8. In addition, the time and speed of gravitational separation can be determined on this setup.

A study of the filtration process of an aqueous emulsion suspension in a field of centrifugal forces is necessary to determine the resistance of a compressible precipitate of crushed spinach leaves, which, taking into account the constant resistance of the filtering partition, determines the intensity of the process W .

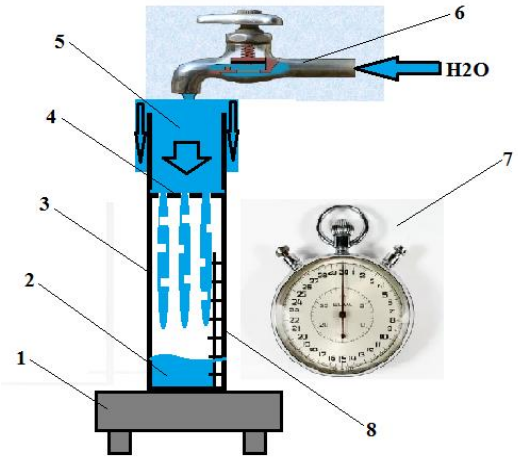


Fig. 8. Installation diagram for determining and the rate of gravitational deposition: 1 - stand; 2 - filtrate; 3 - graduated cylinder; 4 - filtering partition; 5 - water; 6 - node supply fluid to the installation; 7 - stopwatch; 8 - volumetric scale

The classical kinetic differential filtration equation in general terms is represented by the expression:

$$W = \frac{\partial V}{F \cdot \partial \tau} = \frac{\Delta P}{\mu(R_ф + R_{OC})} = \frac{\Delta P}{\mu(R_ф + r_{OC} h_{OC})}, \quad (2)$$

where V – is the filtrate volume, (m^3); F – area of the filtering partition, (m^2); τ – the duration of the process, (s); μ – coefficient of dynamic viscosity of the dispersion phase (filtrate), (Pa · s); ΔP – pressure difference before and after the septum (driving force), (Pa); $R_ф$ – resistance of the filtering partition, (1 / m2); R_{OC} – sediment resistance, (1 / m); r_{OC} – resistivity per unit height of the sediment layer, (1 / m^2); h_{OC} – sediment height, (m).

The filtrate volume can be found as a function of the duration of the process, i.e.:

$$V_\tau = V(\tau). \quad (3)$$

In this case:

$$W = \frac{\partial V(\tau)}{F \cdot \partial \tau}. \quad (4)$$

The pressure difference before and after the partition can be determined through centrifugal force $F_Ц$, which is equal to:

$$F_Ц = m_{OC} \omega^2 R,$$

where m_{OC} – is the mass of the dispersed phase (precipitate), kg; ω – the angular velocity of rotation of the working body of the centrifuge, c^{-1}; $R = 0{,}12$ м – is the radius of the working body of the centrifuge, m

In this case ΔP, it is equal to:

$$\Delta P = \frac{F_Ц}{F} = \frac{m_{OC} \omega^2 R}{F},$$

where, given 2:

$$\frac{\mu W}{\Delta P} = \frac{1}{R_Ф + R_{OC}},$$

then:

$$\frac{\Delta P}{\mu W} = R_Ф + R_{OC}. \quad (5)$$

From equation 5 we can find the value R_{OC}

$$R_{OC} = \frac{\Delta P}{\mu W} - R_Ф = \frac{m_{OC} \omega^2 R F}{\partial V(\tau) F \mu} \partial \tau - R_Ф.$$

The change in the height of the sediment layer h_{OC} during the filtering process can be represented as an empirical linear relationship:

$$h_{OC} = a\tau + b,$$

where a, b – are the experimental coefficients.

Then the resistivity of the unit height of the sediment layer will be equal to:

$$r_{OC} = \frac{R_{OC}}{a\tau + b} = \frac{\left(\frac{m_{OC}\omega^2 R}{\partial V(\tau)\mu}\partial\tau - R_{\Phi}\right)}{(a\tau + b)}. \quad (6)$$

Considering that the experimental data and dependences are due to the rotation speed of the centrifuge working body, having conducted a series of experiments at various speeds, we can obtain generalized equations for calculation depending on the rotation speed or the corresponding pressure drop for use in engineering calculations of filtering centrifuges.

Results and discussions. An experimental study of filtering an aqueous emulsion suspension in a centrifugal force field to determine the functional dependence of the filtrate volume on the duration of the process was carried out on a MLW-T51 laboratory centrifuge at three speed modes $\omega_1 = 41{,}8c^{-1}$; $\omega_2 = 104{,}6c^{-1}$; $\omega_3 = 209{,}3c^{-1}$. The results of the study are presented in table 2.

Table 2

The Change in the volume of the filtrate depending on the time of the process when filtering 2 g of raw materials at different angular speeds of the working body of the centrifuge

$\omega = 41{,}8 \cdot c^{-1}$	**τ, с**	**0**	**20**	**40**	**60**	**120**
	m, г	0	0,578	0,738	0,844	0,924
	V·10⁶, м³	0	0,58	0,74	0,84	0,92
$\omega = 104{,}6 \cdot c^{-1}$	**τ, с**	**0**	**20**	**40**	**60**	**120**
	m, г	0	0,854	0,941	0,985	1,028
	V·10⁶, м³	0	0,85	0,94	0,96	1,03
$\omega = 209{,}3 \cdot c^{-1}$	**τ, с**	**0**	**20**	**40**	**60**	**120**
	m, г	0	0,904	0,972	1,008	1,046
	V·10⁶, м³	0	0,91	0,97	1,01	1,05

According to the data presented in Table 2, Figure 9 shows the graphical dependences of the change in the filtrate volume on the duration of the process at different angular centrifugation velocities, as well as mathematical approximation curves describing them.

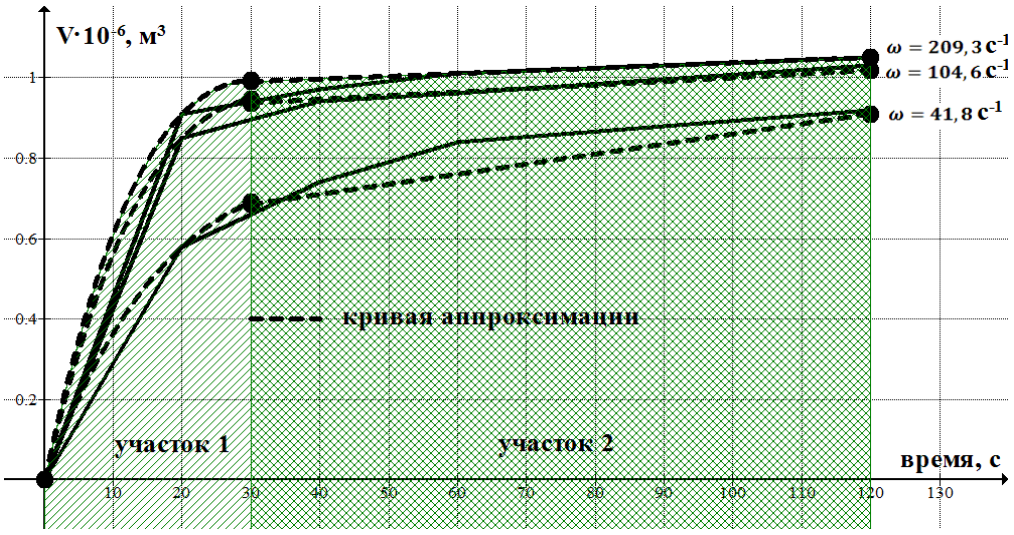


Fig. 9. Graphs of changes in the volume of the filtrate during centrifugal separation of the aqueous emulsion suspension and their mathematical approximation

The results of the mathematical approximation of the empirical dependences of the change in the filtrate volume, on the duration of the process, are presented in table 3.

Table 3

The result of the mathematical approximation

Mode	Plot 1	Plot 2
$\omega = 41{,}8 \cdot c^{-1}$	$V \cdot 10^6 = 7.5 \cdot 10^{-6}\tau^3 - 0.000975\tau^2 + 0.0455\tau$	$V \cdot 10^6 = 0.0025\tau + 0.61$
$\omega = 104{,}6 \cdot c^{-1}$	$V \cdot 10^6 = 1{,}4375 \cdot 10^{-5}\tau^3 - 0.0018\tau^2 + 0.073\tau$	$V \cdot 10^6 = 0.0009\tau + 0.91$
$\omega = 209{,}3 \cdot c^{-1}$	$V \cdot 10^6 = 1{,}729 \cdot 10^{-5}\tau^3 - 0.0021\tau^2 + 0.08058\tau$	$V \cdot 10^6 = 0.0007\tau + 0.97$

An analysis of the graphical dependencies shows that the filtration process takes place in two conditional zones, in the first of which almost the entire filtrate is separated, and after the inflection point the filtration rate drops sharply. As a result of this, it can be concluded that in order to avoid unjustified energy costs, it is advisable to complete the process after passing through the first zone, because the proportion of filtrate in the second zone with respect to its total volume is negligible. In addition, the value of the angular velocity of the working body equal to $105c^{-1}$. is rational. Exceeding this value, for example, $200c^{-1}$, does not lead to a noticeable increase in the intensity of the process, and a decrease in it leads to a significant decrease in the filtration rate. Thus, for the rational values of the influencing parameters, one can take: $\omega_p = 105c^{-1}$ and $\tau = 30c$ (curve 2 in Figure 9).

In this case, the intensity of the filtration process at $\omega_p = 105c^{-1}$, according to the obtained ratio of 4, will have the form:

$$W = \frac{\partial V(\tau)}{F \cdot \partial \tau} = \frac{1}{F}\frac{\partial(1.4375 \cdot 10^{-11}\tau^3 - 0.18 \cdot 10^{-8}\tau^2 + 0.73 \cdot 10^{-7}\tau)}{\partial \tau},$$

$$W = \frac{4.3125 \cdot 10^{-11}\tau^2 - 0.36 \cdot 10^{-8}\tau + 0.73 \cdot 10^{-7}}{F},$$

where the area of the filter partition in the experimental setup is equal to:

$$F = \frac{3.14 \cdot (13.5 \cdot 10^{-3})^2}{4} = 143.07 \cdot 10^{-6}(м^2),$$

then the dependence of the intensity of the process on time will have the form:

$$W = 0.3 \cdot 10^{-6}\tau^2 - 0.25 \cdot 10^{-4}\tau + 0.51 \cdot 10^{-3}.$$

The pressure difference before and after the partition ΔP, which can be determined through centrifugal force $F_Ц$, is:

$$\Delta P = \frac{F_Ц}{F} = \frac{m_{OC}\omega^2 R}{F} = \frac{0.002 \cdot 105^2 \cdot 0.12}{143.07 \cdot 10^{-6}} = 1.85 \cdot 10^4 (Па) \cdot$$

To find the resistance of the sediment R_{OC} according to dependence 5, it is necessary to know the resistance of the filtering partition, $R_Ф$, which was determined from the ratio 1, where the values included in it were determined experimentally. The values obtained during the experiment at five replicates are summarized in table 4.

Table 4

Values obtained during empirical studies for calculation $R_Ф$.

Liquid column height h, m	Filter diameter d, m	Experiment duration τ, s	Filtrate volume V, m³	The density of the liquid ρ, kg / m³	Dynamic viscosity of the liquid μ, Pa · s
0,063	0,04	63	0,000016	1000	0,001

By substituting the experimentally obtained data in a ratio of 1, the value of the resistance of the filtering partition is obtained:

$$R_Ф = \frac{1000 \cdot 10 \cdot 0{,}063 \cdot 3{,}14 \cdot 0{,}04^2 \cdot 63}{4 \cdot 0{,}000016 \cdot 0{,}001} = 3{,}12 \cdot 10^9 (1/м) \cdot$$

Thus, from equation 5, knowing the quantity $R_Ф$, we can find the quantity R_{OC}:

$$R_{OC} = \frac{\Delta P}{\mu W} - R_Ф = \frac{1{,}85 \cdot 10^{10}}{0{,}0003\tau^2 - 0{,}025\tau + 0{,}51} - 3{,}12 \cdot 10^9,$$

$$R_{OC} = (1{,}62 \cdot 10^{-14}\tau^2 - 1{,}35 \cdot 10^{-12}\tau + 2{,}76 \cdot 10^{-11})^{-1} - 3{,}12 \cdot 10^9.$$

The change in the height of the sediment layer h_{OC} during the filtering process can be represented as an empirical linear dependence, due to the small range of changes in the sediment layer and the short time interval of the process:

$$h_{OC} = -0,00017\tau + 0,032 .$$

Then the resistivity of the unit height of the sediment layer, depending on time, according to 6 will be equal to:

$$r_{OC} = \frac{(1,62 \cdot 10^{-14}\tau^2 - 1,35 \cdot 10^{-12}\tau + 2,76 \cdot 10^{-11})^{-1} - 3,12 \cdot 10^{9}}{-0,00017\tau + 0,032} .$$

The resulting equation makes it possible to calculate the specific resistance of the sludge at any value of the current process time, as well as to calculate the specific productivity of a real industrial filtering unit for chopped spinach, taking into account the driving force and resistance of the filtering partition in it, using the basic kinetic equation 2.

Conclusion. Thus, when considering the main stage of preparing chopped spinach leaves for extraction of chlorophyll, namely, mechanical removal of moisture from the obtained precipitate, which is formed as a result of partial separation of the emulsion after the soaking stage, it was possible to calculate the specific resistance of the precipitate at any value of the current process time. Moreover, using the materials presented in the article, it is possible to calculate the specific productivity of a real industrial filtering unit for chopped spinach, taking into account the driving force and resistance of the filtering partition in it.

Of interest is the calculation method presented in the article, according to which, using the obtained experimental data and the dependences due to the rotation speed of the centrifuge working body, after conducting a series of experiments at different speeds, it is possible to obtain generalized equations for calculating the specific resistance of the sediment depending on the angular velocity or on the corresponding differential pressure for use in engineering calculations of filtering centrifuges.

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АНАЛИЗ КАЧЕСТВЕННЫХ ПОКАЗАТЕЛЕЙ СИДРА, В ЗАВИСИМОСТИ ОТ ТЕХНОЛОГИЧЕСКИХ РЕЖИМОВ

ANALYSIS OF QUALITATIVE INDICATORS OF CIDER, DEPENDING ON TECHNOLOGICAL MODES

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Аннотация. *Слабоалкогольные напитки из натурального сырья широко распространены по всему миру, известными примерами являются вина и сидр. Такие показатели, как содержание сахара и спирта в процессе производства имеют важное значения. В результате чего исследование в данной области представляет широкий спектр возможностей внедрения инновационных технологий в производство.*

Материалы и методы. *Рассмотрен традиционный процесс производства слабоалкогольного напитка – сидр. Представлен обзор методов исследования с помощью измерительного прибора, рефрактометра. Подробно описан процесс брожения. Так же представлен вниманию метод исследования содержания сахара и спирта с помощью виномера. Представлены обработанные результаты экспериментальных данных.*

Результаты и обсуждения. *Проведён физико-химический анализ содержания сухих веществ, а так же показателя преломления с помощью рефрактометра. На основании полученных данных построены графики зависимостей рассматриваемых показателей от температурного режима брожения. Так же представлены зависимости содержания сахара и спирта от температуры брожения сидра.*

Заключение. *С увеличением потребительского спроса на слабоалкогольные напитки, рассматриваются более эффективные и менее затратные методы на их производство. Увеличиваются требования к производимой продукции. В данной работе рассмотрены основные методы анализа продукта, применяемые в процессе его производства.*

Ключевые слова: сидр, рефрактометр, брожение, спирт, виномер, сухие вещества.

Abstract. *Low alcohol drinks made from natural raw materials are widespread throughout the world, well-known examples are wine and cider. Indicators such as sugar and alcohol in the manufacturing process are important. As a result, research in this area presents a wide range of possibilities for introducing innovative technologies into production.*

Materials and methods*. The traditional process of producing a low-alcoholic beverage, cider, is considered. A review of research methods using a measuring device, refractometer is presented. The fermentation process is described in detail. A method for studying sugar and alcohol content using a wine meter is also presented. The processed results of the experimental data are presented.*

Results and discussions. *A physicochemical analysis of the solids content, as well as the refractive index using a refractometer, was carried out. Based on the data obtained, graphs of the dependences of the considered indicators on the temperature regime of fermentation are constructed. The dependences of sugar and alcohol on cider fermentation temperature are also presented.*

Conclusion. *With an increase in consumer demand for low alcohol drinks, more effective and less costly methods for their production are considered. Requirements for manufactured products are increasing. This paper discusses the main methods of product analysis used in the process of its production.*

Key words: cider, refractometer, fermentation, alcohol, wine meter, solids.

Introduction. Cider is a low-alcohol drink made from the fermentation of apple juice. In the production of cider, apple varieties are used in which tannin is present. The apple varieties in question are cultivated specifically for the production of this drink. Depending on the organoleptic characteristics, the considered varieties can be divided into four main groups: sweets, sharps, bittersweets and bittersharps. The presented varieties differ in the amount of sugar, in taste and in other organoleptic characteristics.

The purpose of the research is to study the effect of temperature conditions on the intensity of fermentation.

Materials and methods. In the traditional production scheme for such a low-alcohol drink as cider, apples are used. The first stage of manufacturing is the preparation and grinding of the product. At the next stage, the juice is squeezed out, after which it is filtered. Then the resulting juice is sent to fermentation vats, the duration of this process

takes about two weeks, depending on the apple variety. After that, the drink is clarified and cleaned of impurities. One of the objects of research in this work is the analysis of the quality indicators of cider, depending on the technological mode of fermentation. The stages of cider production were carried out according to a typical scheme, consisting of the following operations.

1) The apples were stored for 2-3 days in a warm room. This was done in order not to wash away wild yeast from the surface of the fruit, which is needed for fermentation.

2) The leaves and stems were removed. Apples in the amount of 2.2 kg, together with the peel and seeds, were crushed with a juicer.

3) Mix the juice with the crushed apples and stir until smooth.

4) Divide the homogeneous mixture into two parts. Each mixture obtained had a mass of 1.1 kg.

5) 0.16 kg of sugar was added to each mixture.

6) Then the resulting mixtures were left to ferment for 2 days.

7) After 2 days, the juice was squeezed out of the fermented mixture and each mixture was placed for further fermentation at different temperature conditions.

For two weeks, fences were taken and the percentage of dry matter and the refractive index were examined. These studies were carried out using a refractometer shown in Figure 1 [1].

A refractometer is an optical device, one of the purposes of which is to measure the specific gravity of a liquid. To carry out this measurement, a few drops of liquid are taken and its optical properties are examined. The refractometer is widely used in the wine-making and brewing fields.

Also, thanks to the refractometer, the specific gravity of the obtained liquids is monitored. At this point, it is a good alternative to a hydrometer, and often these two methods are used together, for more accurate readings [2].

One of the main advantages of a refractometer in comparison with a hydrometer is the small volume of liquid required for research.

When examining pure water in terms of optical characteristics, there is a certain deviation that occurs due to the transmission of light. The deflection resulting from the passage of light through a transparent medium, in our case water, is called refraction. Moreover, when light passes through other substances, its deviation will deviate from the standard by a certain value [3].

When sugar-containing substances are added to water, there is an increase in the deviation of light from its original value. A refractometer uses this effect, resulting in a quantitative determination of sugar in the test sample due to the amount of deflection of light.

The light source can be either a lamp that illuminates the sample under study or natural light in the room. These features depend on the characteristics of the refractometer [4].

Two alcoholic beverages of the same composition, cider, fermented at different temperature conditions were investigated. First sample of cider was fermented at 20 ℃, the second – at 27 ℃.

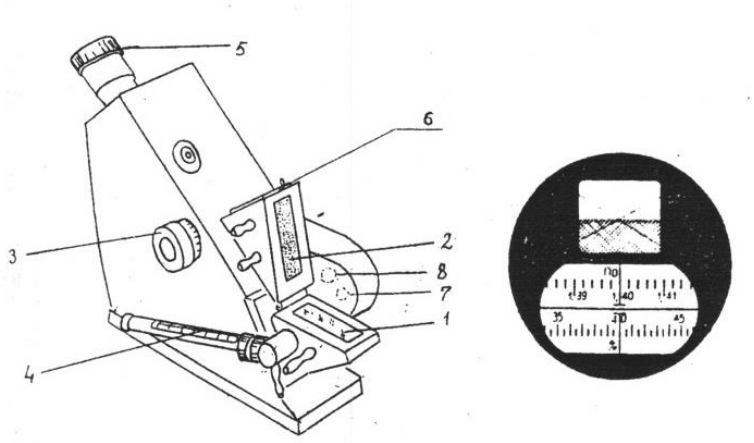

Fig. 1. Refractometer

When working with a refractometer, the following guidelines should be followed. The first thing to do is check the zero point setting in the refractometer. It should be remembered that the setting of the zero point, as well as the measurements carried out on the refractometer, must be carried out at the same temperature conditions. Checking and

setting the zero point should be carried out with distilled water [5]. As a result of the study of distilled water, the required light and shade limit should be on a division equal to 1.33299 on the refractive index scale and 0% on the dry matter scale. Checking and setting the zero point is carried out according to the following plan:

– move the upper chamber and rinse the surfaces of the measuring and lighting lenses with alcohol, then wipe the surface dry with a clean cloth;

– apply a few drops of distilled water with a pipette on the measuring surface of the lens and close the previously opened chamber;

– moving the illuminator, direct the light beam to the lens of the upper camera;

– by rotating the handle with the eyepiece along the scale, find the chiaroscuro border;

– the found border of chiaroscuro, rotating the handle, combine with the hairline. With the correct setting of the zero point, the light-shade border will pass beyond the refractive index scale equal to 1.33299 and then 0% of the dry matter scale [6].

In the course of the work, a study was also carried out, as a result of which the dependence of the change in the amount of sugar during fermentation was measured. This dependence is due to a decrease in the amount of sugar, as a result of which the amount of dry matter decreases, as well as the refractive index.

Thus, in the first sample, fermentation proceeded at a temperature of 20 ° C, and in the second sample, the temperature was 27 ° C. The study was conducted over two weeks, during which fences were taken and changes in the amount of sugar and alcohol were observed [7].

Alcoholic fermentation is a process, as a result of which, under the influence of yeast, a qualitative reaction of converting glucose into ethyl alcohol and carbon dioxide occurs in an anaerobic environment. The equation for the described reaction is shown below:

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2.$$

As a result of this reaction, one glucose molecule is split into two molecules of ethyl alcohol and two molecules of carbon dioxide. Also, the result of the reaction is a small release of energy, under the influence of which there is a slight increase in the temperature of the medium. It should be noted that during the fermentation process, fusel oils are also formed that negatively affect the finished product: butyl, amyl and other alcohols, which are by-products of the exchange between amino acids [8].

Yeast is a spherical, single-celled fungus. The substance in question has the peculiarity of actively developing in a liquid medium, which in turn is rich in sugars. In this study, we used naturally-produced yeast that forms on the surface of apples.

The main factors for the development of yeast are the amount of sugar, temperature and acidity of the environment. An additional influence is exerted by the presence of the necessary macro- and microelements, the percentage of alcohol, as well as the access of the environment to oxygen [9].

1. The amount of sugar required for stable fermentation should be kept in the range of 10-15%. When sugar concentration exceeds this value, fermentation weakens.

2. The optimum temperature for the yeast should be 20-27 ° C. Since at significantly lower values, the fermentation process slows down significantly.

3. The acidity of the medium should be maintained in the range of 4.0-4.5 pH. At this value, the medium is acidic, which favorably affects alcoholic fermentation.

4. Ethyl alcohol has a double effect on the fermentation process. First of all, it is a necessary product for the life of yeast. At the same time, ethyl alcohol is a strong toxin, which slows down the fermentation process. Empirically, it was calculated that for the formation of approximately 0.6% alcohol, 1% sugar is needed. Thus, to achieve a result of 12% alcohol, a solution is needed, the sugar content of which will be 20%.

5. In an anaerobic environment, the so-called survival of yeast occurs, in which the maximum amount of alcohol is released. Thus, in order to protect the wort from the ingress of oxygen into it, as well as to provide removal of carbon dioxide, a water seal is used [10].

Within the framework of this work, the dependences of the dry matter content and the refractive index on the temperature regime in which the fermentation process takes place will be obtained. The results obtained give an idea of the reaction rate. Thus, it is possible to monitor the consumer properties of the product at the stage of wort fermentation.

Also as a result of this work, the dependences of the percentage of sugar and alcohol on the fermentation temperature of the wort were obtained. That allows you to adjust the modes of the technological process.

Results and discussions. As a result of the research, the data were obtained, after analyzing which the table 1 was constructed. This table reflects the dependences of the content of dry substances and the refractive index on the I and II t° modes, which correspond to 27°C and 20°C, respectively.

Table 1

Values of the refractive index and the amount of dry matter during fermentation

Reasearch №	1	2	3	4	5	6	7
I t° mode							
Solids content,%	19,2	15,1	10,8	8,9	8,9	8,9	8,2
n_d	1,3625	1,3552	1,349	1,346	1,344	1,342	1,341
II t° mode							
Solids content, %	20	17,8	15,4	13,9	13,1	12,5	12
n_d	1,363	1,36	1,356	1,354	1,352	1,351	1,351

Analyzing the data from Table 1, visual graphs were built that fully reflect the resulting dependence. Figure 2 and Figure 3, respectively, show the changes in dry matter and refraction indicators during wort fermentation.

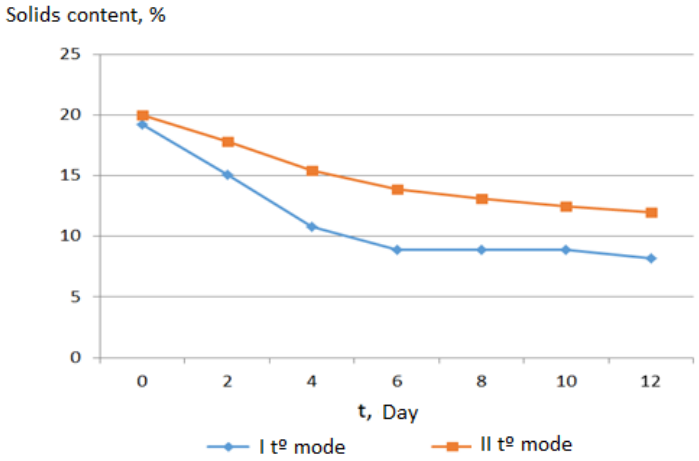

Fig. 2. Changes in the dry matter index during fermentation

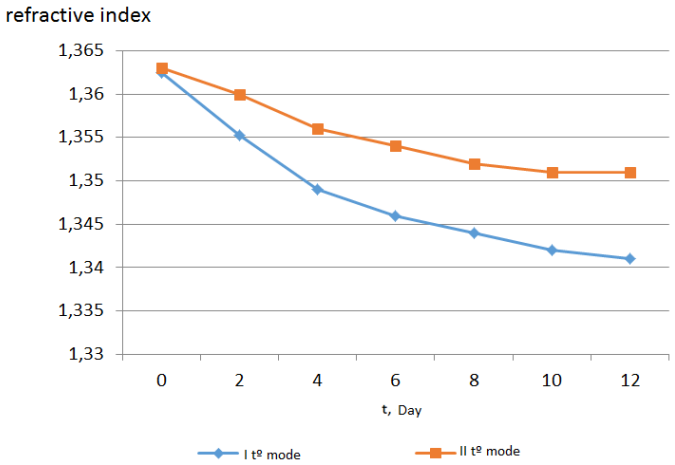

Fig. 3. Change in refractive index during fermentation

After analyzing the data obtained, we can conclude that with the classical scheme for making a low-alcohol drink from apples, the optimal values that allow the use of the drink according to GOST are achieved: during fermentation at a temperature of 27 ℃ - this indicator corresponds to the 2nd dimension (2 days after the start of fermentation). At 20 ℃, this indicator corresponds to the 3rd dimension (4 days after the start of fermentation).

The research results for cider fermented at I and II temperature regimes are presented in Table 2. The presented table reflects the dependence of the sugar and alcohol content on the temperature under the influence of which fermentation proceeds.

Table 2

Values of indicators of sugar and alcohol

Reasearch №	1	2	3	4	5	6	7
I tº mode							
Sugar content,%	21	11	5	4	3	0	0
Alcohol content,%	3	5	9	11	12	12,5	12,5
II tº mode							
Sugar content,%	21	20	15	12	10	10	9
Alcohol content,%	1,5	2,1	5	6	8	8	9

Analyzing the data from Table 2, visual graphs were built that fully reflect the resulting dependence. Figure 4 and Figure 5 respectively show the changes in the sugar and alcohol content in the samples under consideration.

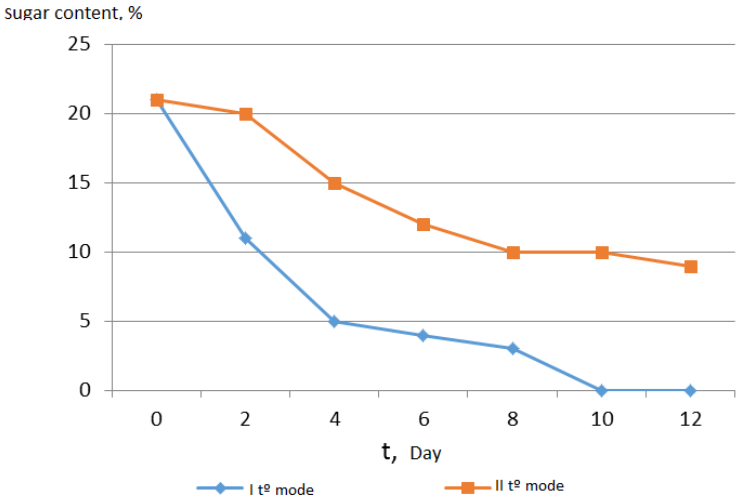

Fig. 4. Sugar content in samples

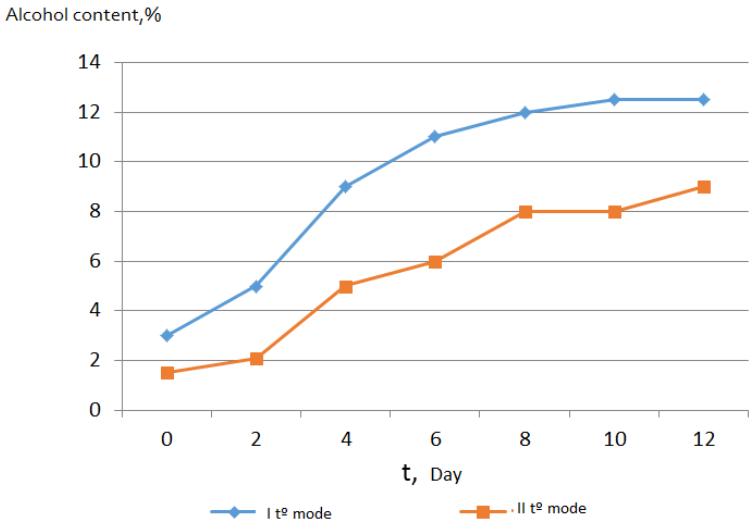

Fig. 5. Alcohol content in samples

As can be seen from the graphs, at II tº mode, yeast stops processing sugar at an alcohol content of 8%. At the I tº mode, the yeast processes sugar completely in 2 weeks. The last measurement corresponds to 0% sugar and 12.5% alcohol content.

Conclusion. Based on the results of the work, the dependence of the intensity of fermentation on its temperature regime was established. Thus, the optimal fermentation temperature is 26-27 ℃. Exceeding this temperature regime is impractical, as this will lead to the death of yeast fungi. Lowering the temperature regime, in turn, inhibits the development of yeast, which leads to a slowdown in the fermentation process.

Based on the results of the work, the dependences of the content of dry substances and the refractive index on the temperature regime of wort fermentation have been established. Also presented are graphs reflecting the obtained dependencies.

When carrying out the research, the optimal indicators for wort fermentation were revealed. At a temperature of 27 ℃, this figure corresponds to 2 days after the start of fermentation. At 20 ℃, this figure corresponds to 4 days after the start of fermentation.

Thus, as a result of the work done, it was determined that the increased temperature significantly accelerates the fermentation process, thereby increasing the productivity of the enterprise.

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ВЛИЯНИЕ ПРОЦЕССА ЗАМОРАЖИВАНИЯ НА ОРГАНОЛЕПТИЧЕСКИЕ ПОКАЗАТЕЛИ КУЛИНАРНЫХ ИЗДЕЛИЙ ИЗ СЛОЕНОГО ТЕСТА

INFLUENCE OF FREEZING PROCESS ON ORGANOLEPTIC PARAMETERS OF PUFF PASTRY PRODUCTS

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Аннотация. *В данной статье представлено описание результатов исследования влияния процесса замораживания на органолептические показатели кулинарных изделий из слоеного теста. Исследование проводилось в два этапа. Качественные показатели экспериментальных изделий оценивалось органолептическим методом. В ходе исследования было выявлено влияние условий дефростации на внешний вид, цвет, вкус, аромат и консистенцию готовых изделий. А также выбраны оптимальные условия дефростации изделий для сохранения лучших органолептических показателей в процессе производства.*

Ключевые слова: тесто, слоёное тесто, заморозка, дефростация.

Abstract. *The article describes the results of a study of the effect of the freezing process on the organoleptic characteristics of culinary products from puff pastry. The study was conducted in two stages. Qualitative indicators of experimental products were evaluated by the organoleptic method. The study revealed the influence of defrosting conditions on the appearance, color, taste, aroma and texture of finished products. And also the optimal conditions for defrosting products were selected to maintain the best organoleptic characteristics in the production process.*

Key words: dough, puffed, frost, microwave heating, defrosting.

Introduction. Recently, in the food industry and catering, frozen semi-finished products or frozen raw materials are widely used. You must select the correct mode of defrosting raw materials or semi-finished products to obtain products with the best organoleptic characteristics. The purpose of this study is to identify the influence of the freezing process on the organoleptic characteristics of finished products from puff pastry [1]. The objectives of the study are: 1) determination of the quality indicators of finished products by the organoleptic method; 2) determination of the organoleptic characteristics of the test pieces by the organoleptic method [2, 3]. For work, two types of puff pastry were taken: yeast and yeast-free. The layers were halved. The study took place in two stages.

First step. At the first stage, one part of the yeast and yeast-free dough was thawed using microwave heating for 40 seconds at high power, and the second part was thawed at room temperature 25 ° C.

The results of the study. The dough, thawed using microwave heating, was more solid in consistency than when defrosting at room temperature. It was revealed that yeast dough thawed faster than yeast-free; the dough thawed by microwave heating has less stickiness than the dough thawed at room temperature; yeast dough is less sticky than yeast. Table 1 presents the merchandising characteristics of experimental products.

Conclusion. Based on the presented in table. 1 data merchandising characteristics, we can conclude that the yeast dough, thawed at room temperature, gives the finished product more airiness and softness than thawed using microwave heating. However, with the yeast-free situation, the opposite is observed in the case of puffs. Puffs from yeast-free dough thawed at room temperature were less lush. products from dough thawed at room temperature have a milder flavor. Despite all the advantages of using microwave heating [4], the traditional method of defrosting has a better effect on finished products.

Second phase. At the second stage of the work, semi-finished products were made from puff yeast and yeast-free dough [5], thawed at room temperature 25 ° C and under microwave heating for 30 seconds. Then the semi-finished products were frozen in two ways: shock freezing [6, 7] at a temperature of -36 ^{0}C and gradual at a temperature of -18 ^{0}C [8].

Table 1

Commodity characteristics of experimental products

 Fig. 1. Bows	Appearance: looks like a bow, sprinkled with sugar. Color: golden, uneven, white sugar on the surface. Odor: the smell of baked dough. Taste: sweetish taste of evenly baked dough. Consistency: crisp, soft inside.
Defrosting conditions: the dough is thawed using microwave heating for 30 seconds; the product is baked in the oven at a temperature of 200 ° C for 15 minutes.	
 Fig. 2. Bows	Appearance: the product looks like a bow, sprinkled with sugar. Color: golden, uniform, white sugar on the surface. Odor: pronounced aroma of baked dough. Taste: sweet, baked pastry flavor. Consistency: more airy, softer, firmer inside, crisp.
Defrosting conditions: the dough is thawed at room temperature 25 °C; the product is baked in an oven at a temperature of 200 ° C for 15 minutes.	
 Fig. 3. Puff product with raspberry jam	Appearance: opened puffs with raspberry jam. Color: jam dark red; the dough is unevenly golden. Smell: aroma of raspberry jam and baked pastry. Taste: the sweet taste of raspberry jam, the taste of baked dough. Consistency: thickened jam; the dough is soft inside, the outside is crisp.
Defrosting conditions: the dough is thawed in the microwave for 30 seconds; the product is baked in the oven at a temperature of 200 ° C for 20 minutes.	
 Fig. 4. Puff product with raspberry jam	Appearance: puffs with raspberry jam. Color: jam dark red; golden dough interspersed with darker shades of golden. Smell: aroma of raspberry jam and baked pastry. Taste: the sweet taste of raspberry jam, the taste of baked dough. Consistency: thickened jam; the dough is soft inside, more airy, crisp.
Defrosting conditions: the dough is thawed at room temperature 25 °C; the product is baked in an oven at a temperature of 200 ° C for 20 minutes.	
 Fig. 5. Puff with sugar	Appearance: air puff, looks like a loaf of bread (a rectangle with one "swollen" surface). The product is sprinkled with sugar on top. Color: light golden. Odor: aroma of baked dough. Taste: sweet, baked pastry flavor. Consistency: airy, crisp on top, soft inside.
Defrosting conditions: the dough is thawed using microwave heating for 30 seconds; the product is baked in the oven at a temperature of 200 ° C for 10 minutes.	
 Fig. 6. Puff with sugar	Appearance: air puff, looks like a loaf of bread. The product is sprinkled with sugar on top. Color: light golden. Odor: aroma of baked dough. Taste: sweet, baked pastry flavor. Consistency: less airy, crisp, soft inside.
Defrosting conditions: the dough is thawed at room temperature 25 °C; the product is baked in the oven at a temperature of 200 ° C for 10 minutes.	
 Fig. 7. Strudel with raspberry jam	Appearance: a small strudel with raspberry jam, sprinkled with sugar. Color: golden with burgundy jam. Smell: raspberry jam and baked dough. Taste: sweet, raspberry, taste of baked dough. Consistency: crisp, marmalade jam.
Defrosting conditions: the dough is thawed using microwave heating for 30 seconds; the product is baked in an oven at a temperature of 200 ° C for 15 minutes.	
 Fig. 8. Strudel with raspberry jam	Appearance: opened small strudel with raspberry jam, sprinkled with sugar. Color: pale golden with burgundy jam. Smell: raspberry jam and baked dough. Taste: sweet, raspberry, taste of baked dough. Consistency: less crisp, marmalade jam.
Defrosting conditions: the dough is thawed at room temperature 25 °C; the product is baked in an oven at a temperature of 200 ° C for 15 minutes.	

The results of the study. Semi-finished products were stored for two days [9]. Semi-finished products were also thawed in two ways: part at room temperature 25 ° C, part using microwave heating for 30 seconds at high power. During the defrosting of semi-finished products using microwave heating, it was noticed that semi-finished products from yeast dough, which was thawed at room temperature, noticeably darkened after microwave heating, became more liquid and sticky. Semi-finished products from yeast-free dough also had stickiness and a more fluid consistency. The following table 2 presents the merchandising characteristics of experimental products made from semi-finished products, gradually frozen at a temperature of -18 ° C.

Table 2

Commodity characteristics of experimental products

 Fig. 9. Bows	Appearance: A bow-like product sprinkled with sugar. Color: golden uneven with white sugar on the surface. Fragrance: baked pastry. Taste: The sweet taste of evenly baked dough. Consistency: crisp, not airy inside.
Defrosting conditions: the dough is thawed in the microwave for 30 seconds; the semi-finished product is frozen gradually, thawed using microwave heating for 30 seconds; the product is baked in the oven at a temperature of 200 ° C for 15 minutes.	
 Fig. 10. Bows	Appearance: A bow-like product sprinkled with sugar. Color: golden with white sugar on the surface. Fragrance: baked pastry. Taste: The sweet taste of evenly baked dough. Consistency: crisp, not airy inside.
Defrosting conditions: the dough is thawed at room temperature; the semi-finished product is frozen gradually, thawed using microwave heating for 30 seconds; the product is baked in the oven at a temperature of 200 ° C for 15 minutes.	
 Fig. 11. Bows	Appearance: A bow-like product sprinkled with sugar. Color: golden with white sugar on the surface. Fragrance: baked pastry. Taste: The sweet taste of evenly baked dough. Consistency: not crisp, slightly airy inside.
Defrosting conditions: the dough is thawed at room temperature; the semi-finished product is frozen gradually, thawed at room temperature; the product is baked in the oven at a temperature of 200 ° C for 15 minutes.	
 Fig. 12. Bows	Appearance: A bow-like product sprinkled with sugar. Color: golden with white sugar on the surface. Fragrance: baked pastry. Taste: The sweet taste of evenly baked dough. Consistency: crisp, slightly airy inside.
Defrosting conditions: the dough is thawed at room temperature; the semi-finished product is frozen gradually, thawed at room temperature; the product is baked in the oven at a temperature of 200 ° C for 15 minutes.	
 Fig. 13. Puff with raspberry jam	Appearance: puffs with raspberry jam. Color: jam dark red; golden dough. Odor: aroma of baked dough. Taste: taste of baked dough. Consistency: thickened jam; the dough is soft inside, not airy, rather dry.
Defrosting conditions: the dough is thawed using microwave heating for 30 seconds; the semi-finished product is frozen gradually, thawed using microwave heating for 30 seconds; the product is baked in an oven at a temperature of 200 ° C for 20 minutes.	
 Fig. 14. Puff with raspberry jam	Appearance: puffs with raspberry jam. Color: jam dark red; golden dough. Odor: aroma of baked dough. Taste: taste of baked pastry, raspberry jam. Consistency: thickened jam; the dough is soft inside, not airy, a little dry, crispy on the outside.
Defrosting conditions: the dough is thawed at room temperature; the semi-finished product is frozen gradually, thawed using microwave heating for 30 seconds; the product is baked in an oven at a temperature of 200 ° C for 20 minutes.	
 Fig. 15. Puff with raspberry jam	Appearance: puffs with raspberry jam. Color: jam dark red; golden dough. Smell: aroma of baked dough, raspberries. Taste: taste of baked pastry, raspberry jam. Consistency: thickened jam; the dough is soft inside, slightly airy, crisp on the outside.
Defrosting conditions: the dough is thawed using microwave heating for 30 seconds; the semi-finished product is frozen gradually, thawed at room temperature; the product is baked in an oven at a temperature of 200 ° C for 20 minutes.	

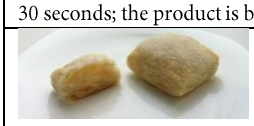
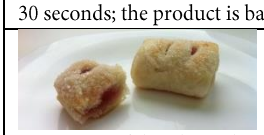
 Fig. 16. Puff with raspberry jam	Appearance: puffs with raspberry. Color: jam dark red; the dough is golden brown. Smell: aroma of baked dough, weak aroma of raspberries. Taste: taste of baked pastry, raspberry jam. Consistency: thickened jam; the dough is soft inside, airy, a little dry, crisp on the outside.
Defrosting conditions: the dough is thawed at room temperature; the semi-finished product is frozen gradually, thawed at room temperature; the product is baked in an oven at a temperature of 200 ° C for 20 minutes.	
 Fig. 17. Puff with sugar	Appearance: a cylindrical puff, looks like a loaf of bread. The product is sprinkled with sugar on top. Color: pale golden. Odor: aroma of baked dough. Taste: sweet, baked pastry flavor. Consistency: not airy, crisp, soft, dry inside.
Defrosting conditions: the dough is thawed in the microwave for 30 seconds; the semi-finished product is frozen gradually, thawed using microwave heating for 30 seconds; the product is baked in the oven at a temperature of 200 ° C for 10 minutes.	
 Fig. 18. Puff with sugar	Appearance: a cylindrical puff, looks like a loaf of bread. The product is sprinkled with sugar on top. Color: pale, almost white. Odor: aroma of baked dough. Taste: sweet, baked pastry flavor. Consistency: airy, crisp, soft, dry inside.
Defrosting conditions: the dough is thawed at room temperature; the semi-finished product is frozen gradually, thawed using microwave heating for 30 seconds; the product is baked in the oven at a temperature of 200 ° C for 10 minutes.	
 Fig. 19. Puff with sugar	Appearance: a cylindrical puff, outwardly similar to a loaf of bread. The product is sprinkled with sugar on top. Color: pale, almost white. Odor: aroma of baked dough. Taste: sweet, baked pastry flavor. Consistency: less airy, crisp, soft inside.
Defrosting conditions: the dough is thawed using microwave heating for 30 seconds; the semi-finished product is frozen gradually, thawed at room temperature; the product is baked in the oven at a temperature of 200 ° C for 10 minutes.	
 Fig. 20. Puff with sugar	Appearance: a cylindrical puff, outwardly similar to a loaf of bread. The product is sprinkled with sugar on top. Color: pale golden. Odor: aroma of baked dough. Taste: sweet, baked pastry flavor. Consistency: slightly airy, crisp, soft, dry inside.
Defrosting conditions: the dough is thawed at room temperature; the semi-finished product is frozen gradually, thawed at room temperature; the product is baked in the oven at a temperature of 200 ° C for 10 minutes.	
 Fig. 21. Strudel with raspberry jam	Appearance: a small strudel with raspberry jam. Color: pale, closer to white. Smell: baked dough. Taste: baked dough. Consistency: crisp, marmalade jam, not airy.
Defrosting conditions: the dough is thawed in the microwave for 30 seconds; the semi-finished product is frozen in the freezer, thawed using microwave heating for 30 seconds; the product is baked in an oven at a temperature of 200 ° C for 15 minutes.	
 Fig. 22. Strudel with raspberry jam	Appearance: a small strudel with raspberry jam. Color: Golden. Smell: baked dough. Taste: raspberry jam, baked dough. Consistency: crisp, marmalade jam, airy consistency.
Defrosting conditions: the dough is thawed at room temperature; the semi-finished product is frozen gradually, thawed using microwave heating for 30 seconds; the product is baked in an oven at a temperature of 200 ° C for 15 minutes.	
 Fig. 23. Strudel with raspberry jam	Appearance: a small strudel with raspberry jam. Color: pale golden. Smell: baked pastry, raspberries. Taste: sweet taste of raspberry jam, baked dough. Consistency: a little crisp, marmalade jam, not airy consistency, dry.
Defrosting conditions: the dough is thawed using microwave heating for 30 seconds; the semi-finished product is frozen gradually, thawed at room temperature; the product is baked in an oven at a temperature of 200 ° C for 15 minutes.	

 Fig. 24. Strudel with raspberry jam	Appearance: a small strudel with raspberry jam. Color: pale golden. Smell: baked pastry, raspberries. Taste: sweet taste of raspberry jam, baked dough. Consistency: slightly crisp, marmalade jam, airy consistency, dry.
Defrosting conditions: the dough is thawed at room temperature; the semi-finished product is frozen gradually, thawed at room temperature; the product is baked in an oven at a temperature of 200 ° C for 15 minutes.	

Table 3 presents the merchandising characteristics of products made from semi-finished products frozen using shock freezing at a temperature of -36 ° C.

Table 3

Commodity characteristics of experimental products

 Fig. 25. Bows	Appearance: A bow-like product sprinkled with sugar. Color: golden with white sugar on the surface. Fragrance: baked pastry. Taste: The sweet taste of evenly baked dough. Consistency: crisp, not airy inside, slightly dry.
Defrosting conditions: the dough is thawed in the microwave for 30 seconds; the semi-finished product is frozen using shock freezing, thawed using microwave heating for 30 seconds; the product is baked in the oven at a temperature of 200 ° C for 15 minutes.	
 Fig. 26. Bows	Appearance: A bow-like product sprinkled with sugar. Color: golden uneven with white sugar on the surface. Fragrance: baked pastry. Taste: The sweet taste of evenly baked dough. Consistency: crisp, not airy inside, slightly dry.
Defrosting conditions: the dough is thawed at room temperature; the semi-finished product is frozen using shock freezing, thawed using microwave heating for 30 seconds; the product is baked in the oven at a temperature of 200 ° C for 15 minutes.	
 Fig. 27. Bows	Appearance: A bow-like product sprinkled with sugar. Color: golden with white sugar on the surface. Aroma: pronounced aroma of baked dough. Taste: The sweet taste of evenly baked dough. Consistency: not crisp, airy inside, slightly dry.
Defrosting conditions: the dough is thawed using microwave heating for 30 seconds; semi-finished product is frozen by shock freezing, thawed at room temperature; the product is baked in the oven at a temperature of 200 ° C for 15 minutes.	
 Fig. 28. Bows	Appearance: A bow-like product sprinkled with sugar. Color: golden uneven with white sugar on the surface. Fragrance: baked pastry. Taste: The sweet taste of evenly baked dough. Consistency: crispy, airy inside.
Defrosting conditions: the dough is thawed at room temperature; semi-finished product is frozen by shock freezing, thawed at room temperature; the product is baked in the oven at a temperature of 200 ° C for 15 minutes.	
 Fig. 29. Puff with raspberry jam	Appearance: puffs with raspberry jam, uneven. Color: jam dark red; golden dough. Aroma: the aroma of baked dough and raspberries. Taste: The sweet taste of baked dough and raspberries. Consistency: thickened jam; the dough is soft inside, a little dry.
Defrosting conditions: the dough is thawed using microwave heating for 30 seconds; the semi-finished product is frozen using shock freezing, thawed using microwave heating for 30 seconds; the product is baked in an oven at a temperature of 200 ° C for 20 minutes.	
 Fig. 30. Puff with raspberry jam	Appearance: even puffs with raspberry jam. Color: jam dark red; the dough is golden brown. Aroma: the aroma of baked dough. Taste: taste of baked dough, raspberries. Consistency: thickened jam; the dough is soft inside, not airy, rather dry.
Defrosting conditions: the dough is thawed at room temperature; the semi-finished product is frozen using shock freezing, thawed using microwave heating for 30 seconds; the product is baked in an oven at a temperature of 200 ° C for 20 minutes.	
 Fig. 31. Puff with raspberry jam	Appearance: puffs with raspberry jam. Color: jam dark red; the dough is golden, sometimes dark golden, closer to brown. Aroma: aroma of baked dough, weak aroma of raspberry. Taste: the taste of baked dough and raspberries. Consistency: thickened jam; the dough is soft inside, slightly airy, rather dry.
Defrosting conditions: the dough is thawed using microwave heating for 30 seconds; semi-finished product is frozen by shock freezing, thawed at room temperature; the product is baked in an oven at a temperature of 200 ° C for 20 minutes.	

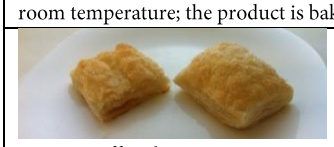
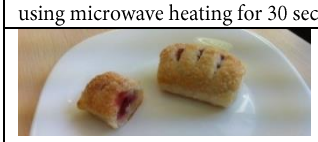
 Fig. 32. Puff with raspberry jam	Appearance: puffs with raspberry jam. Color: jam dark red; the dough is golden brown. Aroma: the aroma of baked dough. Taste: The sweet taste of baked dough and raspberries. Consistency: thickened jam; the dough is soft inside, airy.
Defrosting conditions: the dough is thawed at room temperature; semi-finished product is frozen by shock freezing, thawed at room temperature; the product is baked in an oven at a temperature of 200 ° C for 20 minutes.	
 Fig. 33. Puff with sugar	Appearance: a cylindrical puff, looks like a loaf of bread. The product is sprinkled with sugar on top. Color: golden with pale golden patches. Aroma: weak aroma of baked dough. Taste: The sweet taste of baked dough. Consistency: not airy, crisp, soft, dry inside.
Defrosting conditions: the dough is thawed using microwave heating for 30 seconds; the semi-finished product is frozen using shock freezing, thawed using microwave heating for 30 seconds; the product is baked in the oven at a temperature of 200 ° C for 10 minutes.	
 Fig. 34. Puff with sugar	Appearance: a cylindrical puff, outwardly similar to a loaf of bread. The product is sprinkled with sugar on top. Color: pale golden. Aroma: the aroma of baked dough. Taste: The sweet taste of baked dough. Consistency: not airy, crisp on top, inside soft, dry.
Defrosting conditions: the dough is thawed at room temperature; the semi-finished product is frozen using shock freezing, thawed using microwave heating for 30 seconds; the product is baked in the oven at a temperature of 200 ° C for 10 minutes.	
 Fig. 35. Puff with sugar	Appearance: smooth cylindrical puff, looks like a loaf of bread. The product is sprinkled with sugar on top. Color: light golden. Aroma: weak aroma of baked dough. Taste: The sweet taste of baked dough. Consistency: airy, crisp on top, soft inside.
Defrosting conditions: the dough is thawed using microwave heating for 30 seconds; semi-finished product is frozen by shock freezing, thawed at room temperature; the product is baked in the oven at a temperature of 200 ° C for 10 minutes.	
 Fig. 36. Puff with sugar	Appearance: a cylindrical puff, looks like a loaf of bread. The product is sprinkled with sugar on top. Color: pale golden. Aroma: the aroma of baked dough. Taste: sweet, baked pastry flavor. Consistency: airy, crisp on top, inside soft, dry.
Defrosting conditions: the dough is thawed at room temperature; semi-finished product is frozen by shock freezing, thawed at room temperature; the product is baked in the oven at a temperature of 200 ° C for 10 minutes.	
 Fig. 37. Strudel with raspberry jam	Appearance: a small strudel with raspberry jam. Color: Golden. Aroma: baked dough, weak raspberry aroma. Taste: sweet taste of raspberry jam, baked dough. Consistency: crisp, marmalade jam, slightly airy consistency.
Defrosting conditions: the dough is thawed using microwave heating for 30 seconds; the semi-finished product is frozen using shock freezing, thawed using microwave heating for 30 seconds; the product is baked in an oven at a temperature of 200 ° C for 15 minutes.	
 Fig. 38. Strudel with raspberry jam	Appearance: a small strudel with raspberry jam. Color: Golden. Fragrance: baked pastry. Taste: sweet taste of raspberry jam, baked dough. Consistency: crisp, marmalade jam, airy consistency, dry.
Defrosting conditions: the dough is thawed at room temperature; the semi-finished product is frozen using shock freezing, thawed using microwave heating for 30 seconds; the product is baked in an oven at a temperature of 200 ° C for 15 minutes	
 Fig. 39. Strudel with raspberry jam	Appearance: a small strudel with raspberry jam. Color: pale golden. Aroma: baked dough, weak raspberry aroma. Taste: sweet taste of raspberry jam, baked dough. Consistency: crisp, marmalade jam, airy consistency.
Defrosting conditions: the dough is thawed using microwave heating for 30 seconds; semi-finished product is frozen by shock freezing, thawed at room temperature; the product is baked in an oven at a temperature of 200 ° C for 15 minutes.	

 Fig. 40. Strudel with raspberry jam	Appearance: a small strudel with raspberry jam. Color: pale golden. Fragrance: baked pastry, raspberries. Taste: sweet taste of raspberry jam, baked dough. Consistency: crisp, marmalade jam, airy consistency.
Defrosting conditions: the dough is thawed at room temperature; semi-finished product is frozen by shock freezing, thawed at room temperature; the product is baked in an oven at a temperature of 200 ° C for 15 minutes.	

Findings. In semi-finished products frozen by means of gradual freezing, it was noticed that products from semi-finished products thawed by microwave heating lost their airiness and became dry. Also, stuffed products lost their pronounced raspberry flavor, or the fragrance was subtle. The color of some products was rather pale.

For semi-finished products frozen by shock freezing, it was noted that yeast semi-finished products thawed by microwave heating also slightly darkened. For semi-finished products, the dough of which was thawed in the microwave, a slight loss of flavor is characteristic. Semi-finished products from microwave were drier and slightly airy. Semi-finished products, the dough of which was thawed at room temperature, often had a paler color, but they had a more pronounced aroma, the consistency was more airy, it was not as dry as from a microwave.

General conclusions. In the course of the work, an organoleptic analysis of the quality indicators of products from puff pastry, as well as dough pieces was carried out; The influence of the freezing process on finished products is revealed. Dough thawed at room temperature is more preferable for products, since products from this dough subsequently have organoleptic characteristics higher than products from the same dough, thawed by microwave heating. The same dependence is observed for semi-finished products from puff pastry. In semi-finished products frozen at a shock temperature, more often the indicators are higher than in products frozen gradually. This is due to the features of shock freezing.

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КРАТКИЕ СООБЩЕНИЯ | SHORT REPORTS

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ПРОИЗВОДСТВО КВАСА ХЛЕБНОГО С ДОБАВЛЕНИЕМ СИРОПОВ ИЗ ЕЛИ ОБЫКНОВЕННОЙ И КОРНЯ СОЛОДКИ, МЯТЫ ПЕРЕЧНОЙ СВЕЖЕЙ И ШИПОВНИКА КОРИЧНОГО (МАЙСКОГО)

THE PRODUCTION OF BREAD KVASS WITH THE ADDITION OF SYRUPS FROM COMMON SPRUCE AND LICORICE ROOT, PEPPERMINT FRESH AND CINNAMON ROSE

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Аннотация. *В статье рассматривается производство кваса с добавлением сиропов из ели обыкновенной и корня солодки, мяты перечной свежей и шиповника коричного (майского). Разработана модель технологического модуля биологической очистки сточных вод при производстве кваса хлебного с добавлением различных сиропов.*

Ключевые слова: квас хлебный, модель технологического модуля биологической очистки сточных вод.

Abstract. *The article deals with the production of kvass with the addition of syrups from common spruce and licorice root, fresh peppermint and cinnamon rose. A model of the technological module of biological wastewater treatment in the production of kvass has been designed.*

Key words: bread kvass, model of technological module of biological wastewater treatment.

The problem of the quality and safety of drinks in modern conditions plays an important role and can only be comprehensively solved, both by manufacturers and various state bodies [4, 5, 6, 8]. Consumers are interested in obtaining high-quality and safe products [7]. High-quality products can only be made from raw materials that meet all quality and safety requirements.

Kvass bread - one of the most popular non-alcoholic national drinks in Russia. It is nutritious, valuable in biological indicators, pleasant in taste, affordable. The raw materials are rye or barley malt, rye flour, sugar, fructose, dextrose, maltose, glucose syrup. Formula may include nutritional supplements.

Kvass is produced as a result of incomplete alcohol or alcohol and lactic fermentation of wort. Manufacturers pay great attention to quality and focus on the naturalness of the drink. Kvass (unfiltered and filtered) made by domestic manufacturers of various brands is presented on the consumer market.

The most popular bread kvass, which is made from kvass wort concentrate (KWC), sourdough and other raw materials that increase the organoleptic characteristics and nutritional value of the drink. Using KWC allows you to reduce time and labor costs for the production of kvass. In order to enrich bread kvass with nutrients, natural plant components are used, for example, products of processing fruit and berry raw materials.

In this article we consider the production of bread kvass with the addition of syrups from common spruce and licorice root, fresh peppermint and cinnamon rose hips.

The technological process for the production of bread kvass consists of the following operations: preparation of raw materials (sorting and washing peppermint, cinnamon rose and spruce); cooking syrups from peppermint, cinnamon rose and common spruce, and KWC; fermentation of KWC for 48 hours at a temperature of 15-20 ° C; blending of kvass wort; filtering, cooling and pouring kvass into PET bottles (polyethylene terephthalate) in accordance with GOST R 51760.

Ready-made syrups have a homogenous liquid consistency, are opaque, do not foam, without sediment and impurities, the color, smell, taste and aroma according to the used ingredients. KWC has a viscous, opaque, dark brown

texture, sweet and sour taste and aroma of rye bread. Table 1 presents the content of biologically active substances in syrups from common spruce and licorice root, fresh peppermint and cinnamon rose hips.

Table 1

The Content of biologically active substances in syrups

Syrup	The content of biologically active substances, mg / 100g		
	Vitamin C	Vitamin P	Total flavonoid content
common spruce and licorice root	43,4	0,03	0,1
peppermint fresh	26	0,02	0,2
cinnamon rose	223,8	0,4	2,4

Test samples of kvass were studied after its preparation when 48 hours have passed according to GOST 31494-2012 [1]. The organoleptic characteristics of bread kvass with the addition of syrups from ordinary spruce and licorice root, fresh peppermint and cinnamon rose hips are quite high. The resulting samples taste good, have a rich aftertaste and aroma. Table 2 presents the organoleptic characteristics of the obtained samples of bread kvass with the addition of fresh peppermint, common spruce and licorice syrup, cinnamon rose.

Table 2

Organoleptic characteristics of bread kvass with the addition of fresh peppermint, common spruce and licorice syrup, cinnamon rose

Characteristic	Kvass with syrup		
	from common spruce and licorice root	from fresh peppermint	from cinnamon rose
consistence	homogeneous, liquid, opaque, without sediment	homogeneous, liquid, opaque, without sediment	homogeneous, liquid, opaque, without sediment
color	brown with a greenish tint	brown with a greenish tint	dark brown
taste	refreshing, sweet and sour	refreshing, sweet and sour	refreshing, sweet and sour
aftertaste	spruce and licorice root	mint	berry with a cinnamon rose hip flavor
aroma	rye bread	rye bread	rye bread

The physical and chemical analysis showed that the obtained samples of bread kvass with various syrups meet the requirements of GOST 31494-2012, and microbiological characteristics meet the requirements of SanPiN 2.3.2.1078-01 (Table 3).

Table 3

Physico-chemical characteristics of bread kvass with the addition of fresh peppermint, common spruce and licorice syrup, cinnamon rose hip

№	Name of Indicator	The list of studied kvass and indicator values			Value according to GOST 31494-2012
		Fresh kvass with fresh peppermint	Kvass with the addition of common spruce and licorice syrup	Kvass with the addition of cinnamon rose	
1	Mass fraction of solids (density)	4,8	5,6	4,9	>3,5
2	Acidity, ° T	1,8	1,8	1,9	1,5-7,0
3	Volume fraction of alcohol, %.	0,4	0,4	0,5	<1,2
4	Color	1,2	0,43	1,2	-

The obtained samples of bread kvass can be attributed to sweet and sour (acid content from 1 to 1.3). The study showed that the obtained samples of bread kvass with the addition of various syrups are characterized by a sufficiently high level of vitamins C and P, as well as an increased content of minerals.

In the production of bread kvass, residual organic substances are formed, which are in a different state and enter the water bodies along with the sewage of the enterprise. As they have fell to water, organic substances decompose, forming toxic compounds, violating the flora and fauna of water bodies [2, 3].

Consider the scheme of the biological wastewater treatment plant, which is shown in Fig. 1.

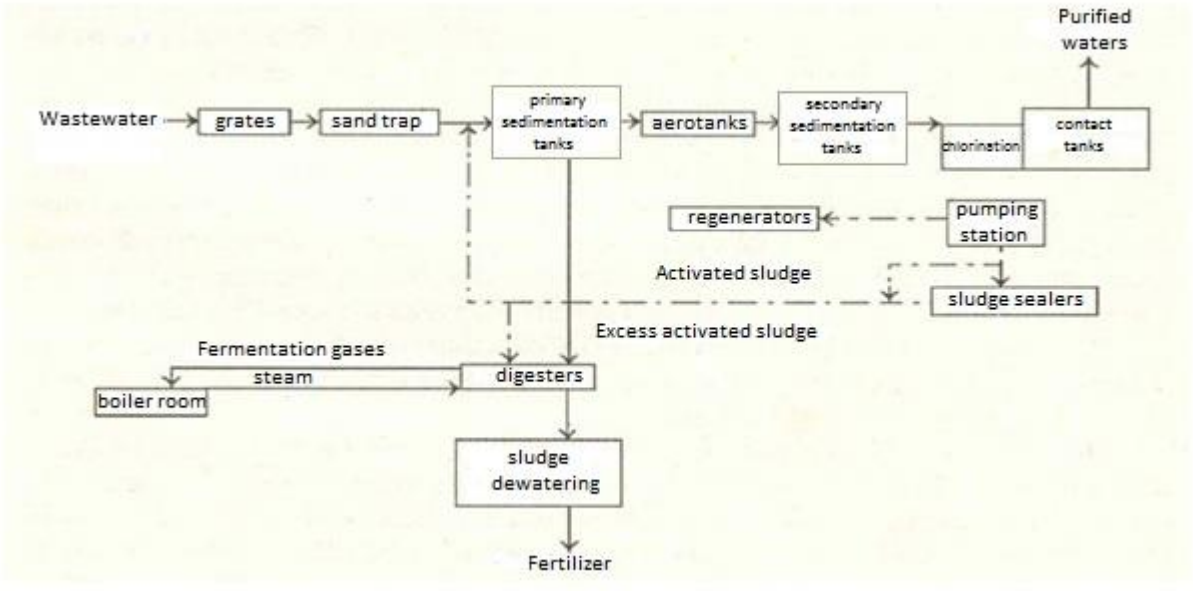

Fig. 1. Scheme of biological wastewater treatment

To control the biological wastewater treatment (BWT) process for the production of kvass, a mathematical model of the technological scheme in the form of a modified Petri net (MPN) was disigned (Fig. 2). On the basis of the Petri net-model, it is advisable to create a software package that allows you to analyze the BWT process, in order to predict the development of emergency situations.

The Petri net C is a five, C = (P, T, I, O, M).

T = {tj} is a finite set of transitions, j ≥ 0.

P = {pi} is a finite set of positions, i ≥ 0.

I: PxT → {0, 1} is an input function that defines the set of its positions for each transition ti.

O: PxT → {0, 1} - an output function that displays a transition to a set of output positions $p_i \in O(t_j)$ displays transition.

M: P → {1, 2, 3 ...} is the network marking function that maps the set of P positions to the set of non-negative integers N.

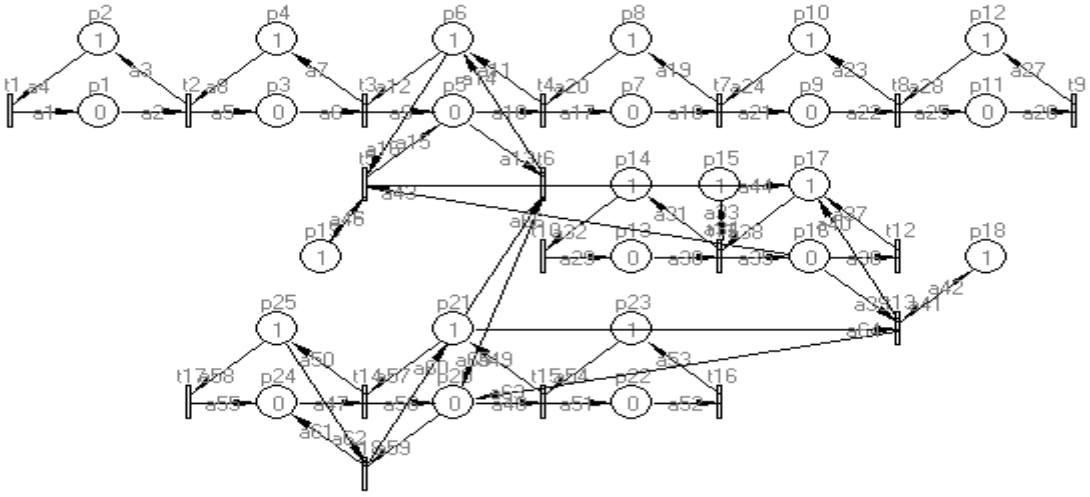

Fig. 2. Common Petri net of the entire installation

An analytical description of the common Petri net (Fig. 2):

25 Positions

18 Transitions

1 color

P = (p1, p2, p3, p4, p5, p6, p7, p8, p9, p10, p11, p12, p13, p14, p15, p16, p17, p18, p19, p20, p21, p22, p23, p24, p25)

T = (t1, t2, t3, t4, t5, t6, t7, t8, t9, t10, t11, t12, t13, t14, t15, t16, t17, t18)
O(t1)={p1}
O(t2)={p2, p3}
O(t3)={p4, p5}
O(t4)={p6, p7}
O(t5)={p5, p17, p19}
O(t6)={p6, p20}
O(t7)={p8, p9}
O(t8)={p10, p11}
O(t9)={p12}
O(t10)={p13}
O(t11)={p14, p15, p16}
O(t12)={p17}
O(t13)={p17, p18, p20}
O(t14)={p25, p20}
O(t15)={p21, p22}
O(t16)={p23}
O(t17)={p24}
O(t18)={p21, p24}
I(t1)={p2}
I(t2)={p1, p4}
I(t3)={p3, p6}
I(t4)={p5, p8}
I(t5)={p6, p16, p19}
I(t6)={p5, p21}
I(t7)={p7, p10}
I(t8)={p9, p12}
I(t9)={p11}
I(t10)={p14}
I(t11)={p13, p15, p17}
I(t12)={p16}
I(t13)={p16, p18, p21}
I(t14)={p24, p21}
I(t15)={p20, p23}
I(t16)={p22}
I(t17)={p25}
I(t18)={p20, p25}
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 1 0 1 0 1 0 1 0 1 0 1 0 1 1 0 1 1 1 0 1 0 1 0 1
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

Thus, the new recipes for bread kvass with the addition of syrups from common spruce and licorice root, fresh peppermint and cinnamon rose hips will expand the range of drinks, as well as satisfy growing consumer demand for quality and safe products. All characteristics are within acceptable standards and meet the requirements of state standards.

The developed model of biological wastewater treatment will allow to create a software package that analyzes the BWT process, both in general and in order to predict the development of emergency situations.

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РЕЦЕНЗИЯ НА НАУЧНЫЕ ТРУДЫ « ПЛАТОНОСФЕРА» Л. Я. ПОДВОЙСКОГО

REVIEW ON SCIENTIFIC PAPERS "PLATONOSPHERE" BY L. Ya. PODVOYSKY

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"Wise people say because they have something to say,
fools, because they have to say something "
Plato

An interesting treatise by Podvoisky Leonid Yakovlevich, one of the leading Russian researchers of the philosopher Plato's scientific heritage was published in Moscow. The publication contains the author's selected works and is named by the capacious scientific term "Platonosphere".

The author, a graduate of the Faculty of Philosophy of Moscow State University, by his jubilee's date, put together the works devoted to various aspects of Plato's creative heritage of the Soviet and post-Soviet periods. It was Podvoisky L.Ya. who theoretically substantiated the term "platonosphere", implied as a combination of philosophical understanding of idealism.

Political science was formed under the influence of Plato's ideas, and the author devotes to this philosopher a whole chapter in his collection "Russian Platonism and Political Culture" (p. 338-370). In our opinion, there was a reincarnation of our hero of the day Podvoisky L.Ya. through creativity to the very personality of Plato. The ancient philosopher combined in his work the genius of the philosopher with the genius of the poet. Many colleagues of Podvoisky L.Ya. appreciated his "original" poetic talent. Plato was famous for his dialogues, where Socrates acted as the main interlocutor. And Leonid Yakovlevich is always pleasant to listen to as an interlocutor. He causes someone's heart with his charm and the beauty of the "Platonic style". An extraordinary uplift of thought and mood, along with simplicity of presentation, subtle mockery, along with deep and serious penetration of thought, abstract analysis, along with brilliant images and jokes. All this fascinates Podvoisky's listeners who gues in master's style Plato's style of himself.

Discussing the impact of Plato to the history and theory of political science, we should quote G.A. Almond: "If we set ourselves the task of constructing a graphic model of the historical development of political science in the form of a curve, then we should start it with the begining of political science in ancient Greece ...."[1] Almond proposes to include the "classical period" (before the formation of political science as a discipline) in the periodization of political science development, thereby appreciating the ancient Greece thinkers, whose ideas were the basis of many political science theories.

L. Podvoisky follows the same point of view and devoted an entire chapter to the political views of Plato in a peer-reviewed monograph. The object of the author's research is a wide range of domestic studies of Plato's works. In particular, the works of E. Orlov, N.Ya. Grot, A.A. Khuseynov, F.L. Kesendi, K.A. Kuznetsova, P.I. Novgorodtseva, S.N. Trubetskoy, P.D. Yurkevich and etc. [2]

The works of L. Podvoisky himself concerning the political views of Plato should be noted in the bibliographic review too, because all his works throughout the entire career of a scientist were "permeated" by the political theme of Plato[3].

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Returning to the analysis of L.Ya. Podvoisky's works, we should quote his friend, like-minded person, co-author and first interlocutor (according to Plato) – Professor P.L. Karabushchenko: "... it should be recognized as one of his (Podvoisky's) positive aspects a desire to cover as many topics and problems related to the development of Russian Platonism as a global historical phenomenon as possible" (p. 467). We agree with P. Karabushchenko that in his works on political issues L.Ya. Podvoisky investigated and then summarized and analyzed the maximum number of particular cases of the genesis of Platonism on the basis of Russian philosophical thought. Podvoisky L.Ya. offered four methodological approaches to the study of Plato:

– subjective method;
– method of psychological and intellectual influence;
– critical-dialectical method;
– critical scholastic method.

Plato's political views were, in fact, not utopian, but ideal, in the opinion of L. Podvoisky. Humanity has not yet realized that it is necessary for it not to deny Plato, but to live "according to Plato" in the man's daily political activity. A rare case, in philosophy – the way from the abstractive ideas, to the concrete actions.

L.Ya. Podvoisky in his study of Platonosphere, takes as the interlocutors and hypothetical opponents such the world and Russian philosophers as: S.N. Trubetskoy, P.D. Yurkevich, V.S. Soloviev, G. Hegel, A.F. Losev, L.N. Tolstoy, N.I. Nadezhdin, V.V. Rozanov, N.A. Berdyaev, P.A. Florensky, V.I. Lenin, I. Brodsky and others.

There is a tradition in the scientific community , it is customary for scientists to give informal assessments; titles and scientific degrees. L. Podvoisky as our hero of the day, an author of the peer-reviewed treatise on philosophy and all his scientific researches is worthy of the degree of Doctor of Philosophy. Who of russian contemporary scientists wrote the doctrine which is more penetrating, more relevant? Who else devoted all his life to the study of Plato's heritage?

Congratulations to the "Astrakhan chudik" (according to V. M. Shukshin) on the anniversary! We wish him inspiration and look forward to new publications on an endless topic – Platonosphere!

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ПОЛИТИЧЕСКИЕ НАУКИ | POLITICAL SCIENCES

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ПОЛИТИЧЕСКИЕ ЭЛИТЫ КОЛЛЕКТИВНОГО ЗАПАДА НА ФРОНТАХ И В ОКОПАХ ХОЛОДНОЙ ВОЙНЫ С РОССИЕЙ

POLITICAL ELITES OF THE COLLECTIVE WEST ON THE FRONTS AND IN THE TRENCHES OF THE COLD WAR WITH RUSSIA

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Аннотация. *В последние годы русофобия достигла своих новых исторических высот, что заставляет нас взглянуть на это явление политической жизни, как на очередное обострение в холодной войне коллективного Запада против России. Еще начиная с XVI в. русофобия является составной частью объявленного Западом против России «крестового похода», целью которого является подчинение своей воли этого восточноевропейского «монстра». План максимум этого похода предусматривал расчленение и полное уничтожение России как государства, как культурно-исторической общности. Современная русофобская традиция в значительной части копирует накопленный за эти пять столетий опыт создания негативного образа потенциального противника, даже в мирное время представляющего его в качестве коварнейшего врага, вынашивающего откровенно зловредные намерения.*

Ключевые слова: русофобия, элиты, правда, фальсификация, информационная война, химера, агрессия, конфликт интересов.

Abstract. *In recent years, Russophobia has reached its new historical heights, which makes us look at this phenomenon of political life as yet another aggravation of the collective West against Russia in the Cold War. Since the XVI century russophobia is an integral part of the "crusade" declared by the West against Russia, the purpose of which is to subordinate this Eastern European "monster". The maximum program of this campaign provided for the dismemberment and complete destruction of Russia as a state, as a cultural and historical community. To a large extent, the modern Russophobian tradition copies the accumulated during these five centuries experience of creating a negative image of a potential adversary, even in peacetime, representing him as an insidious enemy, who is carrying out frankly evil intentions.*

Key words: Russophobia, elites, truth, falsification, information war, chimera, aggression, conflict of interests.

Introduction. On the fronts of the Cold War, in the trenches on the front lines in the form of long-term myths and momentary fakes are ideas that are designed not only to repel enemy frontal attacks, but also to carry out active offensive actions deep into the enemy's information space. On the fronts of the information war, hostilities never stop and are conducted in real time. The object of such a war is Russia, and the subject is negative perception and a destructive assessment of its role in history and politics. At the same time, the subjects of this conflict are mainly the political elite of the collective West, who consider themselves the main actors (more precisely, "play-actors") of this propaganda company, assigning Russia and Russians the status of a silent and powerless extras. From the very beginning, they even deprive Russia of the right to make excuses, therefore they do not admit the principle of innocence in relation to it. In their opinion, Russia should repent and pay for its past, present and future sins. Thus, Russophobes present themselves as inquisitors who had previously sentenced their ideological opponent to execution and are sincerely surprised when the "convict" openly calls their delirium as delirium and refuses to submit to their court.

Fronts and trenches of the Cold War. *Wishful thinking is a favorite pastime of Russophobes of all time.* And they are rarely ever confused by the contradictions and inconsistencies that arise in their "ideological" constructions. The main thing for them is that none of the persons under their control doubts the correctness of their speculative positions. To do this, their fakes must be bright and convincing. Moreover, no one checks their reliability anyway. It is prac-

tically impossible to verify Russophobia, since all the charges are transcendental. *Essentially Russophobia is the propaganda of personal achievements, against the background of specific other people's flaws.*

Russophobia has become an essential element of the Cold War of the West against Russia. It was noted that Russophobia appears and activates where and when crisis political and economic situations arise and politicians need to distract the attention of their citizens from these pressing problems. It was at such a time that Russophobic hysteria was gaining momentum and the fakeworm of fakes about the terrible Russians and their ever-aggressive country, called the "Russian Empire", started.

Russophobic ideas are a kind of "ideological guard" in the information war of Western democracies with the Kremlin. And the most effective and proven means of such a fight is to bribe journalists. The very journalists who are the essence of freedom and truthfulness of the "fourth power" in the liberal and democratic Western world. The fact that the Western media have long become an instrument of Western propaganda is openly written by Western journalists themselves, in whom the voice of conscience woke up.

The German journalist Udo Ulfkotte (Udo Ulfkotte, 1960-2017), who in his book "Selling Journalists" (2014) revealed the secret mechanisms of manipulating public consciousness [24]. Allegedly free and democratic Western media actually turn out to be corrupt communities of ideological workers who willingly carry out instructions from financial and political elites and cover events in a light favorable to them. At the same time, bribing of journalists may also be optional financial in nature. Ulfkotte illustrates this by his own example, when he himself, unaware of this, became an honorary citizen of Oklahoma. The award ceremony was a complete surprise for him and was initiated by the German branch of the Marshall Fund with the only goal - that the journalist had no choice but to write his articles in a pro-American manner [24. S.50]. The author of the book expresses resentment for himself and his colleagues, since the CIA representatives themselves respond in a very unflattering manner. For example, the editor of the Washington Post, Philip Graham, said that some CIA agents admitted to him that a journalist could be bought cheaper than a good prostitute, for only a few hundred dollars a month [24. S. 45].

In support of the above, Ulfkotte cites the words of the Austrian conflict expert Dr. Kurt Gritch, who, after careful research, allowed himself to call the leading newspapers of the Federal Republic of Germany "war provocateurs": "If you like to read newspapers, you are probably readers of Frankfurter Allgemeine and Neue Zurich Zeitung , "Süddeutsche Zeitung" or "Di Zeit." I must admit that I am no longer their reader since I realized that the preparation of the war begins there ... this is the instigation of the war and it should be called that" [24. S.21]. Ulfkotte cites an example related to the crash of a passenger plane by a Malaysian airline in the middle of June 2014 in eastern Ukraine: "before the wreckage of the plane reached the ground, Russia was found guilty of everything that happened" [24. S.21]. W. Ulfkotte categorically declares that to unleash a new war, Americans can go to any provocation, and corrupt Western journalists will obediently spread this misinformation around the world.

Ulfkotte comes to the conclusion that many democratic structures of the collective West become fiction in the hands of the ruling elite groups. For example, the so-called The Bilderberg Club "is just one of many similar elite circles" lobbying for NATO's interests, the goal of which is to influence public opinion in a pro-Western spirit. States openly buy "allies" and then themselves accuse them of being used to being dependent on them. This, in his opinion, leads to a decrease in responsibility for the strategic decisions made by the elites and loss of time in anticipation of the next batch of "valuable instructions" from Washington [24. S.21]. We have no reason not to believe the statements of W. Ulfkotte. In the past, he was a Chancellor Helmut Kohl's adviser, lived for many years in the Middle East (1986-1998), becoming one of the most famous critics of Islam. He was affiliated with Pax Europa, a German right-wing organization.

In similar tones, Italian journalist and politician D. Chiesa speaks of Western political elites and the media. For him, the Russophobic Sabbath is a sign of the degradation of the political class of the collective West. The lack of the possibility of a constructive dialogue with an uncomfortable competitor is compensated by the fact that the competitor is declared insane and the usual (normal) principles of relations do not apply to him [7].

American film director, screenwriter and producer Oliver Stone admits that he grew up on the fake history of the United States, that in America, citizens have a version of world history from Disney, and this is a big problem that the Americans themselves do not realize, or do not want to admit [22]. The problem of the USA is that "there they have always seen the enemy in Russia." "I grew up with the thought that the communist movement seeks to conquer the world, I grew up in great fear. We must leave the arguments of the Cold War in the past, move into a new era, but we could not do it ... I have hope in America, hope that there are sane people who can still control the results of this empire" [11].

O. Stone and P. Kuznik argue that from childhood, Americans were “inspired by popular and somewhat mythological ideas that were carefully passed through the prism of American altruism, generosity, nobility, national exclusiveness and devotion to the ideas of freedom and justice. We involuntarily absorb such ideas into flesh and blood, calm down and cease to doubt. However, the school curriculum covers only a small part of our history. It suits those who do not want to dive deeper, but the ideas about the world that are instilled in us are incredibly harmful, dangerous and corrupting. Because of these perceptions, Americans are not only unable to understand the attitude of the rest of the world towards the United States, but, due to limited knowledge, they cannot change the world for the better. As a result, most people in our time simply lost the ability to imagine a world different from the modern one, which would be better than what we have today” [14, S.9-10]. In this light, Americans are the most backward nation in terms of historical science, because *what the Americans do not know is known to the whole world.*

From this "secret story" the Americans learned what their country really is in international relations [8]. The authors, in particular, recalled the words of President Roosevelt, who at one time brought all his anger to right-wing politicians: “We have gained the hatred of inveterate profit lovers. These self-lovers want to return power to their hands. Give them freedom - and they will embark on the autocracy of the past centuries: slavery to the people, to the people. ” He believed that "it is time to eliminate the profit factor from the war" [14, P.118, 129]. It was precisely this kind of cynical considerations that the US authorities were guided by, unleashing wars, revolutions and coups d'etat in a particular region of the globe.

Which of the two warring empires (the USSR and the USA) was more bloodthirsty, it can be seen from the words of Senator Harry Truman who said cynically about war and peace: “if we see that Germany wins, we will help Russia, and if Russia prevails, we must help Germany. And let them kill each other as much as possible" [14. p.164]. After such words, one cannot speak of US peace. The United States has always pitted and divided, in order to later become the winners. They fought not valor, but treachery. And most often even this was done with the wrong hands.

In January 2020, in an interview with the RT TV host and former president of Ecuador, Rafael Correa, American director Oliver Stone suggested that the United States expects "retribution for evil." According to him, the United States has become a "force of evil" for people who want reform, "for those who seek to change things." The filmmaker added that in the world there is a “historical force” that bears retribution. In his view, "everything could return as boomerang to the US." In addition, Stone said that in his country the scale of corruption is superior to those in other countries. The producer emphasized that democracy in the USA is only in words, "but in fact money rules everything" [10].

The US strategy for Russia and China was clearly outlined by Paul Craig Roberts: “Russians have no awareness of the Wolfowitz Doctrine. They don’t understand that Russia is unacceptable, because Russia is not a vassal of the USA ... Russians believe all the Western stuff about “freedom and democracy” ... In other words, Russians do not understand that they want to destroy them ... Russia is hated because it is an obstacle for Washington’s sole global authority. This is what leads to war. If the Russians and the Chinese are not ready to prevent nuclear attack from Washington, they will be destroyed” [4]. Well-known American politician and analyst G. Kissinger believes that the geopolitical situation will be ideal for the United States, when relations between Russia and the United States will be much better than relations between Russia and China. There is still the same imperial principle of "divide and conquer."

And finally, another thing: for Western political elites, Russophobia is a wonderful excuse, allowing them to pretend that they do not notice their own ignorance and quackery. The statement "Russians are to blame for everything" - allows them to relieve themselves of any responsibility for their failed policy.

Terry chimera of Russophobia. Over the fronts and trenches of the Cold War, the shadow of the chimera of Russophobic hysteria is constantly floating. Mostly nationalists of different stripes and politicians, playing on the side of Anglo-Saxon imperialism, are hysterical. Russophobia attracts them with its primitivism and impunity. You can pour over Russia with any dirt and not bear any political or moral responsibility for this. What they sometimes say about Russia cannot be called anything but idiocy. Idiocy is very aggressive and loud. But it shares the same features as a medical (psychiatric) disease - poor understanding of the meaning of words, primitive vocabulary, damaged emotionality and limited independence (dependence on an external sponsor). For a politician, Russophobia is indeed a sign of deep mental retardation, a clear sign of higher political moronity.

Political idiocy is not a diagnosis, but a sentence of history.

A political idiot himself becomes a victim of his own delusions.

Russophobes (political idiots) are fixated on fierce criticism of all Russian (including in culture, science, religion, etc.) and ideas of political and economic destruction of Russia. Therefore, we have the right to characterize this political sect as totalitarian and destructive.

Russophobia has always been unsystematic. All critics have always lined up in accordance with the chosen goal. It was this unsystematic nature that fed the chimera of Russophobia, preventing it from forming as a kind of political ideology. Often, Russian critics themselves do not hear and do not listen to each other.

Russophobia should be equated with a criminal offense, as well as anti-Semitism. These are phenomena of the same order. Therefore, the assessment, and reaction, and punishment for them should be the same.

It was noticed that the Russophobes themselves are very narrow-minded people, obsessed with hatred of the Russians and Russia. The chimera generated by these idiots is distinguished by extremely external aggressiveness, militarism and, like all chimeras, is rapidly digging its own deep grave.

As political history convincingly shows, over the past three hundred years, the Anglo-Saxons have broken off all their geopolitical teeth about the granite of Russian statehood. No matter how much they tried to nibble it, the Russian world was stronger and more durable. Most Russophobic West is afraid that Russia will be reborn from the Anglo-Saxon ashes.

The chimera herself is afraid of her horror stories.

She is afraid of them because the truth does not just prick her eyes - it literally burns them. Russian officials from the Ministry of Foreign Affairs of the Russian Federation repeatedly accused the Anglo-Saxons of outright lies against Russia. So in February 2020, the official representative of the Russian Foreign Ministry, Maria Zakharova, admitted that she was shocked by the words of the British Permanent Representative to the UN Security Council, Karen Pierce, about the Donbass. Speaking to members of the international community, the British ambassador to the UN said that Russia allegedly did not ensure the safe delivery of humanitarian aid to the Donbass. And at the same time, Pierce demanded to stop sending "unexpected humanitarian convoys." “They even lie on such an occasion,” said Zakharova, “for which it would seem impossible to deceive people. This is just some kind of surrealism. Honestly, I can’t believe that these words were spoken, but it really sounded” [5].

No matter how much we write about Russophobia as political idiocy, it will always be extremely difficult to convince these idiots that they are pathologically ill. Uprooting this weed with a bulldozer is useless. It can be treated and cured only with the help of a kind word and colt ...

When truth burns eyes, then grandiose lies become the only means of salvation.

The history of the Russophobic chimera is the most shameful page in the political history of the collective West. So shameful that it degrades the honor and dignity of the enlightened mind of Europe, which for a long time was considered the standard of scientific rationalism and competence. In Russophobia, we see the moral decline of the West, the triumph of its historical ignorance. Russophobia is a crooked political mirror, in which not the shortcomings of Russia, but the vices of Europe itself are actually obvious.

Russophobia is a lie that tried to become true.

There are good geopolitical reasons for the existence of Russophobia. And they are associated with the struggle of the Russian world with the Anglo-Saxons.

"The Englishwoman spoils." Virtually all memoirs of Anglo-Saxon retired politicians from the beginning of the 21st century are written in Russophobian frenzy [See: 19-22, 25]. One gets the impression that they simply do not have enough intelligence to somehow explain in different ways the reasons for their failed government and clumsy professional behavior.

Russophobia has been an integral part of British foreign policy over the past three hundred years. It is Russia, according to official London, that actively prevents England from being Britain. It all started with the fact that the Russian Empress Catherine II supported the freedom-loving aspirations of North American colonists who fought against the tyranny of the English monarchy. If in the era of Peter the Great England looked at the appearance of ships under the St. Andrew’s flag in the oceans even through her fingers, then in the time of Catherine II this flag began to corpse their eyes in their imperial aspirations.

Anglo-Saxons consider themselves the stronghold and foundation of Western civilization.

It is noteworthy that the Russian and British empires began their political and geographical formation at about the same time. And with approximately the same success, they developed during the XVII-XVIII centuries, until the first tangle of geopolitical contradictions matured between them.

The historical dispute between the Russians and the Anglo-Saxons is essentially a dispute of morality and wealth. Each of the parties is trying to prove the other correctness of its chosen goals and means. The Russians believe that wealth is not the winner, but dignity; wealth is only a means, but not a goal. The goal is truth, and only the true goal justifies any moral means. But immorality cannot justify the truth.

By choosing wealth as the meaning of its existence, Britain has proved to the world that it is ready to commit any crime in order to achieve this desired goal. In the world there is no such moral disgust that the "Englishwoman" could afford to be constantly rich.

The main Russophobes in Western Europe have always been Poles and the British. The famous expression "The Englishwoman spoils" - became the diagnosis of their Russophobic hysteria. At present, Britain has found itself in the darkness of the fog of its own political ignorance. The father of the British conservatives E. Berg once wrote: “There is nothing more true than our customs and our civilization, and all that is beautiful, inseparable from the customs of this part of Europe, for centuries depended on two principles and was the result of their combination. I mean the spirit of chivalry and religion” [23, P.337]. This, according to E. Berg, was a basis of English civilization. But in our time, gentlemen are no longer the same, and Anglicanism is no longer quite Anglicanism. Nowadays, all these fundamental concepts of English civilization are so dilapidated and worn out that to call England "Great Britain" the Russian language does not turn around anymore, because only Britain is left from Great Britain.

Today, absolute Russophobes are the Anglo-Saxon political and financial-economic elites. For the Anglo-Saxons, Russia is the most important historical enemy that prevented Great Britain from becoming the mistress of the whole world and securing world domination for the Anglo-Saxons for centuries. The Anglo-Saxons primarily associate their fall with Russia, whose resistance upset all their grandiose plans in the past, upsets them in the present and will oppose them in the future. Such things are simply not forgiven. *England, having lost its former imperial gloss, still considers itself Great Britain. And this mistake costs her dearly.* Having reduced to one small island on the outskirts of the Eurasian continent, she looks enviously and with undisguised spite at the great geographical Russia, manically jealous of its natural resources and human wealth. In addition to the football of the former Great Britain there is nothing more to be proud of, and even that has recently left much to be desired. *The dignity of Russia lies in its conscience, which will never be taken away from it or belittled by anyone.* England so often changes its conscience that everyone has long forgotten what it is and whether it really is[4]. *Unscrupulous is easier to live, but difficult to die.* In Russia, Truth has always been valued higher than brute physical strength.

As long as the Russians have a conscience, they are an indestructible force.

It is precisely according to the geopolitical order of the Anglo-Saxons that a corps of countries is being formed in the world whose political elites put Russophobic mythologemes at the center of their patriotic ideas.

Russophobia is paranoia of British greatness. The British crown has always seen in Russia an existential threat to its world domination. Therefore, Russia can rightfully ascribe the merit of the collapse of the British Empire. Nobody did more than she did for this.

It is British Russophobia that creates the temptation of the Polish gentry to defeat Russia with its help. Poland - the hornet's nest of Russophobia, located under the Anglo-Saxon protectorate. Poland always needs someone to defend it, for it itself can only act stealthily. This explains her centuries-old political prostitution. Being a Russophobe and being a political prostitute is basically the same thing.

It would be naive to believe that the "Englishwoman" (the British Empire) managed to spoil not only one Russian! She made even more nasty things about other peoples - Indians, Chinese, Spaniards, Germans, French and even Americans (we generally modestly keep silent about the Scots and Dutch [Boers] ... Even her closest allies - the Poles - could not escape of their great (as they naively believed) geopolitical patron’s betrayal in 1939...

Trusting an Englishwoman means signing a death sentence on ourselves ...

[4] In general, the author likes English aesthetics, but English ethics is pathologically disgusting. Since the time of Shakespeare, the British have only degraded. The renaissance of their mental ability falls on the days of Winston Churchill, after which we see one continuous degradation. Queen Elizabeth II is the most unfortunate monarch of Great Britain, because she was the first (after the collapse of the British Empire) to become the Old English queen again, which her Scottish “loyal subjects” even look askance at. At the same time, we are far from Anglophobia, since we consider Anglophobia the reverse side of Russophobia. Since we cannot reach and descend to such a level, therefore we reject Anglophobia in the bud. With all our positive attitude towards English culture, we experience persistent negativity towards the entire English politicum, which has branded itself bloody crimes that degrade human dignity.

At the same time, the British are ashamed of some pages of their own history. They simply try not to otice such shameful things. Meanwhile, all progressive humanity (which lives not only in the West, but also in the East, North and South) is well aware of the words of an English historian who was clearly dissatisfied with the imperial rule of Great Britain. We are talking about the English historian Thomas Babington Macaulay (1800 - 1859) who openly admitted: *«the English government [India] was heavier than the most barbaric despotism; it was more like the rule of evil spirits than the tyranny of people»*[5].

In all its wars, Great Britain blames anyone, but not itself. You listen to them, it is Russia's fault that the First and Second World War began, and the Cold War was also unleashed not by the Anglo-Saxons but by the Soviet Union. They forget about the treaty of Versailles that was humiliating for Germany (1920), and about the humiliating Munich agreement for Great Britain and France (1938), when the Third Reich took revenge on the former Entente.

The Anglo-Saxons humiliate and insulted the defeated Second Reich and humiliated Germany went and fell into the arms of Nazism. And after the Anglo-Saxons were surprised to ask themselves the question - why did bombs fall on them and where did all this horror of the Second World War come from? It came because of their pathological mercantile greed. If not for their mercantile greed, the oligarchs would not have been able to provoke politicians to unleash a new world war. Big money loves not only silence, but also requires to be protected and increased with the help of geopolitics.

Experts note that a new round of Russophobic sentiments in the same Poland began to increase when Warsaw, led by its atlantists, decided to implement the global interests of transatlantic players to the detriment of its own country. Polish atlantists turned to the crazy concept of the eastern policy of Yezhi Gedroyts, according to which the existence of“Greater Ukraine” in the Stalin-Khrushchev geographic format ensures that Poland will not be threatened by “danger” from Russia. It was after 2014, when Warsaw supported the coup in Ukraine, Russophobia and Ukrainophilism became signs of Polish patriotism. At the same time, Warsaw calls for joining the so-called “competition” against Russia within the framework of NATO, instead of creating its own modern army and defense potential [12].

Russophobia is used by Ukrainian nationalists. To justify their self-determination, they are trying with all their might to divide the unity of the Russian people into Russians and "Ukrainians." "The former and current creators of the doctrine of the Galician-Mazepian" Ukrainians "openly build it on the idea of an armed struggle against Russia and the Russians" [1, P.52]. Moreover, in Russia itself there have always been those who supported these views. So, academician G.G. Matishov claims that even in the Central Committee of the CPSU there were figures who supported Ukrainian nationalism, since they themselves came from Ukraine [16, p. 43].

The West came up with "Ukraine" to break the unity of Russia. And now he criticizes Russia for restoring its unity. Ukraine was created as an anti-Russian project with frankly Russophobic subtext. There is no other political meaning of its existence and cannot be. Based on the betrayal of the Russian world, “Ukrainians” can only survive as an aggressive Nazi chimera fueled by Anglo-Saxon finances.

Speaking at the Munich Security Conference in February 2020, Polish Foreign Minister Jacek Chaputovic stated that Russia poses a serious threat to the interests of the West, “that it is a serious player acting to the detriment of the interests of the West, to the detriment of democracy. Therefore, Europe and the European Union should unite here with other countries, primarily with the United States ... We believe that sanctions should be maintained. Until Russia returns to the path of compliance with international law, we must act together to make it do this, at least to show our discontent. These statements are premature” [2]. According to the Russian Minister of Foreign Affairs S.V. Lavrov, in European affairs there is a sharp crisis of confidence. “The escalation of tension, the advancement of NATO's military infrastructure eastward, the unprecedented scale of exercises at the Russian borders, the pumping up of defense budgets beyond measure - all this generates unpredictability. The structure of the Cold War confrontation is being recreated in the hardware” [2]. The Minister called for ceasing to cultivate the phantom of the “Russian threat” and proceeding to establish a dialogue on security issues in Europe on the basis of the “principle of equality and equal security”.

In July 2014, when a scheduled Malaysian Boeing-777 flying the flight MH17 on the route Amsterdam - Kuala Lumpur was shot down in the sky over the Donbass, a baseless story was put forward about Russia's involvement in this tragedy, and a new wave of Russophobic hysteria began. Then the Western countries began to blackmail, threaten and

[5] Let’s note that British propaganda cultivated terry Russophobia in India itself, which sometimes took on simply absurd forms. The British painted Russia with a terrible northern monster hanging over defenseless India and the Indians themselves should have been grateful to Great Britain for protecting them from these terrible Russians. Knowing about the geopolitical friction between Russia and Great Britain, Indian politicians guessed the reasons for such demonization of the "North" and considered Russia as their natural ally in the struggle against British colonialism.

force Russia to admit its guilt. Long before the trial, the West designated Russia as a criminal and imposed sanctions against it. Moreover, the tone of the statements of Western politicians and their "free" media was extremely cynical and frankly arrogant [5]. After a year, this story has already left all the news feeds and has been safely forgotten until the right moment. However, the sanctions imposed by the collective West against Russia remained.

A similar case of Russophobic hysteria occurred in March 2018 in Great Britain, which was contrived by the British secret services and politicians scandal, dubbed the "case of the Skripals." He was associated with the alleged poisoning of the former GRU colonel S. Skripal and his daughter by the Russian special services in Salisbury. Official London unprovenly accused Moscow of using chemical weapons (Novichok poisonous gas) on its territory and demanded that Russia plead guilty to this crime.

In the Western media, as if on command, the persecution of Russia broke out, which, by hook or by crook, began to be forced to confess to this crime. Moreover, no evidence was so provided by the British authorities. Later it turned out that the Skripals were alive and well, and were in a safe and unknown place. But Russia did not succumb to blackmail. It steadfastly survived this impact. Blackmail also came to a standstill and was quietly "forgotten" by the blackmailers themselves. Russophobia again broke off its "rotten teeth" about Russian endurance.

The Information War or "Empire of Lies" strikes back at truth. Russophobia has always been the most active segment of the information war of the West against Russia.

According to the German political scientist A. Rahr, anti-Russian rhetoric is indeed very strong in Western countries, and this is due to several reasons. After the collapse of the USSR, when the country could not come to its senses for a long time, the West was sure that it had seized the riches of the Russian Federation. However, the plans failed after V.V. Putin became the head of state. A significant role in Russia's victory over the West was played by Moscow's statements regarding NATO's eastward expansion. "And everyone understood that further attempts to expand NATO are the third world war with Russia. This, of course, is a grand victory in foreign policy for the Russian Federation. " In recent years, Russia has consolidated its influence and authority in the international arena. That is why the country is called one of the main locomotives for developing the right decisions [9].

In July 2019, Mark Green, Director of the United States Agency for International Development (USAID), introduced the strategy to "counter the malicious influence of the Kremlin." "The concept ... responds to the challenges associated with the negative influence of the Kremlin by creating the economic and democratic sustainability of the countries [which it is aimed at]", the main goal specified in the concept is to increase the sustainability of the US partner countries. To achieve it, USAID sets four goals: 1) counteracting efforts to undermine democratic institutions, 2) resistance to information manipulation, 3) reducing economic and 4) energy vulnerability. The latter involves strengthening energy security and reducing the dependence of US partner states on Russian-controlled energy resources [15].

Under the pretext of combating the imaginary Russian threat, the collective Russophobic West itself is strengthening its position and Russophobia is needed as an informational and ideological cover for its own militarism. Obviously, for them, Russophobia has the same nature as fakes. Strictly speaking, Russophobia is the main fake of the collective West.

Russophobes constantly arrange provocations that become the very meaning of their existence (without these demarches, they simply would never have been noticed). So, for example, on July 7, 2019 on the Georgian television channel Rustavi-2 live, its journalist George Gabunia insulted Russian President V.V. Putin in an openly obscene form. In particular, he called him "a smelly occupier." Rustavi 2 apologized, specifying that it was not going to dismiss an employee. On the night of July 8, the channel had to stop working due to rallies began at a building in Tbilisi. In the morning, the television company resumed normal operation [13].

Demonization of the image of V.V. Putin leads to the opposite result. The number of its supporters and fans is growing in the world. So, in July 2019 honorary President of Formula 1, the former owner of the series, Bernie Ecclestone, expressed his attitude to the President of Russia V.V. Putin: "If someone aimed a machine gun at Vladimir Putin and would like to shoot, I would have blocked him. He is a good guy. He never did anything that did not benefit people. Skripals? Putin did not do this. He is too busy to worry about such things. I would like Putin to rule Europe. We don't have anyone, so it can't be worse. He does what he says, fulfills his promises. I am not a supporter of democracy. Need a dictator. The dictator simply says that he is going to do something, but in a democracy this is blurred" [18].

Usually the collective West (led by the United States) declares that they are really (!) afraid of Russia's military maneuvers near its borders. Russia responds to them that it is also concerned about the military maneuvers of the countries of the collective West (NATO led by the United States) around its borders. A legitimate question arises: if these

maneuvers concern everyone so much, maybe they should not be carried out at all? Or is it a saber-rattling part of a political strategy to intimidate a potential adversary? Conflicting parties simply intimidate each other with the possibility of using force. And all this hysteria is compensated by a similar enemy hysteria. Opponents exhaust each other's nerves, and test each other for psychological strength (who will surrender first).

The first to surrender are those who find its personality diseased.

Many modern Western politicians lack signs of a stable personality. They can't find their inner core in any way. They are loose and devoid of cementing their base. Their inner world is filled with various kinds of anxieties and even outright phobias, the inconsistency of opinions and preferences makes them vulnerable to various kinds of manipulations. They manifest very serious complexes that reduce the level of trust in their power to a minimum.

Apparently, by 2020, the collective West is already beginning to get tired of Russophobic hysteria. This topic is perceived by the western layman as a jaded record. Many people got tired of it and more and more begin to distrust it. The situation is still far from a turning point. But statistics are beginning to record changes in the public opinion of Western democracies more often. This is especially true for countries of the so-called "Old Europe".

Civilization code of Russia. The whole centuries-old history of Russia shows that it survived and won thanks to the national (cultural) codes embedded in it. Russian philosopher N.A. Berdyaev noted the dual nature of Russian character. We share his point of view, because Russia really has a certain historical duality, a combination of the incompatible: aggression and defense, slavery and freedom, individualism and collectivism, etc., which determine the unique nature of its codes of resistance and survival. The enemies of Russia are just trying to change its code, to destroy this uniqueness of it[6].

The categories of "catholicity", "community", "good-neighborliness / internationalism" (ethnic tolerance), "pluralism" (polyconfessionality), "activity / aggressiveness" (increased resistance to external challenges and threats), "freedom (liberation of oneself and other peoples) are most often called the cultural and historical code of Russia... All these qualities determine the historical mission of Russia - who it is and what it should be in world history.

The mission of Russia, as the power center of Eastern Europe, is to remain an element of solidarity of the Russian people with other ethnic groups. Its mission is to carry out "neo-Byzantism" of imperial action in the space of the Eurasian ojkumena. The code of the Russian state is the Empire liberating other peoples.

The imperial mission of Russia is historical. It is its own power. Therefore, it does not need any allies and vassals. Russia does not really need allies - there is no need for them, but there are a lot of expenses for their maintenance.

We emphasize once again that the aggression of the Russian Empire is directed, first of all, against the foreign policy threat. Russia does not have an offensive military doctrine. Its military doctrine is purely defensive in nature.

Russia's mission is to guarantee the survival of many peoples that are historically associated with it. The myth of Russia "as a prison of peoples" does not stand up to criticism and must finally be recognized as a Russophobic fake. Stop listening to the stupid shouts of the Anglo-Saxons about the "prison of nations." This Great Britain was a "prison of peoples", which with the stubbornness of a maniac does not want to release until now.

Once again, we draw our attention to the fact that the civilizational code of Russia is imperial in nature. Russia is an empire (either in potential or in real life), whether we want it or not. The Russian people and all the peoples of Russia are imperial peoples. They have experience of life (political, cultural, economic) as part of one common Empire. And this historical memory plus the very geography of our state pushes us into the arms of imperial geopolitics. The new Russian Empire is not so much a restoration project as a project aimed at joint survival and prosperity in the future. It is concern for future generations that forces the current generation of Russians to build a new building for their imperial state. If the idea of an empire were unnatural for Russia, it would never be an empire. The thing is that the idea of an empire is natural for Russia, which means that external obstacles for it will not be objective. The main objective condition for the implementation of this project is the real growth of its internal forces.

The peoples that were part of the Russian empire voluntarily or under duress became here a part of the imperial people. The empire attached to itself only those countries and peoples that in the future had a worse version of their development. In this regard, the Empire became for them the best option for their development, because within the

[6] So, the 66th US Secretary of State (from January 26, 2005 to January 20, 2009) Condoleezza Rice, while still in power, said in relation to Russia that America was called upon to change its civilization code. What does it mean? To change the civilization code of a people means to destroy this people in the form in which it exists. In her opinion, in August 2008 (after Russia's response to Georgia's military aggression against South Ossetia), the Kremlin made a "gloomy turn" in the country's development, and a "paranoid, aggressive impulse" now manifests itself in its behavior. [6]. According to the US Secretary of State, "from this pattern of behavior is the picture of Russia, which is becoming more authoritarian within the country and aggressive abroad" [6].

framework of the empire, more could be done than individually. The empire gives them the opportunity to participate in the construction of their common home and never forced them to change their faith, language or culture. At the same time, each of the peoples that became part of the Russian Empire remained himself. In this we see another code of Russia - do not spoil others (do no harm). To offer "others" the best option for their development so that they become "their own".

The project of the new Russian empire begins in a crisis of the global world order, when previous models of the world order no longer work, and new mechanisms are just beginning to take shape. In the 2020s there will be a final demolition of the monopolar world, which will require the "victorious countries" to hold a *"new Yalta"* [17]. Since 2008, the world has been plunged into the last global financial and economic crisis, which has only slowed down its growth, but which has not disappeared. Modern economic science is not able to answer the question of what to do in order to overcome this crisis. The main culprits of this crisis are global financial institutions, which started a globalist project as a "new wave" of their development.

* * *

An analysis of the development of globalism indicates that it dictates to the world a new laws of world order, the main of which is the finite development of the liberal model of capitalism. Capitalism is experiencing the final stage of its historical development and we are all witnesses of it. Probably, together with the monopolar world, not only the Anglo-Saxon monopoly on world domination, but Russophobia itself, as their main ideological weapon in the fight against Russia, is living out its last days. In the future, Anglo-Saxons will have to come up with new forms and new options for the struggle with Russia. These new forms would correspond to the realities of the 21st century, and would not be an anachronism of previous centuries ...

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ПОЛИТИЧЕСКАЯ ПРОПАГАНДА КАК ИДЕЙНАЯ СОСТАВЛЯЮЩАЯ КОММУНИКАТИВНОГО ПРОЦЕССА: ТЕОРЕТИЧЕСКИЕ АСПЕКТЫ

POLITICAL PROPAGANDA AS AN IDEOLOGICAL COMPONENT OF THE COMMUNICATION PROCESS: THEORETICAL ASPECT

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Аннотация. *Политическая пропаганда соотносится с областью взаимодействия субъектов политического процесса при формировании новых установок, влияющих на социальное или политическое поведение социума. Целью пропаганды является осуществление передачи общественности политической информации и влияние на ее восприятие, которое обеспечит общее направление мыслей и поступков, позитивного или негативного отношения к определенному объекту или определенной ценности.*

Ключевые слова: политическая пропаганда, политические коммуникации, манипуляция сознанием, информационное общество.

Abstract. *Political propaganda correlates with the interaction of subjects of the political process in the formation of new attitudes that affect the social or political society behavior. The purpose of propaganda is to transmit political information to the public and influence on its perception, which will provide a general direction of thoughts and actions, a positive or negative attitude to a particular object or certain value.*

Key words: political propaganda, political communications, manipulation by the social consciousness, information society.

The political process does not exist without the circulation of political information as a connecting thread of the institution of the political system, and at the end of the 20th century a new direction has emerged in foreign sciences, the subject of study of which is public relations from the perspective of political communication. The development of macro-level models that conceptually represent the trends in the development of political propaganda and its place in political relations was comprehended. This direction is presented in the works of such famous researchers as E. Fromm [11], M. Horkheimer and T. Adorno [12], G. Marcuse [6] and others. But the growing influence of information technology on the minds and hearts of citizens continues to cause scientific interest.

It is assumed that the term "political propaganda" was used by scientists in the middle of the last century, when the study of the information society and the role of information began. Of course, all studies were conducted by sociological schools, political science and communication analysis has not been presented properly. Gradually, by the end of the last century, political communication, as a scientific and applied discipline, attracted the attention of scientists, and political propaganda began to be seen as a process of communicative technology.

In modern society, the role of political communication has sharply increased, since it is vital to have an interchange between political structures, political entities, groups and individuals, and social structures [14:87]. Political communication is the deliberately used political information whose task is to circulate between the components of the political and social system. This is a peculiar process of submission effective information by powerful political structures, as well as social groups and individuals [18]. Therefore, we agree with the researchers that political propaganda is a part of political communication, as it serves for spreading information while encouraging participation in any political activity, and formation of certain values, etc. [5].

As Kh.I. Saykhanova rightly suggests, modern propaganda in the communication process has the following characteristics [8: 196]:

– a growing influence on human consciousness, his preferences and tastes;

– an increase in the amount of unfairly information and propaganda based on politically incorrect and biased information;

– the growth of the ability to manipulate the consciousness of an individual, as well as entire social groups, classes;

– transformation of manipulation types, subjects and objects, etc.

G. Lasswell, the founder of propaganda study, defines mass propaganda as the new “hammer and anvil of social solidarity." The researcher comes to the conclusion that there is an individualized mass community where mass communication depends on social connections that can be destroyed or, on the contrary, firmly soldered, performing various functions - replacement or compensation. The scientist defined propaganda as "control of public opinion using special characters." The task of such control is to cause the consolidation and mobilization of the masses in line with a single goal (in the case of a military situation - the goal of victory), when the masses rally on the basis of general hatred of the enemy, whose image is created by propaganda [20: 14].

Continuing to work in this direction, G. Lasswell later proposed the theory of the “magic bullet”, which is based on the postulate that among the individuals of the society surrounding us, the role of mass communication is to compensate and replace broken social and other connections and, therefore, determines each individual an isolated subject has no change in influence, which for psychological reasons they cannot resist [20]. Following this theory, in the process of mass communication, each individual member of society receives a pre-measured "dose" of exposure that falls into it like a bullet. According to G. Lasswell, like a magic bullet, which always accurately finds its addressee, political propaganda operates in the same exact and faultless manner in society. A single system of incentives gives rise to a single system of reactions, and mass communication completely subjugates the social organism [20: 16].

The ultimate goal of propaganda is to convey the main ideological values and theoretical knowledge about something to the perception of a wide audience and turn it into personal beliefs, personal thoughts. As Ian Cooke writes in the article “Propaganda as weapons? Influencing international opinion ”, all parties to the international conflict use propaganda to form international opinion [18]. Therefore, we are interested in the study of propaganda through the prism of mechanisms of influence on a person, which involves the consideration of the psychological model of communication presented by the German emigrant Serge Chakotin. He argued, on the basis of personal experience in conducting propaganda during the Hitler regime, that Hitler propaganda was based on psychological influence, the basis of which was borrowed in the I.P. Pavlov’s theory of the conditioned reflex of animals. According to S. Chakotin, four human reflexes (aggressive, protective, sexual and food) are the four whales on which propaganda rests [22: 18]. Here you can see that the model of S. Chakotin is related to the idea of the ancient Greek philosopher Plato that the word serves as a conviction, and a competently persuader at the same time pleases the listener, as it touches the hidden strings of the soul.

According to S. Chakotin, ideological principles can be closely linked with the internal reflexes of a person, since a person is a creature that is completely subordinate to the categories of instinct than the mind. Propaganda bases on the repetition of slogans affecting certain feelings and instincts of a person, make him completely obedient, subject to the influence of propaganda. It turns out that the communicative process can be brought into a unipolar form and thus create a kind of model of society and man, directing political propaganda to large masses of people. Dose information, impose ideological slogans, reinforce all this with life reflexes and human feelings, and get the result by making the masses “the right audience” [22: 176].

In the sixties of the last century, S. Chakotin’s theory was further continued in the model, justified by the postulate that the basic human instincts, in particular, the desire of the consumer, play a role in the development of marketing, including political marketing [7: 287]. As evidence, it was argued that people do not buy furniture, but a climate of prosperity and comfort, do not buy powder, but family values, they choose not politics or a party functionary, but democracy and welfare [3: 36].

Despite the fact that political propaganda in mass communication is a relatively new phenomenon, nevertheless, we have a rich experience of its studies which rely on two main approaches that directly depend on the stages of the development of the phenomenon, on the conditions of existence of the principles of production and consumption of information. In the aims of our study, we will consider both models based on the works of American researchers: in the 1940s, American scientists divided their research into two related fields, the study of atomism and opinion leaders. According to the first concept, the concept of atomism, the audience consists of the smallest subjects - individuals independent from each other, conditionally called atoms. But they all independently perceive information, in a single-order,

mass version [16: 187]. As we can assume, there are basic instincts that can unite large masses of people, and the greater the stratification shift and the level of crisis in society, the more effective will be any massive propaganda aimed at large masses in critical periods.

At the same time, there are examples in political practice when the behavior of a mass audience differs from the course outlined by propaganda, when after quite professional actions groups of specialists in political propaganda received an unexpected opposite effect. The problem was the discovery of new phenomena in the communication system, which potentially and kinetically contain a devastating effect on propaganda. This served to the birth of new theoretical and methodological foundations of the study in the sociology of mass communication and allowed to expand ideas about the features and structure of political propaganda. As a result, a second concept appeared - the concept of "opinion leaders", which was released after a series of unsuccessful propaganda actions in election campaigns. During the 1940 election campaign for the presidency of America, most newspapers and radio conducted a massive propaganda campaign against Roosevelt, but he passed by a significant majority. The massive propaganda campaign directed against Truman also ended unsuccessfully. Less than 15% of newspapers came out in support of Truman, however, almost half of America voted for him - 49.5% of the total number of votes. P. Lazersfeld explained the phenomenon of such voter behavior by the fact that the one who had not yet decided whom to vote for, was determined at the last moment under "personal influence" (under the influence of someone whom he personally trusted), and not under the influence of propaganda ideology. And mass communication is called upon to show or consolidate preferences that an individual already has at a conscious level, or to actualize latent preferences, which leads to a strengthening of initially existing beliefs [21: 87-91].

Subsequently, P. Lazersfeld in the book "The People's Choice" presented the theory of the existence of a two-stage model of communication in political propaganda. The essence of P. Lazersfeld's theoretical model was that mass communication does not directly affect an individual, but needs a microgroup that can mediate the influence of propaganda. Moreover, there should be a "leader of public opinion" in the microgroup, a person who enjoys a certain authority, who is able to bring the opinion to the majority who are interested in this topic. Only few people at first were interested in the scientist's idea of transferring ideas through radio and newspapers to the leader, and from him to the mass consumer. But after a series of failures in the election campaigns, the idea has become attractive and was positively received by the scientific community. Later M. Yanovich and E. Shills came to the conclusion that political propaganda does not directly affect the individual, that the effect itself is mediated by a microgroup. Scientists tried to convincingly prove that public opinion leaders (people who are respected in this microgroup) are needed for effective propaganda, [19: 403].

As we have already noted, the sources of propaganda are political actors, it is implemented through the media, and the target of political propaganda (the object) is the mass consciousness of a wide audience. The subject of political propaganda can be any subject with political interests, including the opposition interested in promoting their ideas. However, some researchers do not identify belief with propaganda, considering propaganda a negative phenomenon [15: 43-65]. Another part of the authors considers political propaganda more widely and suggests that "the escalation of the sentiments of nationalism, militant clericalism, separatism, extremism in the territories of other states, as well as indirect or open aggression (usually under the pretext of fighting terrorism) and" latent "types of wars that neither they are not recognized as forms of war or forms of terrorism "- these are methods of state terrorism that cannot be implemented without political propaganda [1: 408].

We assume that the process of persuasion, which remains the basic foundation of the process of political communication, and with it the tools used by it, are almost identical to the methods and tools of propaganda. But there is one difference that does not allow confusing these two concepts: unlike persuasion, propaganda is a one-way communication process [17: 78]. In the conceptual aspect, propaganda is understood as "the dissemination and suggestion of views, ideas, opinions in order to positively or negatively tune the audience (of any composition - from a few people to the masses and even society as a whole) and stimulate its reactions in the desired direction)" [10: 539].

The following types of propaganda are determined by their focus on the target audience: [13: 50-51]

– propaganda of a positive outlook, a positive arrangement of something;
– propaganda of courage and patriotism;
– promotion of health or education;
– propaganda of the separation and destruction of something established;
– propaganda of aggression and intimidation;

– propaganda of detachment and despair, etc.

As for propaganda methods, there are many of them. As the leading methods of propaganda influence on human consciousness, scientists call: "chattering", anonymous authority, emotional resonance, "everyday story", boomerang effect, halo effect, primary effect, etc. [4: 69].

Note that the mechanism of influence on human consciousness occurs due to logical substitutions and emotional experiences occurring in the human mind. It turns out that the mechanisms of influence on a person with a propaganda goal are based on the psychological effect on the consciousness and affect the entire psychological and emotional sphere of the person. From here, the "way of life prevailing in the current type of society and the corresponding" moral "(or rather, immoral) attitudes [2: 227] are quite clear. Moreover, the media is only one of many factors involved in the mechanism of influence on the consciousness of individuals. The impact is also carried out through mass communication (radio, internet, smartphones, etc.), printed matter (newspapers, books, magazines, posters, leaflets, etc.), as well as through cultural and entertainment events (cinema, theater, amateur performances). For example, for propaganda purposes a feature film may be shot or a performance staged (which, incidentally, was widely used in the Soviet years). And, as A.I. Soloviev, "It is clear that the degree of stability and effectiveness of political communications, based on the above methods of organizing discourses (local or affecting the whole society), is far from the same" [7: 17].

It should be noted that such types of political influence as political agitation, political advertising, political PR, etc. after the election campaign are completely indifferent to the remaining views or behavior of individuals. Political propaganda, on the contrary, expects a lasting effect, expects profound changes in political consciousness. Therefore, political propaganda is designed for a longer period of time, and manipulates abstract categories, which are characterized by blurring the boundaries between fiction and truth. Manipulation is the main companion of political propaganda, because the formation of a certain picture of the world should be facilitated by a game with the consciousness of man and the masses, since the imposition of certain political views and projects should go unnoticed. Due to the logical substitutions and emotional experiences occurring in the human mind, the formation of new attitudes is produced that affect the social or political behavior of the individual. It turns out that the impact affects the entire psychological and emotional sphere of personality [17: 197]. Therefore, propaganda is more often demanded in political communication, where it is relevant to introduce ideological guidelines into the human mind.

Thus, we can conclude that propaganda, as a component of the science of public relations, is a synthesis of the everyday levels of consciousness of the audience with a specific way of presenting information for the propagandist's specific purpose. Political propaganda as a communicative technology is deliberately used political information, the task of which is to circulate between the components of the political and social system. Propaganda is a peculiar process of presenting information by powerful political structures, as well as public groups and individuals for a specific purpose. Therefore, it is logical to make the system of political communication and political propaganda dependent on the political regime of the state, since both communication and propaganda are products of the political system of a given state. Accordingly, under a democratic, totalitarian or authoritarian political regime there will be different degrees of relevance of political propaganda.

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ДЕЯТЕЛЬНОСТЬ АДМИНИСТРАТИВНО-УПРАВЛЕНЧЕСКИХ И ОБЩЕСТВЕННЫХ СТРУКТУР В УСЛОВИЯХ ПРИРОДНЫХ КАТАСТРОФ

ADMINISTRATIVE-MANAGEMENT BODIES AND PUBLIC ORGANIZATIONS ACTIVITIES IN NATURAL DISASTERS

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Аннотация. *В статье рассматривается и оценивается деятельность административно-управленческих структур, компаний и общественных организаций в процессе предупреждения и локализации последствий опасных природных явлений.*

Материалы и методы, результаты. *Авторы констатируют рост масштабов и учащение стихийных бедствий, нарушающих социальную и экономическую деятельность населения в мире.*

Для Юга России наиболее характерны проявления водной стихии, поэтому исследования сосредоточены преимущественно в прибрежных зонах. Целью статьи является анализ деятельности органов власти и управления, различных компаний, общественных организаций по предупреждению и локализации последствий опасных природных явлений. Включенное наблюдение реакции органов власти и инфраструктурных компаний на природный катаклизм, – ураган и наводнение в регионе Большого Сочи, позволило авторам сделать эмпирические выводы и сформулировать предметные рекомендации по управленческой деятельности в условиях чрезвычайной ситуации, прежде всего, относительно улучшения обслуживания пассажиров дальних рейсов, и информационного обеспечения граждан в регионах, затронутых стихией.

Заключение. *Авторы полагают необходимым создавать компьютерные модели стихийных бедствий для отдельных населенных пунктов, на основе которых отрабатывать варианты развития угроз безопасности населения и формировать эффективные сценарии реализации необходимых мер.*

Ключевые слова: опасное природное явление, стихийное бедствие, чрезвычайная ситуация, органы власти и управления, транспортное сообщение, алгоритмы противодействия стихии.

Abstract. *The article examines and evaluates the activities of administrative structures, companies and public organizations in the process of preventing and localizing the consequences of natural hazards.*

Materials and methods, results. *The authors note the increase in scale and frequency of natural disasters disturbing social and economic activities of population in the world.*

The most typical features for the South of Russia are water-related disasters; that is why the studies focus mainly on the coastal zones. The goal of the article is to analyze the activities of on warning, prevention, and localization of consequences of natural hazards. The observation government and administration, various companies, public organizations of the authorities and infrastructure companies reaction to a natural disaster – the flood and storm in the Big Sochi Region – allowed the authors to draw empirical conclusions and formulate specific recommendations for management under emergency situations, primarily for the improvement of services for long-haul flights' passengers and information providing citizens in regions affected by the disaster.

Conclusion. *The authors consider it necessary to create computer simulations of natural disasters for specific settlements to consider various scenarios of threats to population's safety in order to develop the most effective disaster prevention and reduction measures.*

Key words: natural hazard, natural disaster, emergency, government and transport authorities, traffic, algorithms for counteracting to disaster.

Introduction. The studies of recent years confirm the increase in the scale and number of natural disasters that create security threats that disrupt the social and economic activities of the world's population. Specialists of the European Geophysical Union estimate the global damage caused by natural disasters from the beginning of the 20th century to 2015 in the amount of $ 7 trillion, more than 8 million people became their victims [1]. It is estimated that more than

40% of the world's catastrophes are floods. A similar structure of damage is also characteristic of the South of Russia; therefore, most relevant studies of the Southern Scientific Center of the RAS are concentrated in coastal zones. A significant number of natural hazards take place in the region: floods, storms, hurricanes, temperature drops, tornadoes, dust storms and others [2, p. 6].

The purpose of the article is to analyze the activities of administrative and managerial structures, transport, infrastructure and other companies, authorities and local governments of various levels, units of political parties and public organizations in the process of preventing and localizing the consequences of natural hazards. Based on empirical conclusions, author's proposals are formulated for the organization of managerial processes. Particular attention is paid to the speed and quality of restoration and establishment of transport links after an emergency, life support systems, maintaining law and order, information coverage of the situation and steps taken by management structures.

In a modern "risk society", new technologies give rise to new dangers, depending on social relations and processes [3, p. 23]. The volume of technological and social risks is growing, it enhances the negative impacts of natural hazards, generates latent effects, including global ones. A comprehensive study of the relationship between hazardous natural phenomena and social processes in the coastal zone of the southern seas is one of the key areas of scientific activity of the SSC RAS. This problem requires study since the elements can affect the social situation, exacerbating problems, but also helping to show administrative and managerial shortcomings, stimulating the adoption of necessary measures. Man-made impact also transforms the natural environment. Energy raw materials, transport communications and recreational resources are concentrated in the southern region. Various ethnosocial systems, religious and other structures are intertwined here. At the same time, acute conflicts and unresolved problems remain for many years. Under such conditions, empirical data on specific natural disasters, measures of managerial and other structures in localizing negative consequences, eliminating damage, as well as summarizing the experience gained and developing algorithms for countering the elements are of particular importance. The task of collection and analysis of these materias is to identify patterns in the mutual conditionality of natural and social processes in the coastal zone of the southern seas.

Materials and methods, results. In modern Russia, the localization and elimination of the consequences of natural hazards is carried out on the basis of a set of administrative and legal measures. So, by the Federal Law of December 21, 1994 No. 68-FL "On the Protection of the Population and Territories from Natural and Technogenic Emergencies", an emergency situation is defined as the situation prevailing in a certain territory as a result of negative phenomena of a natural and technogenic (man-made) phenomena. Emergencies are subdivided into situations of a natural, technogenic and social character, and are classified according to the severity of the consequences and the distribution of negative factors. Responsible structures and the procedure for taking urgent legal, organizational, technical and other measures to ensure public order and safety, eliminate the negative consequences of the natural hazard are regulated by Federal Law dated December 28, 2010 No. 390-FL "On Security". The Russian Emergencies Ministry has special powers to solve problems in the field of protecting the population and territories from natural and man-made disasters, acting on the basis of Decree of the President of the Russian Federation of July 11, 2004 No. 868 "Issues of the Ministry of the Russian Federation Issues of the Ministry of the Russian Federation for Civil Defense, Emergencies and Disaster Management. "

In order to unite the efforts of the central and regional authorities, as well as institutions for the prevention and elimination of emergencies, by resolution of the Government of the Russian Federation of 05.11.1995 **The Unified State System for Prevention and Response to Emergencies** was created, which unites government bodies and structures related to ensuring public safety in emergency situations.

Nature creates new, often unforeseen risks and threats to security, which makes society seek new means of counteraction. According to Russian and foreign experts, it is most efficient to stop natural hazards at the local community level, adequate to local needs, both in the village and in the city [4, p. 14]. Self-organization of citizens allows us to find non-standard ways of preventing damage and counteracting the disasters. Measures taken by governments and departments are more critically evaluated, since, according to foreign colleagues, they are usually sporadic and are a late response to a fait accompli. Experts also note that centralized measures of government are more expensive than the development of local capabilities to counter the disasters.

Practice shows that the most complete and objective information about the natural hazards can be obtained during the expeditions, during interviews with eyewitnesses, thanks to a direct visit to the emergency areas. The materials of the expeditions, together with the data of the archives allow us to draw informed conclusions and proposals. Of particular interest are the observations of specialists in the emergency zone. So, one of the authors of this article, having

arrived at a conference at the Sochi Research Center, witnessed a hurricane and flood on October 24-25, 2018 in Greater Sochi. It gave the opportunity to collect materials about the natural disaster, which became a test for residents and guests of the resort region, as well as outlining a number of problems requiring organizational and managerial response. Field research materials were collected through observation, photo and video recording, interviewing citizens and heads of various structures, collection of printed materials, etc.

The natural disaster affected the Tuapse and Absheron districts, Lazarevskoye, Sochi, Adler. In total, about 30 settlements, located mainly on the coast to the south of Tuapse were flooded, and road and rail links with the rest of the Krasnodar Territory were disrupted. A downpour, a gale, and a debris flow coming down from the mountains washed away the railway embankment, destroyed the highway and the bridge over the Tsypka River in the Tuapse region. Natural disaster caused significant damage to coastal villages, destroyed their electricity, gas and water supply.Over 1900 houses were completely or partially flooded [5]. Head of Civil Defense and Emergencies Department of the Krasnodar Territory S.E. Kapustin reported about six victims of the disasters. However, in the reports of the regional department of the Ministry of Emergencies, the disaster is indicated as a set of adverse meteorological phenomena, which means less danger than a dangerous event [6].

The most difficult situation, which affected several thousand people, has developed on the railway. The departure of 36 long-distance trains was canceled [7]. This created the prerequisites for a panic among passengers, most of whom were vacationers returning home. Representatives of Russian Railways Company at first could explain nothing to hundreds of people who had accumulated at the station. The most mobile and wealthy people used the Internet and bought tickets for airplanes flying from Adler airport. However, there was a few of those. plane tickets were quickly sold out, in the next two days it was almost impossible to buy them. Airplane tickets were quickly sold out, in the next two days it was almost impossible to buy them. According to eyewitnesses, prices for flights to Krasnodar by October 25, 2018 rose to 25 thousand rubles per person [8]. Greater Sochi, which has the status of an all-Russian resort even during the off-season period, had serious problems, most acute in the violation of transport links. So there was a regional scale crisis situation.

In such conditions, the actions of government bodies and managerial structures of transport and other communications become crucial. It should be noted that actions to localize and eliminate the consequences of the disasters in Russia are purposefully structured and produce a visible effect. Against this background, the position of transport companies whose actions appear inconsistent does not seem rational. So, on the one hand, Russian Railways Company tried to resolve the crisis situation: an operational headquarters was organized at the Sochi railway station, there was drinking water and the necessary facilities. On the other hand, attempts to solve the problems of passengers, even with the obvious desire of the station staff to help people, did not always look adequate to the situation. So, by speakerphone it was announced that passengers can hand over or reissue tickets for other days and trains. However, no one, including the station head M.S. Levchenko, could confirm or deny that train traffic would be resume from October 26, 2018 or another day.

Then a conflict arose - people filled out applications for ticket delivery in cash and cashless form. At the same time, ticket delivery forms were different. Those who bought tickets for cashless payments, the money was returned to a bank card. It should be reminded that according to the rules of Russian Railways Company, a refund to the payer's account can be up to 30 calendar days [9]. Therefore, people with tickets in their hands were forced to buy new tickets for cash and cashless payments, but it was not possible for everyone, especially for them who was returning from the resort and had no the necessary funds to buy several tickets. This information at the Sochi railway station was confirmed by eyewitnesses during a blitz interview conducted by the author.

Also an unexpected problem for returning vacationers and business travelers was getting certificates on the official delay in Greater Sochi. At first, people stood in line at the Headquarters for more than an hour to get this certificate, but they were informed that the certificates were being given at the inquiry Office. A huge queue also formed there and as a result people received a dubious-looking documents without a seal and the signature.

Information support for the placement of people was not well thought out. Groups of 70 people were formed to be transported by buses to the Olympic Village, to place them in a hotel. Station staff informed people about this. There was nowhere to find out or read more information. Passengers had to gather in groups in the waiting room of the station on the second floor. There the station staff without computer databases or at least information of passenger's flights put people on the list, composing it by hand. In the hall free water, tea, coffee and pate was organized. However, the station staff could not provide people with information about tickets and the opportunity to leave.

Summarizing the difficulties that arose as a result of the natural disaster, we note that in the places of the concentration of the most interested people, i.e. passengers, distinct information about the expected date of resumption of transport links was not announced. Note that this information was published on the Internet, and the dates indicated in it were confirmed. Also, the procedure for reissuing tickets was not announced at the station or in other places, however, at all levels, the station staff replied that passengers should buy new tickets for themselves. Nobody could exchange the tickets, and staff was explaining that such a procedure could not be provided. A Russian Railways Company's staff member answered a direct question about passenger costs that the railway suffered heavy damage as a result of the disaster and was not obligated to bear the costs of reissuing travel documents. Information on the Russian Railways Company's website and a note that could only be obtained from the deputy chief of the station was not clear. In general, the serious assistance provided to passengers was hampered by the poor organization of the processes of accommodation, re-issuing travel documents, and a constant lack of information.

For citizens who decided to leave Sochi by plane using the available tickets, a special situation arose - their applications were considered within 24 hours and they could fly out only to Moscow and St. Petersburg. Next, the passengers themselves had to find the means to pay for travel to their place of residence. It was hypothetically possible for citizens to take advantage of this service with tickets for trains on October 24 and 25. The detailed information could be got at a railway ticket office. However, this was not an ordinary text or other explanation, but a barcode for a smartphone with the appropriate program. Therefore, most passengers, especially the elderly ones, were not able to take advantage of this information.

In general, information support for passengers could not be considered satisfactory. Thus, the owners of electronic tickets did not receive any messages about the cancellation of transport traffic that occurred as a result of a natural disaster – neither about the cancellation of the train, nor about the possibility of exchanging an electronic ticket by non-cash method. Thousands of people stormed the windows of five ticket offices in order to hand over a ticket and buy another one, the situation in this crowd at a certain stage became close to panic. Calls to the Russian Railways Company's website were 5-7 hours late and were generally not effective [8].

However, the tension was limited mainly by the walls of the station. In the city, the effects of the disasters were quickly eliminated. Only in some cafes, hotels and shops the payment by credit cards was stopped and explained by poor internet connection. On the whole, the supply was not interrupted in the city, public order was maintained. There was no massive panic or protest that ussually occurrs in such situations. The branches broken by a hurricane were quickly removed. Public institutions, urban transport, shops and cafes, spa and cultural and entertainment structures functioned.

One of the indicators of public moods in zones of natural disasters is their reflection in the mass consciousness, generating certain reactions. Socially significant large-scale events usually give rise to a subjective interpretation of their causes, content and consequences, which is embodied not only in the media, but also in rumors, conjectures and other interpretations of reality. Note that social reactions to emergencies and subjective assessments, which include rumors, often affect social stability to a greater extent than the fact of the cataclysm and its real consequences. Experts in the field of rumorology (science of rumors) note that the lack of objective information or the uncertainty of available information increases the intensity of rumor [10, p. 501], which can destabilize the socio-political situation.

There almost was no panic rumors in Sochi in October 2018. Except for the situation among car drivers who wanted to stock up on fuel for the future, believing that there would be a disruption in fuel supply until the roads were open. The authorities' explanations in the media about fuel reserves in the temporarily blocked area were not widespread enough and did not reach their goals. Accordingly, kilometer-long lines appeared at gas stations, and the author of the article could observe them.

A small number of rumors in the situation with the Sochi hurricane is explained by the availability of high-quality Internet, which made it possible to obtain information and, in spite of the lack of official information in the places of passenger congestion, people understood the situation. Insufficient coverage of the situation in the "paper" media, such as newspapers or newsletters, which are prefered to use and trusted by representatives of the older generation can be considered a certain flaw.

The studied materials allow us to formulate conclusions and suggestions.

Another natural disaster in the Greater Sochi region showed that the management of infrastructures and various types of support in the city has been established, the situation is under control of law enforcement, administrative, economic and other structures which are able to provide adequate measures in emergency situations. According to ex-

perts, the administrative and managerial structures of Greater Sochi have developed the necessary algorithms for action in emergency situations, which are a result of frequent natural disasters in this region, and their experience is worth spreading.

At the same time, it should be recognized that the measures taken by Russian Railways Company to stop and resolve the crisis were not enough for people returning from vacation. Citizens did not have enough information about actions aimed at solving the problem and at least the approximate dates for restoring train traffic and the possibility of returning home. Meanwhile, such information was available. The queues were the result of officials inactivity, the passengers' psychological condition was negatively affected by the unclear prospects of getting home and the need to hand over tickets, although it was obvious in situation of emergency for officials to arrange ticket re-issuance without people's unforeseen expenses.

The reactions of people affected by the disaster, including those who was leaving, remained within normal limits. There was no panic and conflict. However, the situation had a successful conclusion, primarily due to self-discipline and the well-known patience of Russians. Obviously, the interests of passengers should be more thoroughly protected, especially in situations of disaster. It seems appropriate for large transport companies in Russia (Russian Railways Company, Aeroflot and others) to develop algorithms for action in emergency situations, to fix regulations for protection of passengers' interests. In particular, to provide that passengers whose interests are affected by the disaster the opportunity not to hand over but reissue their tickets. In an emergency, people could be allowed to issue a ticket with an open date (until transport links are restored) in order to save passengers from unnecessary procedures for the delivery and purchase of tickets.

Obviously, there is a need to spread an official information on the progress of repair and restoration work, the estimated timing of the resumption of transport links, the probability of a recurrence of disasters, measures to ensure the affected by a natural disaster, etc. Citizens should not be informed only by Internet sources but by traditional media, including radio, newspapers, and print special newsletters.

And last but not least, the priority proposal concerns the need for strategic scientific planning for the development of the urban environment in coastal regions in a rapidly changing climate. The decisive role in this process should belong to specialists in the field of climatology and urban studies, the attention of representatives of the government and public organizations is necessary. The experience of the international urban sustainability research network (Urban Resilience to Extremes, UREx) demonstrates the relevance of rethinking and predicting the effects of climate change, the need to set long-term goals for several decades, even if in modern socio-political conditions they are difficult to implement [11, p. 3].

Analysis of crisis events in the Greater Sochi region, the study of domestic and foreign researches of such situations allow us to draw generalized conclusions.

1. Over the past decades, Russia has formed and provided a system for the prevention of disasters and localization of consequences. Archive materials indicate that the Soviet period was characterized by a massive use of available forces and means - up to military equipment, army formations, etc., with the general confidentiality of information about the natural hazard. The latest period is characterized by the creation of the necessary legal framework and a unified state system for preventing and eliminating emergencies.

2. Information support for relevant measures needs to be seriously improved. The shortcomings of proactive public warning of disaster risks are being overcome, but so far ineffective methods prevail. So, the excessively frequent sending of SMS alerts about possible disasters, most of which are not confirmed, give rise to distrust of such warnings. The lack of timely and sufficiently complete information contributes to the formation of negative rumors about the extent of the disaster and its consequences, the destabilization of the socio-political situation. It is obvious that in case of emergency it is necessary to intensify the work of collecting and disseminating objective information and refuting rumors not only in the official media, but also on the Internet, on popular television and radio channels. It is necessary to centrally monitor the information background and develop adequate measures to maintain socio-political stability.

3. The increasing role of local communities in Russia does not yet have a noticeable effect. The actions of political parties and public organizations are often aimed at improving their rating, rather than organizing substantive measures. Meanwhile, local communities have significant potential in this direction, especially in preventive work in preparation for natural hazards.

4. It is necessary to establish a system of compulsory insurance in the event of a disaster. Pilot projects should be tested in the south of Russia, where disasters with large-scale consequences are most frequent.

5. The safety of the population and facilities during the natural hazard depends on the diversity of the economy, providing access to basic socio-economic infrastructures, such as communications, transport, water supply, and the services of healthcare institutions.

Conclusion. Based on the above findings, it can be assumed that the plans and prospects of management in hazardous events and natural disasters will correspond to the modern world trend - the creation of computer models of natural disasters in specific settlements, correlated with the analysis of geodemographic processes in the region [12, p. 61]. This will allow to work out the options for risks and the development of security threats, to form effective scenarios for the implementation of the necessary measures.

These include analysis of existing and development of new routes, taking into account the ways and means of moving people from the coast to protect against floods, the proactive construction of artificial reefs and dams, the creation of vegetable barriers, water pumping systems and reservoirs, as well as other infrastructure facilities to increase the sustainability of the population item. Managed evacuation plans should also take into account the likelihood of conflicts of interest between various social groups and organizations that could lose property and incur financial damage in a disaster. The mentioned moments suggest the construction of a complex model of the city and its periphery, which makes possible the spatial design of the parameters of the settlement in the changing environmental conditions.

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МЕТОДОЛОГИЯ ИССЛЕДОВАНИЯ СТРАТЕГИЙ ИНСТРУМЕНТАЛИЗАЦИИ И ТЕХНОЛОГИЧЕСКОЙ РЕАЛИЗАЦИИ МОЛОДЕЖНОЙ ПОЛИТИКИ РФ

METHODOLOGY OF STUDYING THE STRATEGY OF INSTRUMENTALIZATION AND TECHNOLOGICAL IMPLEMENTATION OF THE YOUTH POLICY OF THE RUSSIAN FEDERATION

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Аннотация. *В статье речь идет о методологии исследования стратегии инструментализации и технологической реализации молодежной политики Российской Федерации. Для определения методологической основы данной темы был проанализирован категориальный аппарат. Среди терминов определена системная категория, содержащая в себе потенциал для методологического обоснования – «государственная молодежная политика». Методологический анализ в статье проведен с позиций системного, интегративно-целостного, процессуального, акмеологического подходов. Данный анализ послужил основой для определения принципов реализации государственной молодежной политики и соответствующих стратегий. В свою очередь, стратегии позволили раскрыть технологии реализации государственной молодежной политики. В статье рассмотрены алгоритмы внедрения: ценностной технологии, технологии становления молодой семьи, технологии здоровьесбережения, технологии развития социально-экономического потенциала, информационной технологии в системе молодежной политики Российской Федерации.*

Ключевые слова: молодежь, методология, государственная молодежная политика, системный подход, интегративно целостный подход, процессуальный подход, акмеологический подход.

Abstract. *The article deals with the methodology of studying the strategy of instrumentalization and technological implementation of the youth policy of the Russian Federation. The categorical apparatus was analyzed to determine the methodological basis of this topic. Among the terms, a systemic category that contains the potential for a methodological justification - "state youth policy" is defined. The methodological analysis in the article was carried out from the perspective of a systemic, integrative holistic, procedural, acmeological approaches. This analysis served as the basis for determining the principles for implementing state youth policy and related strategies. The strategies themselves made it possible to reveal technologies for the implementation of state youth policy. The article discusses the implementation algorithms of value technology, technology for the formation of a young family, health-saving technology, technology for the development of socio-economic potential, information technology in the youth policy system of the Russian Federation.*

Key words: youth, methodology, state youth policy, systematic approach, integrative holistic approach, procedural approach, acmeological approach.

Introduction. In the current socio-economic situation, youth policy has become the object of study in the socio-political, economic, psychological spheres. The creative potential of young people at the stage of their disclosure and self-realization is a powerful impulse for the development of all spheres of life. Therefore, the political science context of the strategies of instrumentalization and technological implementation of youth policy requires its theoretical and methodological justification. At the same time, in the field of political institutions, processes and technologies it is important to determine the categories associated with the legal, scientific, social aspects of the implementation of youth policy. Consideration of technological aspects in political science comes to the fore, but at the same time, the institutional and process parameters of this study cannot be discounted. The article uses paradigm analysis as a tool for methodological substantiation of the stated problem, which is important enough for political science research.

Methods, Results, and Discussions. Political studies of youth policy contain a different methodological basis. T.V. Sheludyakova relies on the A.S. Akritov's concept of, where constitutional tools are used in considering the right of education [7]. S.V. Alekseev takes for the methodological basis of the disclosure of youth policy in Russia the works of

M.A. Gorshkov, F.E. Sherega, A.L. Eliseev, Yu.A. Zubok, A.V. Kochetkov, P.A. Merkulov [2]. E.G. Nekrasova notes that the works of scientists, for example, M.S. Borodin, Yu.V. Lunin can be related to studies that contain a theoretical and practical analysis of social support for youth in various directions [5]. S.Kh. Ortsuev used in his dissertation the humanistic concept of I. Ilyinsky, ethnopolitical and institutional approaches, as well as the structural-functional approach and method of grouping [6]. D.Yu. Baskakova makes an attempt to formulate "... a scientific and methodological approach to the development and implementation of a youth activity programs ..." [3]. O.V. Gokova in her study used the polyparadigm approach, which has been acknowledged as productive in sociopolitical studies since the late 1980s [4]. A variety of methodological approaches in the study of youth policy is associated with different research objectives. In our opinion, the analysis of the categorical apparatus is considered reasonable, as the basis for choosing a research methodology.

The categorical apparatus in the field of youth policy contains the fundamental concepts of “youth”, “youth policy”, and “state youth policy”. The concept of “state youth policy” is of the greatest semantic volume.

An analysis of political science sources on the problem of youth policy made it possible to conclude that it is important to define the concepts contained in the document “Fundamentals of State Youth Policy of the Russian Federation for the Period until 2025”.

- **"..." youth "** is a socio-demographic group, distinguished on the basis of age characteristics, social status and characterized by specific interests and values. This group includes persons aged from 14 to 30 years, and in some cases defined by regulatory legal acts of the Russian Federation and constituent entities of the Russian Federation, up to 35 years or more, who have a permanent residence in the Russian Federation or reside abroad (citizens of the Russian Federation and compatriots);

- **"state youth policy"** - the direction of the Russian Federation policy, which is a system of measures of regulatory, financial, economic, organizational, managerial, information-analytical, personnel and scientific nature, implemented through interaction with civil society institutions and citizens, an active interagency interactions aimed at civic-patriotic and spiritual-moral education of youth, expanding opportunities for effective self-realization of youth and increasing the level of their potential in order to achieve sustainable socio-economic development, global competitiveness, national security of the country, as well as strengthening its leadership positions on the world stage;

- **"infrastructure of youth policy"** - a system of state, municipal organizations and public associations, as well as other organizations of all forms of ownership, providing the opportunity for the supplying services and activities aimed at the development of youth ... "[1].

Analyzing the concept of “state youth policy”, we should note the basic methodological approaches for the consideration of this concept – a systematic approach and integrative approach. The use of general scientific approaches in political science research is quite important, because they are the fundamental basis of research and the implementation of youth policy. The category “state youth policy” is presented as a functional system, and as an integrative integrity. In the conception of youth policy as a systemic organization, we can distinguish a system of conditions, a system of institutions, a system of personality formations, a system of qualitative transformations at the state level. The definition of “state youth policy” can be instrumentalized through subsystems that consist in providing measures, as well as through various kinds of integrative paradigms, from the perspective of an integrative approach, which are in specific and interspecific interaction. According to N.N. Pachina "... the integrative paradigm is a characteristic of the relationship between the whole and the parts, the establishment of a certain level of integration (undifferentiated integrity, differentiation, summative unity, complex, synthesis, organic integrity) is associated with the goal, with the expected result ..." [9]. The concept of “state youth policy” includes a system of regulatory, financial, economic, organizational and managerial, information-analytical, personnel and scientific measures, which is important enough for political science. Each of the appropriate measures requires a systematic organization and is correlated with a specific subsystem that somehow interacts with each other. Communication is provided at the levels: "... undifferentiated integrity, differentiation, summative unity, complex, synthesis, organic integrity ..." depending on the specific goal-setting, that is, "... on what goal is set, the optimal choice of one or more integrative paradigms is possible (in depending on the types and number of mastered activities). In this regard, the establishment of certain levels of integration is interconnected with target settings ... ”[8].

In the definition of state youth policy, emphasis is placed on its institutional political science implementation “based on interaction with civil society institutions and citizens” [1]. In this case, we are talking about "... the institutional system, within the framework of which the interaction of different-quality components takes place ..." [8], also of a different level of integrity, which in political science include civil society institutions, interdepartmental institutions.

The next systematic organization of the political science category "state youth policy" is presented in the definition by a system of personal qualities, which includes "... a system of personality formations, consisting of civic-patriotic and spiritual-moral components, self-realization, potential ..." [8]. Different-quality components, both in structure and in content, can be represented at the level of summative unity, complex, and under certain conditions, synthesis and organic integrity.

The resulting functions in the definition of "state youth policy" are contained in "... the system of qualitative transformations at the state level ..." [8] - sustainable socio-economic development, global competitiveness, national security of the country, consolidation of its leadership positions on the world stage. In this case, integrative paradigms can, with different concentration of interaction and dynamics, move from one state to another or include integrative paradigms of other levels. This conclusion is important for the implementation of various kinds of political science tasks in the direction of the study of political institutions, processes and technologies. The institutional system presented in youth policy is aimed at personality formation, which in turn affects the development of the state, which ensures a high level of integrative transformations of these systems, which in the political science study plays the role of dynamic transformations.

The procedural approach in the study of state youth policy allows us to trace the interconnection and the implementation of subprocesses in the direction of fulfilling conditions, then the development of personality formations and, finally, the processes of formation of institutions at the state level. In this case, all the components are presented at the level of political institutions, processes and technologies.

In our opinion, the use of the acmeological approach is justified for a paradigmatic analysis in political science. At the level of political institutions, the acmeological approach allows us to monitor the presence and realization of their developmental potential. At the level of political processes, identify those that are aimed at creating a specific political product or determine the destructive effects. At the level of political technology, an acmeological approach is necessary to determine the basic principles of productive technological solutions.

From the point of view of the acmeological approach, state youth policy is considered as an acme system with optimality properties, passing from the current to the potential state, subject to a certain algorithm for modeling a new qualitative state of all structural components; as an acme process which depends on the properties of sequence, optimality, development, productivity; as an acme result at different levels of implementation; at the level of personality formations, at the level of functioning of the state, at the level of interaction of institutions, at the level of feedback.

A paradigm analysis of the category "state youth policy" made it possible to determine the basic principles: "... The principle of the system-subsystem functioning of state youth policy. The principle of the dynamic transformation of integrative paradigms in the system of state youth policy. The principle of the procedural development of multicomponent structures in the system of state youth policy ... "[8]. And one more principle must be attributed to the basic ones - the principle of acmeological trinity in the system of implementation of the state youth policy: acme result, acme system and acme process.

Description of the results of the paradigm study, definition of basic principles allow us to talk about instrumentalization strategies and technologies for implementing youth policy at the federal and regional levels.

The Government of the Russian Federation dated November 29, 2014 N 2403-r "On the Approval of the Basic Principles of the State Youth Policy of the Russian Federation until 2025" discloses the goals and objectives of the state youth policy [1]. Based on the Government's goals, it is necessary to determine the main strategies for the instrumentalization and technological implementation of state youth policy. The targets are related to values, education, health, socio-economic potential, young family, information support. In accordance with the targets, we describe the strategies.

The value strategy is aimed at "... the formation of a moral and civil value system, taking into account the multinational basis of our state, the values of cultural, historical, national heritage ...". The educational strategy contains the development of "... innovative educational, enlightening and upbringing technologies ..." [1]. The strategy of health protection is aimed at "... the formation of the values of a healthy lifestyle, the creation of conditions for the physical development of youth, the formation of environmental culture, as well as improving the culture of youth life safety ..." [1]. The development strategy of socio-economic potential determines "... the creation of conditions for the realization of the potential of youth in the socio-economic sphere ..." [1]. The strategy for the formation of a young family basically contains "... creating favorable conditions for young families aimed at increasing the birth rate, creating values of family culture and the image of a successful young family, and all-round support for young families ..." [1].

The information strategy is aimed at "... the formation of an information field favorable for the development of youth, the intensification of feedback mechanisms between state structures, public associations and youth, as well as improving the efficiency of using information infrastructure in the interests of patriotic and civic education of youth ..." [1].

In accordance with the strategies, technologies for the implementation of state youth policy are defined: value, technology for the formation of a young family, technology for health conservation, technology for the development of socio-economic potential, information technology. The use of technology in youth policy is necessary for managing political processes using technological procedures, techniques and methods of activity, which allows us to find algorithms for solving problems in the field of youth policy, both at the state level and at the regional level. The description of the results of theoretical and methodological research is the implementation of research technologies of state youth policy. Each of the technologies has its own implementation algorithm. Let us provide a brief description of them.

Technological aspects of the creation and formation of a young family: positive motivation; family forms of education; Information support. So, for large families, support is provided in the field of medicine, education, and employment at the state level. Among the benefits: priority right to enroll children in educational institutions, free travel, free trips to sanatoriums, camps and others. The situation with maternity capital described in table 1 is indicative. With the help of maternity capital, you can pay off mortgage debt; use it as a down payment when buying a home on a mortgage; for the individual housing construction; for the children's education; transfer to the funded part of the mother's pension; receiving a monthly allowance from the birth of a child up to 3 years [11].

Table 1

The amount of maternity capital

Maternity capital	**The sum, rubles.**
For the 1st child	466617
For the 2nd child	616617
For the 3rd child	450000

Figure 1 shows the change in the size of maternity capital at the birth of the first child, then the second and third child.

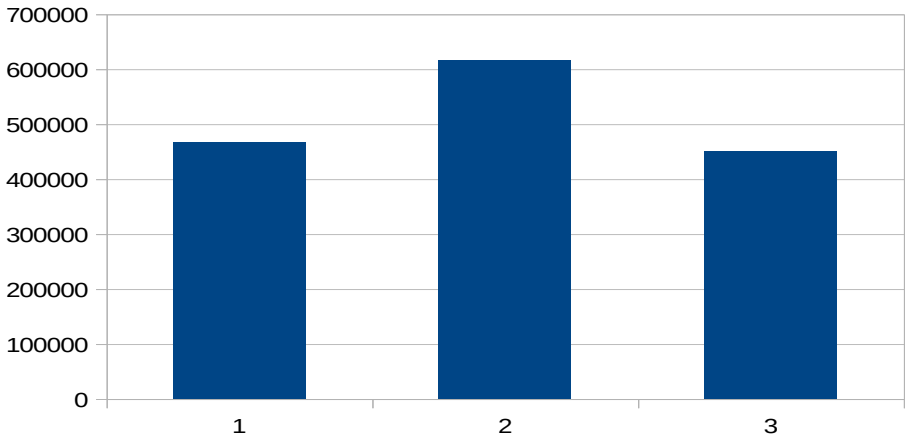

Fig. 1. The amount of maternity capital, depending on the number of children 1- payment for the first child; 2- payments for the second child; 3- payments for the third child

The technology for the formation of national and interethnic values is aimed at developing projects and programs whose goal is to form an active position in all spheres of life; popularization of professionals and their copyright systems of professional activity; development of mechanisms to ensure accessibility of infrastructure. An example is the development program in the field of art, culture, sports. Educational technology at the core contains the following aspects: creating conditions and a system of motivation that promote the education and self-education of young people, including people with disabilities in the humanitarian, legal, economic, and professional fields; training of specialists in organizing work with youth; development of youth self-government in educational organizations.

The past academic year 2018/2019 was a year of important decisions for the entire educational system. 2020 was marked by the upcoming cancellation of bachelor's degrees at pedagogical universities, the unresolved issue of "... the cancellation of the opportunity to enter five universities ...", disputes about the abolition of the Unified State Exam and the unrest in the teaching community over worsening working conditions and its payment [10].

The technology of health conservation is based on the following provisions: the development of motivation for regular physical education, for a healthy lifestyle; implementation of projects in the field of healthy lifestyle; improving infrastructure for a healthy lifestyle. One of the main priorities of the national policy of the Russian Federation is to increase life expectancy and, therefore, improve the health of all age groups of the population [12].

Conclusion. The technology for the development of socio-economic potential is based on the following positions: creating conditions for career guidance, creating an institution of mentoring in organizations, supporting youth programs and projects at the international, Russian, regional levels, creating conditions for self-realization of young people in the socio-economic spheres. An example is career guidance work carried out by universities in conjunction with employers, employment on labor exchanges, and grant support for youth programs.

The implementation of information technology is represented by the following algorithm: development of the principles of information support for youth; development of regulatory mechanisms for informing youth; study of factors and the creation of conditions affecting the improvement of information security culture; the formation of youth information systems; the formation of effective mechanisms for informing youth; self-realization of young people: participation in contests, projects, creation of information systems. A vivid example is the introduction of distance learning due to coronavirus.

A paradigmatic analysis of the study of instrumentalization strategies and the technological implementation of the youth policy of the Russian Federation allowed us to draw the following conclusions. Each of the technologies, when implemented at different levels, depends on the principle of system-subsystem functioning, the dynamic transformation of integrative paradigms, the principle of the process development of multicomponent structures in the system of state youth policy, the principle of acmeological triunity in the system of implementation of state youth policy: acme result, acme system and acme process.

An analysis of the research methodology of the instrumentalization strategy and technological implementation of the youth policy of the Russian Federation is the basis for determining the basic strategic directions at the regional level.

The main links in determining the methodological basis of this topic were the basic concepts. Among the terms, a systemic category is defined that contains the potential for a methodological justification - “state youth policy”. The methodological analysis carried out from the standpoint of a systemic, integrative-holistic, procedural, acmeological approaches allowed us to determine its basic principles and strategies.

In accordance with the strategies, the technologies for implementing the state youth policy were defined and the algorithms for introducing value technology, technologies for the formation of a young family, technology for health protection, technology for the development of socio-economic potential, information technology in the youth policy system of the Russian Federation were considered.

Consequently, it is possible to build a methodological basis for the technological implementation of the youth policy of the Russian Federation, which in turn can be incorporated into the political science model for the implementation of youth policy at the regional level.

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ПОЛИТИЧЕСКИЙ PR В СФЕРЕ МЕЖДУНАРОДНЫХ ОТНОШЕНИЙ

POLITICAL PR IN THE SPHERE OF INTERNATIONAL RELATIONS

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Аннотация. *Возросшее влияние информационных технологий привело к тому, что вопрос построения не только эффективных, но и системных коммуникаций стал актуален, поскольку порядок международных отношений нуждается в более предсказуемых, более открытых взаимодействиях межгосударственного характера, в том числе и в сфере политического PR.*

Ключевые слова: политический PR, политические коммуникации, международные отношения, информационное общество.

Abstract. *The increased influence of information technology has led to the fact that the issue of building not only effective, but also systemic communications has become urgent, as far as the order of international relations needs more predictable, more open interactions of an interstate nature, including in the field of political PR.*

Key words: political PR, political communications, international relations, information society.

Introduction. Today, political PR in the field of international relations has been little studied, which actualizes the research of this problem. The researchers' attention was focused only on certain applied aspects of PR and, first of all, in the context of considering the formation of the image of nation-states in the international arena. We also has not succeeded in developing an integrated theoretical concept of political PR in the field of international relations, since the phenomenon is quite complex and requires further atention of scientists.

Methods of analysis. Most often, political PR is considered in the applied aspect, which, of course, causes a refusing from conceptual evaluations of PR. The study is maintained by using approaches based, first, on the theory of stereotypes of W. Lippman [18] (which made it possible to consider political PR in the context of imposing stereotypes, images, patterns); secondly, on the theory of "party support" by B. Birelson [21] and P. Lazarsfeld [23] (they focus on the effectiveness of political PR according to the country); thirdly, the theory of "political discourse" by S. Black [2] (the focus is on "case studies"); and the theory of "public opinion" (the focus is on methods of forming public opinion through information resources) - D. Butler [1] and D. Thompson [26] and others. The method of comparative analysis made it possible to compare the educational programs of several countries, internal integrativity (integrity) which is aimed at the effective organization of the work of political PR in the field of international relations. At the same time, the problem of isolating the actual concrete methods of political PR in the field of international relations has faded into the background and, accordingly, is not reflected as a methodological setting.

The main part of the study. The political PR in the international sphere was deeply studied by Frank Jeffkins and Daniel Yadin, the authors of the textbook "Public Relations", which was later translated into Russian. The researchers identify an "international PR" with international marketing, and write that the rules of international marketing can be applied in international PR. The author's suggestion that "many of the problems of communication with foreign markets can be resolved using the services provided in the UK" seems disputable [17, 204-205; 25, 3-4].

The basic concept of our research is in understanding of international PR presented by E.V. Kedyarova, Dennis L. Wilcox, Glen T. Cameron and Brian H. Reber, who were more accurate in scientific developments. Thus, domestic researchers interpret political PR in the field of international relations as "a form of political communication oriented to constant contacts between political actors and the public" [10, 2], while Dennis L. Wilcox, Glen T. Cameron and Brian H. Reber use the term "International public relations" and define it as "planned and organized efforts of a company, organization or government aimed at establishing mutually beneficial relations with the public of other countries" [22].

A statement of a systemic understanding of political PR in the field of international relations suggests that the concepts: “advertising and public relations in the politics of international relations”, “state PR in the international arena”, “state PR in the foreign market” or “international PR” are synonymous to our understanding of term "political PR in the field of international relations" and mean a form of political communication between the subjects of international politics and the public.

In this sense, it is legitimate to talk about the following key target users of information coming in line with public relations in the field of international relations, which are:

1. first, The UN and UNESCO, as they are sources and subjects of international law.

2. UN specialized agencies operating under the auspices of the General Assembly and / or Economic and Social Council (ECOSOC): [19]

- The World Bank is a multilateral lending institution, consisting of five closely interconnected institutions uniting members of the International Monetary Fund, whose common goal is to promote the economic and social development of the countries of the world (mainly developing and post-socialist) through financial assistance to advanced economies. The headquarters of all five institutes are located in Washington. The World Bank Group includes: [12]

a) IDA (International Development Association - 169 member countries, including Russia). The goal is to provide poor countries with special incentives and interest-free loans at the expense of donor countries. Russia in the status of a donor [3];

b) IFC (International Financial Corporation - 170 member countries, including Russia). The goal is to encourage private entrepreneurship in developing countries and thus promote economic growth;

c) MAIG (International Agency for Investment Guarantees - 134 member countries, including Russia). The purpose of the organization is to facilitate the flow of investment in developing countries, the provision of guarantees;

d) ICSID (International Center for the Settlement of Investment Disputes - 119 member countries, including Russia). The organization’s tasks include the provision of arbitration and other legal services to member countries, informing about investment legislation. The goal is to promote the growth of international investment;

e) IBRD (International Bank for Reconstruction and Development - 180 member countries, including Russia). The goal is to promote the growth of production and international trade in member countries by providing soft loans and long-term financing of projects and programs in that direction.

- IMF (International Monetary Fund - 181 member countries, including Russia). The purpose of the organization is to promote the growth of international trade, to regulate the stability of exchange rates, the provision of short- and medium-term loans (only to state bodies, in tranches, the receipt of which is strictly linked to the fulfillment by the state of jointly defined obligations). Only from 1992 to 1999, the IMF provided Russia with loans worth more than $ 20 billion. Headquarters - in Washington [6, 77-105];

- UNCTAD (United Nations Conference on Trade and Development - 186 member countries, including Russia). Objectives - international cooperation is aimed at promoting the development of international trade. The focus is on accelerating economic growth in developing countries. Headquarters - in Geneva;

- UNIDO (United Nations Industrial Development Organization - 166 member countries, including Russia). Main goals: industrialization of African countries, promoting industrial growth at the national, regional and global levels, reconstruction of industry in post-socialist countries. Headquarters in Vienna;

- The WTO (replaced by the GATT in 1995 by the World Trade Organization - 159 member countries, including Russia (the Republic of China is a partially recognized state) [16]. The purpose of the WTO is to liberalize international trade, regulate tariff and trade policies, subsidize exports , standardization and certification of goods, setting duties, import licensing, etc. Headquarters in Geneva;

- FAO (food and agricultural organization - 169 member countries plus the European Union). In collaboration with FAO, the World Food Program is operating - the leading international organization for the distribution of food aid. The goal is to end hunger in developing countries;

- IFAD (International Fund for Agricultural Development - 158 member countries, which are conditionally divided into three categories: a) donor countries, which include 22 developed and 12 developing countries - oil exporters and 124 developing countries. The goal is poverty alleviation, increased food production), headquarters in Rome.

3. INGOs (International Non-Governmental Organizations; English Non-governmental organizations), such as: [12]

- Ecumenical Council of Churches;

- Red Cross,

- OPEC (Organization of Petroleum Exporting Countries);
- Pugwash movement (organizations of scientists);
- FIFA (sports organizations);
- Amnesty International (legal organizations, etc.

4. IGOs (International Governmental Organizations):

- OSCE (Organization for Security and Co-operation in Europe), brings together 56 states of Europe, North America and Central Asia. The purpose of the organization is to promote comprehensive security in the military-political sphere, humanitarian, economic and environmental dimension;
- NATO (North Atlantic Treaty Organization - North Atlantic Treaty Organization);
- EU (European Union);
- ASEAN (The Association of Southeast Asian Nations, Association of Southeast Asian Nations). Participating countries: Thailand, Philippines, Cambodia, Laos and Myanmar, Brunei Darussalam, Singapore, Malaysia, Indonesia, Vietnam, East Timor, Papua New Guinea. The goal is mutually beneficial cooperation;
- BRICS (informal interstate association). Composition of BRICS: Russian Federation, Federative Republic of Brazil, China, Republic of India, Republic of South Africa. The BRIC acronym was proposed in 2001 by Jim O'Neill, head of the global economic research department at Goldman Sachs, an American financial and investment company, to designate the four economies of the world with the fastest growing GDPs - Brazil, Russia, India and China. In connection with joining BRIC South Africa in December 2010, the group began to bear the name BRICS. July 25-27, 2018, the tenth anniversary BRICS summit was held in Johannesburg (South Africa);
- SCO (Shanghai Cooperation Organization. Member countries: China, Russia, Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan, India, Pakistan). The objectives of the SCO: strengthening stability and security in the participating countries;
- CIS (Community of Independent States);
- OIC (international Islamic organization), etc.

According to Russian scientists, the list of subjects of advertising and public relations in the politics of international relations also includes: [8, 281]

- governments and elites of foreign countries;
- international public organizations;
- foreign investors and shareholders;
- an expert community whose professional interests affect this state (financial and industry analysts, political scientists, sociologists, economists, etc.);
- representatives of the world community, including citizens, potential and real tourists, as well as the general population of foreign countries.

But this list is far from complete, since “international organizations are one of the notable subjects of international relations only from the second half of the XX century. At the beginning of the XX century there were about twenty intergovernmental and about two hundred non-governmental international organizations, then at the beginning of the XXI century there were about three hundred and more than forty thousand, respectively”[13, 24].

We have already noted that the object of attention of researchers of political PR in the field of international relations is often certain applied aspects of PR and, first of all, in the context of considering the formation of the image of nation-states in the international arena. Researchers suggest that in the corresponding segment in relation to a particular state, image formation in three different dimensions is possible: [8, 281]

1) at the civil level, based on economic or political values,

2) at a specialized level, which covers specialized or professional interests,

3) at the ordinary level: covers the implementation of cognitive, leisure and everyman interest.

S. Anholt notes that the basic criteria for the formation of an international image of the state is a synthesis of “brand management, public diplomacy, trade, investment, tourism and export promotion, competitiveness in the global world, is something that is already starting to pay dividends for many countries,” cities and regions - both rich and poor ”[20, 36]. Speaking about the actual political criteria for communication in the field of international relations, T. Moylanen and S. Rainisto discuss the country's image in terms of commercial marketing: “There are three important concepts ... that are associated with brands: identity, image and communication” [24, 7].

In our opinion, the external image of the state is formed through internationally-visible components of the following nature:

- political;
- environmental;
- social and legal;
- cultural;
- military strategic;
- sports;
- health care;
- living standards of the population;
- scientific achievements;
- human rights and freedoms;
- objectivity of published statistical indicators;
- the activities of political elites;
- international ratings;
- image of the head of state, etc.

We agree with Yu.G. Zheglova, that an effective image of the state can be the result of the synergistic effect of many vectors [7, 10-12]. And, as O.N. Zhiltsova, I.M. Sinyaeva and D.A. Zhiltsov, suppose "external state PR is designed to provide powerful information support" [8, 282] to all disasters that influence the image of the state.

International initiatives of the state are also of great importance for political PR in the field of international relations. So, the next 74th session of the UN General Assembly, which took place on September 24-30 of this year in New York, went down in history by the adoption of a Russian resolution on arms control during the Session. In this sense, it is legitimate to say that the Russian initiative gained almost all votes. Three states: Palau, Ukraine and Georgia abstained. The remaining 179 states, including the United States, voted unanimously, supporting Russia's resolution "on strengthening and developing the system of treaties and agreements on arms control, disarmament and non-proliferation" [5].

At the same time, Western society in accordance with such criteria as the lack of transparency in the conduct of domestic business, the activities of the office of officials, the lack of open databases in the social environment, etc. suggested the sites of Russian campaigns the worst in Europe. [9]. Meanwhile, even according with formal logic, within the framework of the existing paradigm of Russian communication, the Russian side influences world public opinion extremely inefficiently. Created in 2005 on budget money, the Russian-language television channel Russia Today, with a budget of $ 30 million per year, has little impact on public opinion around the world. Effective news agencies today are the USIA (United States News Agency), the Federal Press and Information Office (FRG), and the British Council, together with the Central Bureau of Information. As a result, there is a negative image of Russia as a state with an aggressive foreign policy, implicated in doping scandals, with a lack of transparency in the economy and a corrupt society.

In the modern information society, the role of political PR has greatly increased, therefore, the system of international public relations is becoming more integrated. So, we should expect that the priority in the information impact on the objects of political PR in the field of international relations is given to international media channels. This means that the communication space of the international information society is formed through the basic mechanisms of communication with the public at the global level. As the former US Secretary of State Z. Brzezinski rightly remarked, today "means of communication represent the third generation of means of world domination" [14, 17]. These are diplomatic services, mass media, mass means of communication, representative offices abroad, organizations of cultural cooperation, international activities of transnational corporations [15, 177-178].

We aslo should take into account the dichotomy of the development of the modern global community, where sometimes mutually exclusive trends of globalization and glocalization are observed (glocalization is the term of the English sociologist Roland Robertson, which means the processes of decentralization, the so-called "new regionalism"). On the one hand, globalization demonstrates the desire not only of countries but also of regions to act as full-fledged subjects of international relations. On the other hand, glocalization "is realized, as a rule, from below, and not from above, it includes, in addition to economic issues, environmental and safety problems, and many social and cultural institutions along with states act as its actors" [11, 111]. Consequently, informational work in the field of modern Public Relations implies the development of civil society institutions and responsibility in finding the best ways to integrate

countries included in regional agreements into global processes (glocalization / new regionalism, which is now radically different from the protectionist orientation of old regionalism). In addition, when creating an international PR campaign, it is necessary to take into account social, economic, political and cultural differences in all spheres of life of different societies, since each national culture is distinguished by its originality, a set of its own characteristics. And this is not only about different types of political and economic systems, but also about values, beliefs, stereotypes or language differences.

The recognition of the importance of political PR in the field of international relations determines the actions of most states in the context of building a coherent system of educational programs in master's and doctoral programs. So, according to British standards, several models of master's programs in PR function at the School of Business of the University of Manchester Metropolitan - Manchester Metropolitan University, MMU, UK. The course of the program "Public Relations" lasts one year and ends with the defense of the dissertation. Various programs in the higher education system (mixed type, practical or academic) offer European standards. In the framework of higher education, masters study PR for two years, which makes it possible to continue their studies in doctoral studies. As S.M. Vinogradova, G.S. Melnik and K.A. Pantserev note, "Among the specialized (PR, journalism, marketing, management) educational institutions in Germany, the most famous are, for example, DIPR (Deutsches Institut für Public Relations - German Institute of PR), Free University, Institute of Journalism and Communication in Berlin (Public Relations)), as well as the Universität Leipzig, Institut für Kommunikations- und Medienwissenschaft (communication area, media relations) "[4, 148].

Focusing on building professional potential, Boston University (Boston University, USA) has gained solid experience in training a PR specialist in the international sphere. The university faculty pays close attention to theoretical knowledge and practical skills: the ability to be creative in solving PR tasks and think critically.

In this regard, it is worth noting that Russian universities "are also focused on training high-class specialists in public relations. The Diplomatic Academy of Foreign Affairs of the Russian Federation, Peoples' Friendship University of Russia (PFUR), Moscow State University (MSU), Moscow State Institute of International Relations (MGIMO), St. Petersburg State University "[4, 137] – these are not a complete list of Russian universities that contain educational programs that train specialists for government agencies in the field of external PR. The study of political PR as one of the instruments for influencing public opinion and in general as an instrument of foreign policy is admitted as paramount in this respect.

Our Pyatigorsk State University also achieves success in training of public relations practitioners. In the framework of the training of specialists in International Relations (skills profile - international security) and the training of Masters in Advertising and Public Relations (skills profile - public relations in international relations), specialists are trained to pursue a career in international security and international PR combined with studying two foreign languages.

According to S.M. Vinogradova, G.S. Melnik and K.A. Pantsereva, during the training, the following aspects should be important both for teachers and trainees: [4, 148]

- information support of special international events;
- the study of blogging, mobile marketing, flash mobs, conversion technologies, web presentation, offline events, etc.;
- organization of receptions, presentations, expositions, exhibitions, opening ceremonies, etc. events oriented to the external public;
- the specifics of creating written and oral PR-texts in international public communication;
- newsmaking in the field of international relations;
- news agenda and work with an informational occasion based on modern media technologies;
- information management and spindoktoring;
- news management;
- media relations;
- global and local political image;
- the country's participation in global political, economic and socio-political processes, etc.

The findings of the study. A statement of a systematic understanding of political PR in the field of international relations suggests that the concepts: "advertising and public relations in the politics of international relations", "state PR in the international arena", "state PR in the foreign market" or "international PR" are synonymous with our understanding of "political PR in the field of international relations" and mean a form of political communication between the subjects of international politics and the public.

It can be concluded that a theoretical study of political PR in the field of international relations requires the use of methodological tools in the humanities, which can fully reflect the evolution of the international sphere of human life and the place of political PR in it. On the practical plane, the role of education in the training of international PR specialists has increased.

A systems approach demonstrates that a deeper understanding of the state role in formation of political PR is quite relevant. Consequently, Russia, with its huge geopolitical potential and political opportunities should dominate the international arena, demonstrating a holistic strategy in creation of the state's image, stable political and economic situation in the country, and the formation of civil society and the middle class.

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ПРЕДПОСЫЛКИ ОТКРЫТИЯ РЕСТОРАНОВ «ВЫСОКОЙ» КУХНИ В СИСТЕМЕ ГОСТЕПРИИМСТВА НА КАВКАЗСКИХ МИНЕРАЛЬНЫХ ВОДАХ И КУРОРТАХ КРАСНОДАРСКОГО КРАЯ РФ

PREREQUISITES FOR OPENING OF FINE DINING RESTAURANTS IN THE HOSPITALITY SYSTEM IN THE CAUCASIAN MINERAL WATERS AND RESORTS OF THE KRASNODAR TERRITORY OF THE RUSSIAN FEDERATION

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Аннотация. *В представленной статье проводится анализ развития ресторанного бизнеса в России, как неотъемлемой части туризма.*

Материалы и методы, результаты. *Описываются предприятия питания в Российской Федерации. Дана характеристика тенденций развития ресторанного бизнеса с «высокой» кухней. Определены предпосылки востребованности ресторана «Мишленовской звезды» на территории России. Говоря более конкретно, мы провели анализ статей по выявлению положительных тенденций развития ресторанного бизнеса в мировой практике, Была проведена обработка результатов анализа. Материалы данного исследования могут быть применены в практической деятельности руководителям туристских и ресторанных предприятий, составляющий туристский продукт, инвесторам и другим организациям.*

Заключение*. Сегодня в РФ появились все предпосылки для разработки нового турпродукта который будет способствовать удовлетворению спроса на культурно-познавательные мероприятия, мега-события в том числе будут интересны рестораны «высокой» кухни, как неотъемлемой части турпродукта.*

Ключевые слова: ресторанный бизнес как фактор развития туризма, рестораны «высокой» кухни, организация качественного обслуживания и полноценного отдыха - главная задача ресторана, «Мишленовские звезды», предпосылки создания ресторана с «Мишленовскими звездами». Событийные мероприятия (спортивные, деловые, культурно-познавательные). Создание нового турпродукта.

Abstract. *This article analyzes the development of restaurant business in Russia as an integral part of tourism.*

Materials and methods, results*. The article describes food enterprises in the Russian Federation. The characteristic of development trends of restaurant business with fine dining is given in the paper. The prerequisites of the demand for the Michelin star restaurant in Russia are determined. An analysis of articles was carried out to identify positive trends in the development of the restaurant business in world practice. The materials of this study can be applied in practical activities by the leaders of tourism and restaurant enterprises, which are a tourism product, by investors and other organizations.*

Conclusion. *Today in the Russian Federation there are all the prerequisites for the development of a new tourist product that will be able to meet the demand for cultural and educational events, mega-events including restaurants of fine dining, as an integral part of the tourist product.*

Key words: restaurant business as a factor of the development of tourism, restaurants of fine dining, organization of high-quality service and recreation - the main task of the restaurant, "Michelin stars", prerequisites for creating a restaurant with "Michelin stars", event (sports, business, cultural and educational), creating a new travel product.

Introduction. The restaurant business plays a significant role in the development of tourism in Russia, as foreign tourists coming to our country want to not only see the sights (museums, theaters, etc.), but also try dishes of Russian and other national cuisines of the peoples living in Russian Federation. Guests come to restaurants for various pur-

poses: firstly, to taste the national cuisine of the peoples living in the Russian Federation; secondly, to celebrate an important event in the life of a person or a team, to arrange a banquet or a business meeting. The main task of any restaurant is to provide a high-level service.

At present, in the Russian Federation, catering facilities are classified according to GOST 30389-2013 introduced in 2016, where the following types of catering facilities are defined: restaurant, cafe, bar, dining room, buffet, cafeteria, and culinary store. All these catering facilities are characterized by the nature of their activity, mobility, level of service, organization of catering, location and time of operation.

Of course, such type of an enterprise as the restaurant is of great interest. It provides the consumer with catering services with a wide range of complex dishes, including specialties, alcoholic and non-alcoholic drinks, confectionery and bakery products, and leisure activities.

Research methods. Observation, analysis of articles on identifying positive trends in the development of the restaurant business in world practice, analysis of the results. The theoretical basis of the research are the normative documents (GOST 30389-2013 (the standard establishes general requirements and classification of public catering enterprises in the Russian Federation)), as well as articles by contemporary authors in the field of tourism: M.A. Morozov, V.P. Belyansky, A.M. Vetitnev and others. Modern methods of scientific research, such as a systematic approach, conceptual analysis are used in the article.

Tourism development today is a subject of conflicting trends, which are formed under the influence of both objective and subjective factors. Objective factors are the global financial crisis, fierce competition in the tourism industry, including the restaurant business. Subjective factors are the wrong marketing policy of a restaurant company, namely, the demand for catering products, inflated pricing, poor service and staff training, and others. The financial crisis leads to a decrease in the paying capacity of tourists (tourism product consumers), they choose the most economical offers in the field of restaurant services. Catering facilities such as the canteen and fast food are becoming popular.

There are two groups of restaurant service consumers. One group prefers budgetary catering enterprises, another group believes that for business meetings and during travel it would be interesting to visit restaurants of fine dining. Active tourists plan their holidays in advance, book hotels and restaurants either through tour operators or directly through the Internet, study reviews and make decisions on booking. This group of tourists preferes restaurants with different specializations: for example, Russian cuisine, Caucasian, Tatar or a restaurant specializing in fish and seafood, etc. Previously, Russian cuisine was limited by the "Soviet style", but in recent years, chefs have improved their skills by practical study in the best restaurants in Europe, thereby created their own concept of cuisine that can impress many sophisticated guests.

Today in the Russian Federation the most popular are the restaurants with national cuisine, namely: Caucasian, Chinese, Japanese, Thai, etc. Of course, there are restaurants where the menu of one restaurant offers dishes of different cuisines, for example: Georgian, Uzbek, Mediterranean (kebab, dolma, Uzbek pilaf, Greek salad, fish, seafood, etc.). It is not bad, in general, but at the same time the originality of the kitchen is “loosing” (this is the interior, the uniform of waiters, music, etc.)

The fact is that restaurants imply a luxurious interior, expensive furniture and tableware, qualified staff, and, of course, cooking of a very high standard.

What new can the restaurant business offer especially for wealthy tourists, who consider food as an integral part of the trip. In Europe, there are “haute cuisine” restaurants, whose leaders are French and Italian cuisines. Today, Michelin-starred restaurants can also be refered to fine dining restaurants. Restaurants of this level have star rating criteria. This characteristic was proposed in 1900 by the founder of the Michelin company, which initially had nothing to do with cuisine, because made tires for cars and bicycles, etc., and since 1930, the second direction of the company’s activity has been the production of Via Michelin guidebooks. There are two main Michelin guides (in a red and green covers):

- in the red cover they print information exclusively about restaurans and hotel type establishments;

- in the green cover they put information on a geographical basis (roadmaps, guides, descriptions of attractions). The most famous was the "Red Guide" - a restaurant rating with the information for tourists who traveled to France, including addresses of hotels, restaurants, parking lots for cars.

The most expensive restaurants with fine dining were marked with a sign from which the "Michelin Star" appeared. The Michelin rating represents a conservative methodology; a change in methodology is rare. So, “Michelin Star” means the most expensive restaurant with high-quality cuisine. Today restaurants with Michelin stars are divided into 3 categories - one, two, three. There are also restaurants without stars, but they have an assessment of the quality of

the cuisine in the form of a pictogram of Bib's head - a symbol of the Michelin company. Such a sign indicates good quality food at a reasonable price of 30 euros. Restaurants with stars, in addition to the a la carte menu, offer sets (complexes) minimum cost of which is from 50 to 150 euros. Tourists who take sets will not stay hungry because these menu complexes include from four to seven dishes, with good wine (from 2 to 4 glasses) per person. The quality of food and drinks is very high - guests are satisfied.

The quality of the kitchen is constantly evaluated by independent inspectors from the Michelin company (evaluation criteria are kept in secret).

– one Michelin star is a very serious reward.

– two stars - restaurant dishes can already be considered as works of art.

– three stars - have restaurants with individual author's cuisine of famous chefs.

The chef, leaving the restaurant, can "take" the Michelin star with him to another restaurant, where he plans to work in the future.

Michelin restaurants are found all over the world, the record city for 3-star restaurants is Tokyo (Japan), there are fourteen restaurants of this level. But what about Russia? In Russia, there is no any Michelin restaurants yet.

Michelin star restaurants in Russia or another country can get restaurants with original cuisine that constantly maintaining freshness of products, quality of dishes, respect for cooking times, drinks of their own style, natural taste, constant high-quality work of cooks, therefore restaurants take in staff a chef known for its original dishes who is able to maintain a constantly high quality cuisine. Of course, such restaurants are designed for rich people. That why there will not be many such restaurants, it is possible only in large or tourist cities, such as Moscow and St. Petersburg or Sochi, where there are large tourist flows and there is a demand for original cuisine, for example, Russian, Caucasian.

Michelin-starred restaurants provide consistent income.

There are a number of prerequisites for this:

– qualified chefs;

– demand for elite, author's cuisine;

– steady loading of the trading floor (tables are pre-booked).

European countries are trying to get the cherished Michelin star. Today in the restaurant business in Russia there has been a tendency to fine dining, there are prerequisites for this: chefs who participate in the qualifying rounds of prestigious culinary competitions; there is a demand for such restaurants from the tourism industry.

Such restaurants will demonstrate a high culture of service in combination with the author's gourmet cuisine for the good rest of guests who can eat and dive into the atmosphere of hospitality that restaurants with Michelin Stars will create. There will not be many restaurants of such standard in the world, they will be author's restaurants, due to the following factors:

– requirement of highly intensive work and highly qualified personnel;

– requirement of original dishes and dishes of complex preparation;

– limited market;

– It is difficult to maintain the high quality of dishes, taking into account the refined tastes of guests.

Nevertheless, there is a demand for "gourmet" restaurants during festivals, forums, sporting events and other events that take place very often in the Russian Federation, such as:

– International Economic Forum (St. Petersburg, Sochi);

– Confederations Cup (Sochi)

– World Cup (Sochi, St. Petersburg, Moscow, etc.);

– Choral Games (Sochi) and other major Mega-events;

– Russia-Africa Summit (Sochi).

Large-scale events can provide excellent opportunities for promoting the territory and increasing its attractiveness for tourists. It have been lately understood in European countries, in which tourists are offered holiday packages for various events, which contribute to the development of their territory and the creation of their brand, thereby ensuring the development of the city's economy (infrastructure, loading of hotels and restaurants). Special events will allow the city (region) to timely win the interest of potential consumers of tourism services. The promoted event itself becomes a brand, which allows it to be widely used in building a further strategy to increase the tourist attractiveness of a city or region. The event includes a personal acquaintance with the event venue with the services of hotels and restaurants, which allows for the emotional involvement of tourists in the value system of this territory.

Tour operators need to develop tours dedicated to various cultural or sporting events (festivals, national holidays, etc.). The technology of organizing such tours implies a comprehensive selection of excursions that highlight the national characteristics of the city (territory). It is important to note that consumers of the tour can be not only foreign guests, but tourists from all regions of our country who can choose a set of services in advance (inclusive tour) with a mandatory visit to a gourmet restaurant with a national touch.

Conclusion. Thus, we can conclude that today in Russia all the prerequisites have appeared for the development of a new tourist product that will meet the demand for cultural events, mega-events, including restaurants of fine dining, as an integral part of the tourist product. Organization of new tourism programs will help to create a positive image of the city (region), preserve and revive original cultures, develop interregional contacts. Considering a favorable domestic economic situation and improvement of the life quality, event tourism (sports, business, cultural and educational) can increase investment attractiveness of city (region), forming a new tourist product which includes visits to the restaurants of fine dining, therefore restaurants with the "Michelin star" may appear in the Russian Federation.

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