Austrian Journal of Technical and Natural Sciences

№ 11–12 2018
November–December

PREMIER
Publishing

Vienna 2018

Austrian Journal of Technical and Natural Sciences

Scientific journal

№ 11–12 2018 (November–December)

ISSN 2310-5607

Editorial office Premier Publishing s.r.o.
Praha 8 – Karlín, Lyčkovo nám. 508/7, PSČ 18600

E-mail: pub@ppublishing.org

Homepage: ppublishing.org

Austrian Journal of Technical and Natural Sciences is an international, German/English/Russian language, peer-reviewed journal. It is published bimonthly with circulation of 1000 copies.

The decisive criterion for accepting a manuscript for publication is scientific quality. All research articles published in this journal have undergone a rigorous peer review. Based on initial screening by the editors, each paper is anonymized and reviewed by at least two anonymous referees. Recommending the articles for publishing, the reviewers confirm that in their opinion the submitted article contains important or new scientific results.

Premier Publishing s.r.o. is not responsible for the stylistic content of the article. The responsibility for the stylistic content lies on an author of an article.

Instructions for authors

Full instructions for manuscript preparation and submission can be found through the Premier Publishing s.r.o. home page at:
http://www. ppublishing.org.

Material disclaimer

The opinions expressed in the conference proceedings do not necessarily reflect those of the Premier Publishing s.r.o., the editor, the editorial board, or the organization to which the authors are affiliated.

Premier Publishing s.r.o. is not responsible for the stylistic content of the article. The responsibility for the stylistic content lies on an author of an article.

Included to the open access repositories:

Typeset in Berling by Ziegler Buchdruckerei, Linz, Austria.
Printed by Premier Publishing s.r.o., Vienna, Austria on acid-free paper.

Section 1. Biotechnology

Kaldybekova Zhanat,
candidate of technical sciences,
associate professor of South Kazakhstan State University
named after M. Auezov

Bitemirova Alia,
candidate of chemistry sciences associate professor
of the South Kazakhstan Pedagogical University

Alpamysova Gulzhaina,
candidate of agricultural sciences associate professor
of the South Kazakhstan State Pedagogical University

Turebekova Gaukhar,
candidate of technical sciences associate professor
of the South Kazakhstan Pedagogical University
E-mail: g.ture@mail.ru

Dairabayeva Aigul,
master of ecology, senior lecturer of the M. Auezov
South Kazakhstan State University
E-mail: g.ture@mail.ru

FORMULATION OF COLD DRINKS ON THE BASIS OF DECOCTION OF DRUG PLANTS

Abstract: It is proposed to use natural supplements using drug plants of South Kazakhstan oblast (SKO) in this paper. Such composition of cold drinks allows not only to allay thirst, but also to compensate necessary vitamins and other useful substances in a human body. There are more than 20.000 plant species in Kazakhstan, 6.000 of which contain biologically active substances. But there are other compounds in the composition of plants that are not desirable in the composition of drinks. Therefore, it is very important to separate and obtain necessary biologically active compounds, which positively influence the useful and organoleptic properties of drinks. We have studied trends and prospects of the market of various soft drinks in Kazakhstan and abroad. The developed recipes for enriched cold drinks using dietary supplements derived from SKO drug plants have high biological activity. The obtained cold drinks will be the first domestic products, obtained with the use of SKO drug plants.

Keywords: biologically active substances, biologically active compounds, composition of drinks, drug plants.

The growth in the production and consumption of soft drinks in Kazakhstan is mainly due to increase in the share of drinks based on artificial flavors, dyes and sweeteners. Recently, along with increase in output of products, changes have been observed in the direction of their quality, expansion of assortment, increase in the share of production of drinks based on natural juices, sugar, as well as new types of special-purpose drinks, including low-caloric and energy drinks.

In the segment of the world sweet carbonated drink market, reduction of sugar and artificial ingredients became the main trend. About 40% of the market of soft drinks is sweet carbonated drinks, but sweet soda loses its position, giving way to sports and functional drinks. According to experts' forecasts in 2016, about a quarter of all sales will fall at the share of sports and energy drinks [1].

The share of dietary and low-caloric drinks in the market can reach 15%. Now the market is dominated by such tastes as cola, orange and lemon, but the modern consumer is looking for novelties and is ready to perceive new tastes, including mixed ones. The key trends in the world market are reflected in the Russian reality. According to Inteso Research Group experts, the segment of "healthy" drinks with a low content of sugar and calories, which includes natural ingredients, is actively developing in the Russian and Kazakh markets. Most producers of mineral water expand the assortment through lemonades based on natural components [2].

As for tastes, two opposite tendencies are observed: return to traditions and revival of classical tastes (which are considered by consumers as healthier and more natural), and the second direction is expansion of the assortment due to new, unexpected, exotic tastes (for example, coffee, rose). First of all, the growth of supply in this category is aimed at young people who are willing to try new things. As a rule, these are drinks of the middle and upper price category. Drinks made on natural raw materials (juices, syrups, extracts, tinctures), are characterized by a significant content of sugar (10–12%, and recently 5–6%).

Tonic (refreshing) drinks contain tonic infusions and extracts, owing to that these drinks can relieve fatigue and have a thirst-quenching effect. Thus, "Sayana"drink contains infusions of magnolia vine, leuzea. Composition of "Baikal" drink includes infusions of eucalyptus, laurel and some other plants. "Stepnoy" drink is prepared on the basis of infusions of walnut of milk-wax maturity, hypericum, milfoil, liquorice, orange, vanilla grass [3].

Vitaminized drinks have increased content of vitamin C, introduced as an ascorbic acid or as a part of high vitamin extracts of juices and infusions (lemon, orange, blackcurrant). When using fruit and berryhalf-finished products, drinks are simultaneously enriched with vitamin P.

It is proposed to use natural supplements using SKO drug plants in this paper. Such composition of cold drinks allows not only to allay thirst, but also to compensate necessary vitamins and other useful substances in a human body. There are more than 20,000 plant species in Kazakhstan, 6,000 of which contain biologically active substances [4]. But there are other compounds in the composition of plants that are not desirable in the composition of drinks. Therefore, it is very important to separate and obtain necessary biologically active compounds, which positively influence the useful and organoleptic properties of drinks. We have studied trends and prospects of the market of various soft drinks in Kazakhstan and abroad. The assortment of vitaminized drinks or as they are called "tonics" is increasing every year, since these drinks can relieve fatigue, have a thirst-quenching effect, and also have other medical properties.

It is established that a man is adapted to the consumption of a large number of biologically active substances, the sources of which are representatives of more than 300 plant genera [5]. With plant food, a man receives necessary nutrients, as well as vitamins and minor elements, and not only that. Studies in recent years have identified the need for many

minor components of plant food to preserve health and, to a greater extent, reduce the risk of developing a number of chronic diseases. These components are called chemoprotectors or chemopreventers. Among the most intensively studied natural chemopreventive compounds are flavonoids, food indoles andisothiocyanates, dietary fibers, etc. Although the clinical picture of phyto-compounds' insufficiency is not established, their low concentration in the diet is accompanied by a significant increase in the risk of developing cardiovascular, oncological diseases, diabetes. Some researchers even consider such diseases as manifestations of the state of maladaptation as a result of the constantly low intake of components with food that are absolutely necessary to ensure the protective-adaptive capabilities of a human body. Exceptionally important and the only reliable means of improving the structure of nutrition and achieving the optimal balance of the diet of the population is use in daily diet of healthy and sick people the biologically active additives to food (dietary supplements). In our work we tried to analyze advantages and disadvantages of biologically active additives, and also reflect state of the dietary supplements in Kazakhstan and the most pressing problems associated with production and sale of this product through the pharmacy network.

For production of dietary supplements, food and drug plants are used that contain a rich complex of biologically active substances such as bioflavonoids, vitamins, polysaccharides, amino acids, minor elements, etc. Modern technologies and equipment allow not only extract the whole complex as much as possible, but also preserve its natural combination. Often this leads to the fact that bioavailability and effectiveness of each of the biologically active substances is greatly enhanced. For example, phenolic compounds are more active in combination with polysaccharides, vitamin C is more effective in combination with flavonoids (rutin). Concentration of biologically active substances in extracts from plants is such that it allows then to use the obtained food additives in relatively small amounts (doses), sufficient for both prevention and complex therapy of diseases. Use of a large assortment of drug plants containing various natural substances allows create dietary supplements to food with wide possibilities for correcting various disorders in a human body. As already noted above, it is inadmissible to use highly toxic natural products – poisonousand drastic drug plants in the composition of dietary supplements. Dietary supplements to food are not strictly dosed and controlled means, they are recommended to people of any age and therefore cannot contain substances with possible toxic properties. To obtain a dietary supplement to food, official plants are used. They are relatively well studied in terms of chemical composition and pharmacological properties. At that, a more in-depth study of these parameters is often carried out. This allows obtain new information and expand the scope of many drug plants.

For example, milfoil extract *(Achilleamillefolium)* is known as a stomachic medication, used as a drug and dietary supplement to food –"Akhillan"– in gastritis and ulcer disease. However, it has been experimentally established that the milfoil extract also charms away enterospasmand at the same time has a mild, laxative effect, all along the intestine. Unlike traditional laxatives (senna, buckthorn), which, incensing the intestines, release only its lower parts, causing colicky pains in the small intestine.

Bottlebrush *(Equisetum arvense L)*, which is a part of "Urolizin" additive, is awell-known drug plant recommended for diseases of kidneys and urinary tracts as an anti-inflammatory and diuretic agent. Experimental studies have established that bottlebrush extract does have a pronounced diuretic effect, but this effect is not accompanied by excretion of potassium and sodium salts from a human body, which is a great advantage over synthetic diuretics – furosemide, hydrochlorothiazide, acetazolamide.

Chamomile (Matricária) has long been used as an anti-inflammatory, hemostatic agent, as well as in the treatment of various diseases. Medical properties

of wild chamomile are the most pronounced. Effectiveness of other varieties is lower and therefore they are applied less often. The plant is found in meadows, along roads, as a drug it is specially grown in gardens. Prepared domiciliary chamomile formulations help to cope with viruses, colds, inflammation, charm away spasm, allergy, convulsions, anesthetize. Chamomile formulations help in case ofparasecretion of digestive glands, in gastritis, peptic ulcer, and remove edema of mucous coat of stomach.

We have obtained dietary supplements and found optimal conditions for the process and identified target products – biologically active additives by the methods of thin-layer and column chromatography, as well as IR, NMR, mass spectrometry methods [6]. The flavor syrup is a concentrated solution of all components that make up flavor and aromatic base of the drink. The flavor syrup is made by mixing sugar syrup with all components of the drink, except for soda water, or by boiling fruit and berry half-finished productswith sugar. The flavor syrups are prepared by a cold, hot or semi-hot way.

The cold way of preparing the flavor syrup: all half-finished products are put into the blending tank with mixing in a certain sequence according to the principle: from less to more aromatic types of raw materials. All is thoroughly mixed and filtered until complete transparency. The cold method is used for drinks on citrus infusions, concentrates, compositions, aromatic infusions and essences.

The semi-hot and hot methods are used if the flavor syrup composition includes juices and wines, for their dealcoholization and evaporation.

Drinks are prepared only on drinking water (GOST 2874).

Choice of technology for water treatment depends on its properties. Muddy water, not amenable to filtration, is settled for a day or more. If the process ofwater settling and its clarification is slow and inefficient, water impurities are coagulated. In necessary cases, water suspensions of different molecular weight are removed by filtration.

Water is passed through coal-sand filters to free it from foreign odor, dechlorination or discoloration. Iron compounds are removed from water by aeration, coagulation, liming and cationing.

In case the water is hard, it must be softened in various ways. Ion exchange is the most commonly used. In practice, Na-cationization and H-cationization are used for this purpose. H-cationization of water, in which a significant decrease in pH value occurs, obtained a wide distribution in nonalcoholic industry.

Food lemon, tartaric, orthophosphoric, lactic, ascorbic and sorbic acids are usedin production of soft fruit drinks. From these acids, the latter two are used only to increase persistence of drinks. The most widespread is lemon acid. Alcoholic infusions and extracts, as well as essences from plant raw materials are used to aromatize drinks. Ether oils and some synthetic aromatic substances are widely spread.

The developed recipes for enriched cold drinks using dietary supplements derived from SKO drug plants have high biological activity. The obtained cold drinks will be the first domestic products, obtained with the use of SKO drug plants.

References:

1. Pomozova V. A., Kiseleva T. F., Poznyakovsky V. M. Expertise of drinks, quality and safety.– Kemerovo: Kem TIPP, 2010.– 231 p.
2. Pushkareva Ye. F., Nikitina Ye. V., Gabinskaya O. S. Market of soft drinks: state and perspectives.– M.: Publishing house "KUBiK", 2016.– 137 p.
3. Shuman G. Soft drinks, raw materials and standard specifications.– SPb: Profession, 2011.– 278 p.
4. Turebekova G. Z., Shapalov Sh. K., Issayeva R. A. Prospects for using South Kazakhstan plants // Environmental and engineering aspects for sustainable living: International symposium.– Hannover, 2016.– P. 44–46.

5. Barnaulov O. D. Introduction into phytotherapy.– SPb.: Publishing house Lan', 1999.– 160 p.
6. Turebekova G. Z., Pusurmanova G. Zh., Shyngysbayeva Zh. A. Obtaining Biologically Active Additives From Medicinal Plants Growing in the Territory of the Republic of Kazakhstan // Sakharov readings 2017: Environmental problems of the 21 century.–Minsk, 2017.– P. 36–38.

Section 2. Mathematics

Duka Anila,
Ph D., candidates in mathematics,
the Faculty of Natural Siences
NdricimSadikajUniversity "Ismail Qemali", Vlora
E-mail: anila.duka@univlora.edu.al, ndricim.sadikaj@univlora.edu.al

APPLICATION OF CONFORMAL AND QUASICONFORMAL MAPPINGS IN HUMAN SPLEEN

Abstract: We will use the algorithm in [2] which is a general method for global conformal parameterizations based on the structure of the cohomology group of holomorphic one-forms for surfaces with or without boundaries Gu and Yau, 2002, Gu and Yau, 2003. For genus zero surfaces, this algorithm can find a unique mapping between any two genus zero manifolds by minimizing the harmonic energy of the map. In this paper, we apply the algorithm to spleen surface matching problem. We use a mesh structure to represent the spleen surface. This algorithm is more stable, compared with other genus zero surface conformal mapping algorithms.

Keywords: Tuette energy, quasiconformal mapping, Riemann surfaces.

1. Introduction

Conformal mapping are mappings which preserves the angles, and quasiconformal mappings are generalization of them, in [1] you can find more information. Conformal geometry has been widely applied in medical imaging and computer graphics, such as in brain registration and texture mapping, where the mappings are constructed to be as conformal as possible to reduce geometric distortions.

Examining deformations with human eye is inappropriate and inefficient, for this reason is good to develop automatic methods to track and detect abnormalities.

The spleen is very important in human body, it plays multiple supporting roles.

It acts as a filter for blood as part of the immune system. There old red blood cells are recycled and there are stored platelets and white blood cells. Certain kinds of bacteria that cause pneumonia and meningitis are fight by it.The spleen surface is a genus zero surface, so, we will use these algorithms only for the case of genus zero surface.

1.1 Previews work

For surfaces with arbitrary topologies, Gu and Yau [2] introduce a gen-eral conformal parameterization based on a nonlinear flow for the genus zero case, and on the structure of the cohomology group of holomorphic one-forms in the case of genus greater than one. In this paper, we apply part of these algorithms (for the genus zero case) to the spleen surface matching problem and report our experimental results. We know that all orientable surfaces are Riemann surfaces. If two surfaces can be conformally mapped to each other, they have the same conformal structure. So, computing conformal mappings is the same as computing conformal structures for surfaces. Harmonic maps are equivalent to conformal maps of genus zero closed surfaces. There are

many algorithms for surface parameterization which are based on harmonic maps. To achieve conformal parameterizations are used Harmonic energy minimization, Cauchy-Riemann equation approximation, Laplacian operator linearization, angle based method, circle packing.

1.2 Mathematical work

Suppose S_1, S_2 are two surfaces. Locally they can be represented as $r_1(x^1, x^2)$, $r_2(x^1, x^2)$ where (x^1, x^2) are their local coordinates, and $r_1, r_2 : R^2 \to R^3$ are vector-valued functions. We find the first fundamental form of them and define a mapping between two surfaces. We use the pull-back metric and we call f a conformal mapping, if there exists a positive scalar function, such thatf $f * ds_2^2 = \lambda\left(x^1, x^2\right) ds_1^2$, where $\lambda\left(x^1, x^2\right)$ is called the conformal factor. All the angles on are preserved on.

It is well known that any genus zero surface can be mapped conformally onto the sphere and any local portion thereof onto a disk. This mapping, a conformal equivalence, is one-to-one, onto, and angle-preserving. Moreover, the elements of the first fundamental form remain unchanged, except for a scaling factor.

Conformal mappings are similarities in the small. Since the spleen surface is a genus zero surface, conformal mapping offers a convenient method to take local geometric information.

This algorithm depends only on the surface geometry and is invariant to changes in image resolution and the specifics of the data triangulation. Given two genus zero meshes M_1, M_2, there are many conformal mappings between them.For genus zero surfaces S_1, S_2 $f : S_1 \to S_2$ is conformal if and only if f is harmonic. All conformal mappings between S_1, S_2 form a group, the Möbius group.

Our method is summarized as follows: we first find a homeomorphism h between S_1, S_2, then deform h such that h minimizes the harmonic energy.

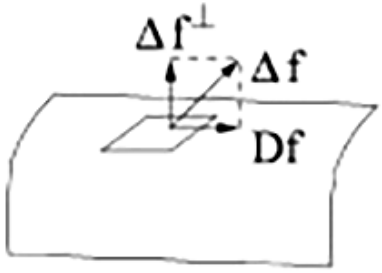


Figure 1. Decomposition of Laplacian operator

Definition 1: All piecewise linear functions defined on form a linear space, denoted by $C^{PL}(K)$.

In practice, we use $C^{PL}(K)$ to approximate all functions defined on K. So the final result is an approximation to the conformal mapping. The higher the resolution of the mesh is, the best approximated conformal mapping is.

Definition 2: Suppose a set of string constants are as-Signed $k_{\{u, v\}}$ for each edge {u, v}, the inner product on C^{PL} is defined as the quadratic form

$$< f, g >= \frac{1}{2} \sum_{\{u,v\} \in K} k_{\{u,v\}} \left(f(u) - f(v)\right)\left(g(u) - g(v)\right).$$

The energy is defined as the norm on C^{PL}.

Definition 3: Suppose f ∈CPL, the string energy is defined as

$$E(f) = < f, f >= \sum_{\{u,v\} \in K} k_{\{u,v\}} \left\| f(u) - f(v) \right\|^2.$$

If $k_{\{u, v\}} = 1$, is called Tuette Mapping.

We see the other definitions in [2].

2. Conformal map for genus zero closed surfaces

Genus 0 closed surfaces can be conformally parameterized over a unit sphere, and harmonic maps of these surfaces are equivalent to conformal maps. We use a Gauss map as the initial map, and then we use the heat flow method to reduce the harmonic energywith special constraints. The final harmonic

map is a global con-formal parameterization. By composing it with a Möbius map of the sphere, we can obtain all possible global conformal parameterizations. The Möbius transformation on the complex

$$\mu(z) = (az+b)/(cz+d), ad-bc \neq 0.$$

A genus zero open surface can be globally conformally parameterized by the unit disk. Two such kinds of parameterizations differ by a Möbius transformation defined on the disk.

3. Mesh parametrization

In the digital geometry, surfaces are mostly represented as triangular meshes, because they are supported by graphics hardware. For display purposes all surfaces need to be converted to triangular meshes [2] In theory, any surface with C^1 continuity can be triangulated, here are based theories of simplical homology and cohomologies in topology.

In practice, all surfaces in real life can be digitalized with 3D scanners.

A triangular mesh is a two-dimensional simplical complex in algebraic topology.

Or we can say that a mesh is a set of triangular faces coherently glued together.

Connectivity gives us all topological information.

A mesh is embedded in R^3, all vertices have Euclidean coordinates and all faces are planar triangles. The lengths of all edges are induced by The Euclidean metric of R^3.

Except at the vertices a mesh is flat everywhere. Meshes help us to solve topological problems, but for differential forms, curvatures, geodesics and conformal mapping can only be solved by approximation.

Mesh parametrization has many applications like Detail Mapping, Texture Mapping, Normal Mapping, Detail Transfer, Morphing, Mesh Completion, Editing, Databases, Remeshing, Surface Fitting.

4. Algorithms

Algorithms used here are Spherical Tuette Mapping and Spherical Conformal Mapping.

Algorithm 1: Spherical Tuette Mapping: Input (mesh *M*, step length, energy difference threshold δE), output ($\vec{t} : M \to S^2$), where $\vec{t}$ minimizes the Tuette energy.

1) Compute Gauss map $N : M \to S^2$. Let $\vec{t} = N$, compute Tuette energy E_0.

2) For each vertex $v \in M$, compute absolute derivative $\Delta\vec{t}$.

3) Update $\vec{t}(v)$ by $\delta\vec{t}(v) = -\Delta\vec{t}(v)\delta t$

4) Compute Tuette energy *E*.

5) If $|f|E - E_0\| < \delta E$, return $\vec{t}$. Otherwise, assign *E* to E_0 and repeat steps 2) –5).

The Tuette energy has a unique minimum, the algorithm converges rapidly and is stable. We use it as the initial condition for the conformal mapping.

Algorithm 2: Spherical Conformal Mapping: Input (mesh *M*, step length, energy difference threshold δE), output ($\vec{h} : M \to S^2$), where $\vec{h}$ minimizes

The harmonic energy and satisfies the zero mass-center constraint.

1) Compute Tuette embedding $\vec{t}$. Let $\vec{h} = \vec{t}$, compute Tuette energy E_0.

2) For each vertex $v \in M$, compute absolute derivative $\Delta\vec{t}$.

3) Update $h(v)$ by $\delta\vec{h}(v) = -\Delta\vec{h}(v)\delta t$.

4) Compute Möbius transformation $\overrightarrow{\varphi\_0} : S^2 \to S^2$, such that $\Gamma(\vec{\varphi}) = \int_M \vec{\varphi}\ o\vec{h}\ d\sigma M$, $\varphi \in Mobius(S^2), \overrightarrow{\varphi_0} =$ $= \min \|\vec{\varphi}\|^2$, where $d\sigma M$, is the area element on *M*, $\Gamma(\vec{\varphi})$ is the mass center and φ minimizes the norm in the mass center condition. $Mobius(S^2)$ is the conformal automorphism group of (S^2), and it can be analytically represented as $\tau^{-1}0 \cdot \theta o \tau$, where $\tau : S^2 \to C$ is the stereographic projection

$$\tau(p) = \left(\frac{x}{1-z}, \frac{y}{1-z}\right), p(x,y,z) \in S^2$$

and θ is a Möbius transformation as defined in Definition 11 in [2].

5) compute the harmonic energy *E*.

6) If $|f|E - E_0\| < \delta E$, return $\vec{t}$, return. Otherwise, assign *E* to E_0, assign and repeat Step 2) through to Step 6).

This approximation method is good enough for our purpose.The resulting angle distortion is propor-

tional to the square of the distance between the mass center and the origin.

With some constraints, u maps infinity to infinity, $u = az + b$, p_i, q_i are landmarks [7] on the surfaces. So the functional of u is:

$$E(u) = \sum_{i=1}^{n} g(z_i) \left\| az_i + b - \tau_i \right\|^2,$$

where z_i is the stereographic projection of p_i, τ_i is the projection of q_i ang g is the conformal factor from the plane to the sphere,

$g(z) = \frac{4}{1 + z\bar{z}}$, so it is converted in a Least Square Problem.

5. Application in Human spleen

Human spleen is a genus zero surface, we can use the algorithm for genus zero to find a conformal spherical map.

Figure 1. 3D human spleen and spherized spleen

This algorithm uses covariant differentiation to solve a geometric nonlinear partial differential equation. The complexity of the algorithm is O(m, n), where m is the number of the vertices of the spleen mesh, n is the number of required iterations, n mainly depends on the initial condition, so, how close it is to a conformal map, n also depends on the step length. In [2] Table II illustrates the CPU time for computing conformal maps of surfaces of different triangle numbers on a 1.9-GHz PC with the Windows XP operating system. This nonlinear algorithm has some advantages: 1) Every point on the spleen is treated in a uniform way, so, no point maps to infinity as in other algorithms. This means that, there are no specific areas with large distortion; 2) The method is general, because it does not require the target surface to be a sphere. It can be used to compute harmonic maps between any two arbitrary genus zero surfaces.

If the distortion is greater we have a quasiconformal mapping, so we can use other methods to find it. It is known that the growth is conformal, but disease is quasiconformal. We can use Beltrami coefficient method or Yamabe flow or other methods to test if there is a problem.

6. Conclusions

The algorithm finds a unique conformal mapping between genus zero manifolds. So, we can detect abnormalities in early stages in spleen surface. This method depends only on the surface geometry, not on the mesh structure and resolution. This algorithm is very fast and stable.

References:

1. Ahlfors L. V. Lectures on quasiconformal mappings, University Lecture Series 38(2006), Amer. Math. Soc., Providence, RI.
2. Gu X., Wang Y., Chan T. F., Thompson P. M., and Yau Sh. Genus Zero Surface Conformal Mapping and Its Application to Brain Surface Mapping. Ieee Transactions On Medical Imaging,– Vol. 23.– No. 8.– August, 2004.
3. Gu D., Sh-T. Yau. Computational Conformal Geometry, ALM3, ISBN978-1-57146-171-1.
4. Periodic conformal maps. Sechelmann S., Rorigh T.
5. Springborn B., Schroder P., and Pinkall U. 2008. Conformal equivalence of triangle meshes. ACM Trans. Graph. 27, 3 (Aug.), 77: 1–77: 11.
6. Levy B. S. Petitjean N. Ray J. Mallyot. Least Squares Conformal Maps for Automatic Texture Atlas Generation. SIGGRAPH 02
7. Jin M., Wang Y., Gu D., Yau Sh-T. Optimal Global Conformal Surface Parameterization.

Section 3. Medical science

Tastanova Gulchekhra Eshtayevna,
candidate of medical sciences,
associate professor, department of anatomy
Tashkent State Dental Institute
E-mail: tastanovag@bk.ru

Safarova Kamola Xamrayevna,
student, Faculty of Dentistry
Tashkent State Dental Institute
E-mail: safarova.kamola98@mail.ru

Tagaeva Adel Yusufovna,
student, Faculty of Medicine and Pedagogy
Tashkent State Dental Institute
E-mail: adel-13_95@mail.ru

ENDOTHELIAL DYSFUNCTION AS A PREDICTOR OF CHANGES IN SYSTEM A MOTHER-PLACENTA-FETUS AT THE COMPLICATED PREGNANCY

Abstract: Were elucidate changes in the NO content, eNOS and iNOS activity, ONO^{2-}, VEGF, VEGFR-2 rate in the placenta and umbilical cord blood of a newborn after pregnancy with hypochromic anemia and gestosis. In pregnancy, complicated by gestosis and hypochromic anemia, unidirectional disturbances in the NO-system are noted – inhibition of e-NOS activity against the background of NO, i-NOS and ONO^{2-} expression. The development of endothelial dysfunction in the mother-placenta-fetus system is combined with the expression of ET-1, VEGF and its VEGFR-2 receptor, which can cause the development of structural disorders in the placenta, disorders of angiogenesis in it and as a consequence the development of placental insufficiency, pre – and postnatal fetal pathology.

Keywords: vascular endothelium, angiogenesis, vascular endothelial growth factor, nitric oxide, hypochromic anemia, gestosis.

Now days the problem of importance of the endothelial dysfunction (ED) of vessels in formation of pathological process in functional system a mother-placenta-fetus is widely discussed [1; 3]. Interest in the specified problem is that an angiogenesis in a placenta and a becoming of an uterine-placental and feto-placental blood flow – the key events which are necessary for ensuring the main function of a placenta – exchange of oxygen and nutrients between a maternal organism and the growing fetus. It is established that whether throughout the entire period of a gestation in a placenta with big smaller intensity two processes proceed: vasculogenesis – formation of vessels of their cages predecessors of angioblast

and angiogenesis – formation of new vessels from already existing.

The modern representation about vascular endothelium underwent some changes, so at the moment endothelium is considered not only as the semi-permeable membrane, but also as the active endocrine organ. The major functions an endothelium – maintenance of a hemo vascular homeostasis, regulation of a hemostasis, inflammation modulation, regulation of a vascular tone and permeability of vessels. In addition, the existence of renin-angiotensin system was revealed. All these functions of endothelium of vessels realizes the blood circulations directed by synthesis, and release of the active different biological agents, which are used for balanced work of the blood circulatory system.

An essential role in regulation of a local tone of vessels is played synthesis level in an endothelium of nitrogen oxide (NO) which is formed of L-arginin with participation of a nitric oxide synthase (e-NOS), and at pathological conditions of an inducible nitric synthase (i-NOS) [2]. In the conditions of a hypoxia the surplus in fabrics of super oxidic anion (O^{2-}) easily reacts with free NO, forming high-reactionary and toxic connection – peroxynitrite (ONO^{2-}) [6]. Now it is known that from a large amount of biologically active agents, which are secreted by endothelium, nitrogen oxide regulates activity of other mediators.

The important regulator of a tonus of vessels and level in an endothelium is endothelium (ET-1) – an endothelial vasopressor peptide [3; 7]. Now ET-1 is surveyed as a marker and a predictor of many pathologies, such as coronary heart disease, acute infarct, atherosclerosis, hestosis, feto-placental failure [1; 8].

The essential role in development of angiogenesis belongs to growth factor an endothelium of vessels (VEGF) [10]. VEGF realizes the angiogenic effects through the specific tyrosine kinase receptors located on a surface of endothelial cages – VEGFR – 1 (flt-1) and VEGFR-2 (flt-1/KDR) [11]. It is established that on endothelial cages mainly expresses VEGFR-2 and, apparently, VEGF carries out the biological effects through linking with these receptors [10]. The inductor of synthesis of VEGF is endogenous NO [5]. There are data that endogenous NO can either oppress, or activate inducible hypoxia VEGF factor gene depending on a redox-condition of a cage.

Therefore, among the reasons there is development of pathology of pregnancy, pre-and post-natal death of a fetus, can be the processes of the dysfunction endothelium (DE) connected with violations of activity of endothelial system and regulation of angiogenesis at the level of feto-placentary blood circulation. Due to above stated, the purpose of our research was to analyse changes of maintenance of NO, activity of e-NOS and i-NOS, the ONO^{2-}, VEGF, VEGFR-2 in a placenta and umbilical blood of the newborn after pregnancy with hypochromical anemia and hestosis.

Materials and methods of research

The survey included 81 biological objects: placenta and serum of umbilical cord blood of newborns, which were distributed into 3 groups. Group 1-placenta and umbilical cord blood from 30 women after pregnancy with gestosis (pronounced edema, systolic blood pressure more than 170 mm Hg. St., proteinuria 3 g/l), group 2 – from 31 women after pregnancy with hypochromic anemia (Hb less than 10 g / 100 cm3) and group 3 – control, from women with physiological pregnancy.

Births in the control group, at 38–40 weeks of gestation (39.4 ± 2.83 weeks), proceeded without complications, ended with the birth of aalivechild without signs of pathology. In puerperas with gestosis and anemia, labor occurred at 34–38 weeks (36.5 + 2.9) of gestation with various complications: the development of fetoplacental insufficiency, premature aging of the placenta, premature detachment of the normally located placenta, the threat of premature termination of pregnancy and early childbirth, intrauterine fetal hypoxia, delay in fetal development, spontaneous miscarriages, low placentation.

In biopsies and serum levels of NO were determined by the content of its main stable metabolites ($NO2^-$ and $NO3^-$) using Griess reagent [2]. The activity of e-NOS for changing the education product of NO from L-arginine in the presence HADSH, the activity of I – NOS by the change of speed of the reaction HADSH-dependent nitroreductase [8], ONO^{2-} oxidation of hydroxylamine. The level of ET-1, as well as VEGF and VEGFR-2 were determined using the enzyme immunoassay at-858 (LTD., China) using standard kits "Human ET-1", "VEGF Elisa" and "VEGFR-2Ymmunoassan" (R&D System, USA). During comparison and analyzing the interaction of indications used nonparametric and parametric tests: U-criterion Hann-Whitney, median test, the test of Sperman's rank correlation. The significance of differences between the groups was considered at $p < 0.005$. For processing of the obtained data was performed using a licensed Statistic's software package (version 5.1 Statsoft).

Results and discussion

Analysis of the data shows that both placenta and serum umbilical cord blood of newborns after pregnancy with gestosis and anemia showed a statistically significant increase NO concentration against the background of reduced e-NOS activity. However, the level of I-NOS activity and the content of ONO^{2-} significantly exceeded the data in the control. It can be assumed that the increase in placenta and umbilical cord blood of newborns NO was associated with the expression of i-NOS, as e-NOS, was depressed. According to literature the expression of i-NOS is accompanied by the synthesis of NO in excess of e-NOS100–1000 times [5]. With an increase in the level of NO in the placenta and umbilical cord blood of newborns, we associate a significant increase in them ONO^{2-} [2]. According to the literature, the expression of exogenous NO, i-NOS and ONO^{2-} can serve as one of the main reasons for the development of the vasoconstrictive effect, violations of the processes of micro – and macro-circulation, metabolicdisorders in the tissues, accelerating the cell apoptosis and necrosis [7]. These data are confirmed in our studies in the morphological assessment of the placental structure of pregnant women with gestosis and hypochromic anemia. It should be noted that in placenta with gestosis, compared with hypochromic anemia, an increase in the volume of interstitial fibrinoid was more often found against the background of thrombosis of the interstitial space, adhesion and deformation of the villi, areas with heart attacks and petrifications, in all placenta, angiomatosis equally. In placenta with women anemia often found syncytial nodules (kidneys), increasing the number of subepithelial capillaries located in terminal villi. In the same group, in placents is more likely to have a variant of intermediate differentiated villi, placenta of pregnant women with gestosis has a variant of chaotic sclerosed villi in the assessment of pathological immaturity of the placenta.

Can put that in the disruption of the structure of the placenta in postpartum women with gestosis and anemia plays a major role expression of VEGF and its receptor VEGFR-2, and Takei ET-1. Increasing the level of VEGF and VEGFR-2 we regard as a compensatory reaction in the placenta to increase its oxygen supply and nutrients. At the same time, it can play a crucial role in stimulating the Pro-angiogenic factor. This process is facilitated by a significant increase in ET-1. Expression of ET-1 leads to vasospasm, stimulation of iNOS, persistent increase in exogenous NO and NO^{2-}, which have a toxic effect on the vessels of the fetoplacental complex.

By doing so, the analysis of the obtained data suggests that among many causes in the pathogenesis of placental insufficiency, pre – and postnatal pathology of the fetus during pregnancy, complicated by the development of gestosis and hypochromic anemia are endothelial dysfunction processes associated primarily with impaired synthesis of endothelial nitric oxide (NO) in angiogenesis process. These data are confirmed by morphological changes in the placenta: abnormalities in the shape of the placenta, an increase in the volume of interstitial fibrinoid,

subepithelial localization of capillaries in terminal villi, an increase in the number of syncytial nodules, against the background of various variants of maturation of the villous chorion, as well as disorders of macro – and microcirculation in the functional system of the mother-placenta-fetus.

Conclusions

1. Placenta and serum of umbilical cord blood of newborns during pregnancy complicated by gestosis and hypochromic anemia show unidirectional disorders in the NO-system – inhibition of e-NOS activity on the background of NO, i-NOS and ONO^{2-} expression.

2. The development of ED (endothelial dysfunction) in the mother-placenta-fetus system is combined with the expression of ET-1, VEGF and its VEGFR-2 receptor.

3. The development of DEP in the system mother-placenta-fetus, expression of ET-1, VEGF and its receptor VEGFR-2 can serve as an important reason for the development of structural changes in the placenta, disorders of angiogenesis, and as a consequence the development of placental insufficiency, pre – and postnatal pathology of the fetus during pregnancy complicated by preeclampsia and hypochromic anemia.

References:

1. Avrutskaya V. V., Orlov V. I., Ponomareva A. Yu., Changes in the endothelial vascular system of pregnant women with gestosis // ROS. Journal of … – gynecologists'. 2007.– No. 1.– P. 4–6.
2. Aylamazyan E. K., Alimhadzhiev M. A., Kostyuchek I. N. etc. the Identification of endothelial NO-synthase in the placenta and nitric oxide in serum of pregnant women in the comprehensive assessment of the effectiveness of treatment of preeclampsia // Arch.pat. 2010.– No. 1.– P. 26–29.
3. Klimov V. Endothelium of fetoplacental complex in physiological and pathological course of pregnancy. and gynecol. 2008.– No. 2.– P. 7–10.
4. Manukhina E. B., Downey H. F., Mallet R. T., Malyshev I. Yu. Protective and damaging effects of peripheral hypoxia: role of nitric oxide // Vestn. RAMS.– 2007.– No. 2.– P. 25–33.
5. Markov H. M. Molecular mechanisms of vascular endothelial dysfunction // Cardiology. 2005.– No. 12.– P. 62–72.
6. Nikitina L. A., Demidov E. M., Radzinsky V. E. et al. Role of matrix proteins, cytokins and angiogenesis factors of uterine placental complex in regulation of implantation and placentation // … and gynecol. 2007.– No. 3.– P. 5–10.
7. Sharygin S. A., Saryeva O. P., Peretyatko L. P., Posiseeva L. V. Additional markers of placental insufficiency in gestosis, accompanying violations of labor activity. pat. 2008.– No. 2.– P. 12–14.
8. Adams J., Carder P. J., Downey s. et al. Vascular endothelial growth factor (VEGF) in breast cancer: comparison of plasma, serum and tissue VEGF and micro vessel density and effects of tamoxifen // Cancer Res. 200.– Vol. 60.– P. 2898–2905.
9. Ferrara N. The role of VEGF in the regulation of physiological and pathological angiogenesis // Experien. Suppl. (EXS). 2005.– Vol. 94 – P. 209–231.
10. Shibuya Ito N., Caesson-Weish L. Structure and function of vascular endothelial growth factor receptor –1 and –2 // Curr. Top. Microbiol. Immunol. 1999.– Vol. 237.– P. 59–83.
11. Soeirs V., Atkin S. L. Production of VEGF and expression of the VEGF receptors Fit – 1 and KDR in cultures of epithelial and stromal cells derived breast tumors // Brit. J. Cancer. 1999.– Vol.– 80.– P. 898–903.

Section 4. Food processing industry

Sabirova Nargiza Nusratovna
Majidov Kahramon Halimovich
Bukhara Engineering-Technological Institute,
Republic of Uzbekistan,
E-mail: kafedra-03@mail.ru

CHARACTERISTICS OF NEW KINDS OF SHORTENINGS

Abstract: shortenings based on hydrogenated cotton oils are characterized with high quality indicators and physico-chemical characteristics. The range of plasticity shortening depends on the choice of fatty basis. The use of hydrogenated fats increases the shortening resistance to fat oxidation. The composition of shortening and the technology of its production ensures the ability of fats to withstand large fluctuations in the temperatures of processing and preserving their structure.

Keywords: shortening, hydrogenated cottonseed oil, hard fats, iodic number, hard triglyceride content, rangeof plasticity, consistency, quality indicators.

Shortenings are suspensions of crystal-like fats in oil or semi-liquid fats [1,2]. Shortening properties give a variant of fat that allows using this product both for baking and for frying [3]. The composition of shortening used in catering includes 3–15% of fully saturated hard fats crystallizing in the -form, the base is a soft partially hydrogenated fat, i.e. a mixture of hard animal fat with vegetable oil, or a interesterified fat [4,5]. Shortening is used for frying, and it has a higher stability during frying than most products based on vegetable oils [6].

Liquid shortening and shortening with plastic properties are distinguished [7]. Production of shortenings is carried out by melting the hard phase and subsequent cooling under the influence of shearing forces. At the same time, crystals are formed which, in liquid shortening, have a size of from 5 to 10 microns. The content of hard, refractory fats in liquid shortening is 5–30% [8].

The shortenings were prepared under laboratory and experimental conditions using hydrogenated cottonseed oil and hard fats. The composition of shortening is given in table 1.

Table 1. – Composition of new kinds of shortenings

Name of fatty raw materials	Content of components,%						
	Vegetable raw materials			A mixture of raw materials of animal and vegetable origin			
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Hydrogenated cottonseed oil, J_n 80	90.0	–	–	–	–	–	91.0
Hydrogenated cottonseed oil, J_n 88	–	88.0	–	–	–	89.0	–
Hydrogenated cottonseed oil, J_n 96	–	–	–	35.0	–	–	–

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Hydrogenated cottonseed oil, J_n109	–	–	–	14.5	–	–	–
Ro palm oil	–	–	91.0	55.0	–	–	–
Hard animal fat	–	–	–	–	82.5	–	–
Hydrogenated cottonseedoil, T = 60	10.0	–	–	–	–	–	–
Palm oil, T = 56	–	12.0	9.0	10.0	–	–	–
Hard animal fat, T = 59	–	–	–	–	3.0	11.0	9.0
Content of TTG,% at: 10.0 °C 26.7 °C 40.0 °C	 26 20 No less than 9	 31 20 11		 25 18 10		 32 21 No less than9	

Note. J_n – iodicnumber, rJ_2/100 g; PO – refined and bleached; T – titer, °C.

As can be seen from the data table.1, new types of shortenings differ in the content and ratio of hydrogenated cottonseed oil and solid edible fats. To analyze the quality and physical-chemical characteristics of new types of shortenings, modern methods of physical-chemicalresearch have been used [9, 10]. The iodic number of solid triglycerides in fat shortening has been determined. The range of plasticity of the shortening has been established depending on the choice of the fatty basis — a mixture of hard animal fat with vegetable oiland solid fats.

The consistency was evaluated by measuring the penetration at a temperature of 26.7 °C, while the holding of solid triglycerides in both types of shortening at 26.7 °C ranged from 15 to 21%. The range of plastic deformation in accordance with this method lays between the values of penetration from 150 to 300 mm / 10 g. As a result of these tests, it was found that shortening of acceptable quality can be performed using any of the above mentioned fats as an approving component.

The functional properties of shortening depend on the solids content at a certain temperature. The composition of shortening was chosen in such a way that, at temperatures from 10 to 15 °C it was not too hard and did not become too soft at 32–38 °C.

The use of hydrogenated fats or oils increases the oxidation stability of shortening and frying stability. To the greatest extent, this occurs under selective hydrogenation conditions and a low iodic number of a mixture of hard animal fat with vegetable oil; however, non-selective hydrogenation provides a flatter melting curve and, accordingly, a wide range of plastic deformation.

An important characteristic of shortening is the range of plastic deformation, since the consistency depends on temperature. A product with a good plasticity range remains soft at low temperatures and hard at high temperatures. When an ideal plasticity range is reached, the product has the same, most desirable consistency at low and high temperatures.

The capacity for whipping and the plasticity range of shortening depend primarily on the correct choice of the fat base — a mixture of hard animal fat with vegetable oiland solid fats, secondly — on the condition of cooling and tempering. Shortenings with a wide range of plasticity are usually subjected to rapid cooling to a temperature of 15–21 °C, followed by a stage of crystallization or processing, then the shortening is packaged and tempered at 27 °C for 24–72 hours. The effect of tempering is shown in Fig. 1, on which shows the data shortening, stabilized with hydrogenated cottonseed oil with a titer of 60 °C and palm oil with a titer of 56 °C; tempering was carried out at a temperature of 26.7 and 29.4 °C for 48 h.

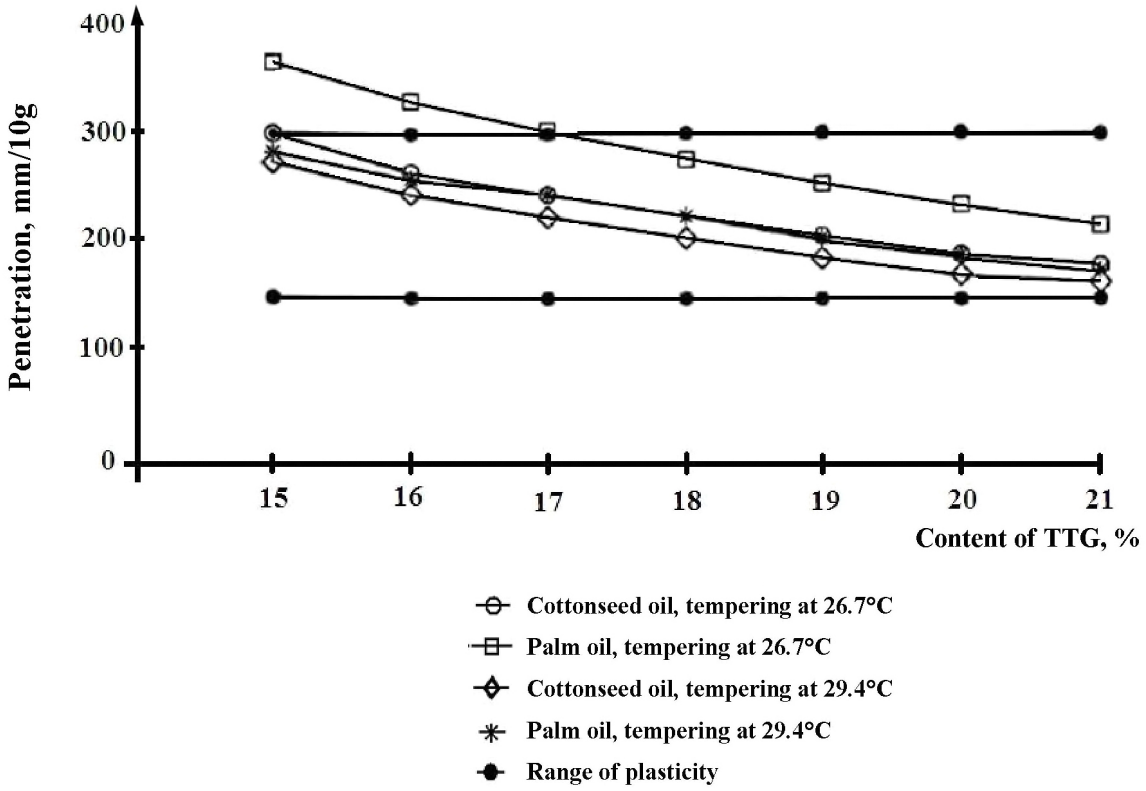


Fig. 1. The effect of tempering on the degree of penetration of fat shortening

The effect of tempering at temperatures of 26.7 and 29.4 °C on the shortening consistency, in which as solid fat was used hydrogenated cottonseed oil with a titer of 60 °C or palm oil with a titer of 56 °C, stabilized with hydrogenated cottonseed oil with a titer of 60 °C and palm oil with a titer of 56 °C; tempering was carried out at a temperature of 26.7 and 29.4 °C for 48 hours. The consistency was evaluated by measuring penetration at a temperature of 26.7 °C, while the content of TTG in both types of shortening at 26.7 °C ranged from 15 to 21%.

The studied and proposed fat shortening formulations are characterized by high quality indicators and solid triglyceride content. The use of hydrogenated cottonseed oil for the production of shortenings ensures the replacement of fatty products imported into the republic. The composition of shortening and the technology of its production ensures the ability of fats to withstand large fluctuations in the temperatures of processing and preserving their structure.

References:

1. Арутюнян Н. С. Технология переработки жиров.– М.: Колос,1999. – 368 с.
2. Тютюнников Б. Н. Технология переработки жиров.– М.: Пищевая промышленность, 1970.– 652 с.
3. Тютюнников Б. Н., Гладкий Ф. Ф. Химияжиров.– М.: Колос, 1992.– 448с.
4. Stevenson, S. G., Vaisey-Genser, M., Eskin, N. A. M. Quality control in the use of deep frying oils // JAOCS, 1984, 61, 1102–1108.
5. Weiss, T. J. Chemical adjuncts // Food Oils and Their Uses – 2nd ed.– Westport, CN: AVI Publishing. 1983.– P. 112–113.
6. Haumann. B. R. The goal, tastier and «healthier» fried foods // INFORM, 1996, 7, 320–334.

7. Min, D. B., Schweizer. D. Q. Lipid oxidation in potato chips, //JAOCS, 1983. 60. 1662–1665.
8. Vandaveer, R. L. Corn chip frying oils // Chipper/Snacker, 1985, May, 35–38.
9. Арутюнян Н. С., Аришева Е. А. Лабораторный практикум по химии жиров.– М.: Пищевая промышленность, 1979.– 176 с.
10. Стопский В. С., Ключкин В. В., Андреев Н. В. Химия жиров и продуктов переработки жирового сырья.– М.: Колос, 1992.– 286с.

Section 5. Agricultural sciences

Sadoyan Ruzanna,
Faculty of Biology, Chemistry and Geography,
Armenian State Pedagogical University
after Kh. Abovyan, Yerevan, Armenia
E-mail: ruzannasad@mail.ru

Azaryan Keti,
Department of Biochemistry, Microbiology and Biotechnology,
Yerevan State University, Yerevan, Armenia

Margaryan Kristine,
Department of Genetics and Cytology, Yerevan State University,
Yerevan, Armenia Research Group of Plant Genetics and Immunology,
Institute of Molecular Biology Yerevan, Armenia
E-mail: kristinamargaryan@ysu.am

EFFECT OF MELANIN ON THE YIELD OF WINTER WHEAT IN THE PRESOWING TREATMENT OF SEEDS

Abstract: One of the prospective aspects to manage the modern agriculture is involvement of biological substances in husbandry systems. Nowadays the innovative technologies of crop production by application of biologically active compounds are the most applicable and environment-friendly alternative which essentially improve the ecological state of agrophytocenosis and increased the efficiency due to integrative effects. The purpose of the presented study was evaluation of melanin influence as a natural stimulator on the quantitative and qualitative characteristics of winter wheat Syuniq. According to the obtained results the presowing treatment of seeds of winter wheat Syuniq using 0.07% of melanin solution positively influenced on the initial phases of ontogeny and further development of plants, promoting the improvement of biological and qualitative indicator parameters. The effect of melanin on the yield of winter wheat Syuniq in the presowing treatment of seeds was confirmed.

Keywords: winter wheat, seed, pesowing treatment.

1. Introduction

Armenia is landlocked country with limited natural resources, covering an area of 29800 km^2. It is located in Southern Transcaucasus, at the crossroads of Western Asia and Eastern Europe. Armenia is a typical mountainous country, where about 90% of territory is over 1000m above sea level, average height of territory makes 1830 m. Geographical situation of Armenia, complex mountain relief and high-altitude zoning of territory have caused unique variety of natural conditions and natural resources. The territory of Armenia is specific for strongly pronounced vertical alternation of six basic climate types – from dry subtropical up to severe Alpine, and

temperature contrasts, where only 47% of the total land fund is suitable for agricultural use.

At present, the agricultural sector remains essential for the economy of the country. Being poor land country Armenia has adopted and follow a policy mainly aimed at the most efficient use of lands and biodiversity preservation. Conservation of existed diversity and issues of human health have become increasingly important in the context of current global climate changes.

Towards the sustainable development strategy of agriculture and rural development 2010–2020 of Republic of Armenia the main problems encompasses following tasks: i) increasing land use efficiency, ii) development of organic agriculture, iii) improvement of food security and sufficiency.

During the last years in parallel with conventional agriculture, the organic agriculture as one of the promising alternatives has been developed in many countries. Organic agriculture is part of Armenia's sustainable development concept and is a priority area in the government's agro-food policy. It is a system that begins to consider potential environmental and social impacts by eliminating the use of synthetic inputs, such as synthetic fertilizers and pesticides, genetically modified seeds and breeds, preservatives, additives and irradiation. These are replaced with site-specific management practices that maintain and increase long-term soil fertility and prevent pest and diseases Avdeenko [2].

One of the prospective aspects to manage the modern agriculture is involvement of biological substances in husbandry systems Ghițău et al., [9]. Nowadays the innovative technologies of crop production by application of biologically active compounds are the most applicable and environment-friendly alternative which essentially improve the ecological state of agrophytocenosis and increased the efficiency due to integrative effects Azaryan et al., [4]. There are described different ways of application of biologically active compounds, which can be used in the presowing treatment of seeds and by root nutrition Pravin et al., [11].

It is well known that the efficiency of the growth stimulators differs depending on the type, mechanism of influence, density and exposure of the substance. The biological substances have a high activity even in small doses application, which in contrast to the synthetic growth stimulants widely used in conventional agriculture is a privilege Calvo et al., [5], Chojnacka [6]. Application of biologically active substances in agriculture has certain advantages: i) can be used at different stages of vegetation as they do not contain harmful elements and do not accumulate in the soil ii) contributes to the increase of photosynthetic surfaces and preservation of biochemical parameters of plant products iii) having organic origin are not affected on the environment and are mostly environment-friendly.

The highest physiological activity of bacterial melanin (BM) as potential stimulator for plant growth and development obtained at the Scientific Center of Biotechnology of the Republic of Armenia was confirmed Popov et al., [10]. The effectiveness of bacterial melanin was confirmed also during grape and stone fruits cultivation Azaryan et al., [7]. It was shown, that the single application of melanin can stimulate the plant growth, development and promotion to the faster transition to the reproductive stages.

The purpose of the presented research was evaluation of melanin influence as a natural stimulator on the quantitative and qualitative characteristics of winter wheat Syuniq.

2. Material and methods

The experiments were carried out at laboratory and field conditions. Field experiments were conducted on the basis of the Armenian Scientific Center of Agriculture of Ministry of Agriculture, located in Echmiadzin, Armavir province. The region is characterized by dry and sharply continental climate and the cultivation of agricultural crops is conducted under irrigation. Agriculture in this region mainly based on production of cereals and vegetable, perennial grasses, grapevines and fruits.

In laboratory conditions the effect of melanin in the presowing treatment of winter wheat Syuniq seeds was studied. For this purpose, the seeds were pretreated with different concentrations of melanin (0.03, 0.07 and 0.1%). As negative control seeds were treated by water. For both of them the cultivation time was 24 hours, following germination at 25 °C in thermostat. On the third day the energy of germination and on the seventh day the potential of germination were estimated. The experiments were carried out in duplicate, for each replication100 seeds were used. For promising variants the experiments were continued in field conditions.

Data on precipitation (mm) and air temperature (°C) relative humidity for the research period in Echmiadzin, Armavir province, are presented in the (Tables 1 and 2).

Table 1.– Monthly and yearly summaries of precipitation (mm) in Echmiadzin

Year/month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
2016	35.9	12.8	10.5	8.4	32.1	19.7	33.8	6	18	15.8	32	35.1
2017	16.8	7.6	8.2	13.7	35.4	3.3	2.4	5.5	1.2	31.5	27.3	8.7

Table 2.– Monthly and yearly summaries of temperature (°C) in Echmiadzin

Year/month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
2016	–2.1	4.2	8.6	13.9	17.9	22.3	25.7	26.8	19.8	12.5	3.6	–4.0
2017	–9.0	–8.1	6.1	13.1	18.3	23.7	27.5	27.8	23.0	12.5	6.9	1.4

The field experiments were carried out in four replications, with 50 m^2 of planting area and 250 kg/ha of seeding norm. From two non-related replication areas four 0.25 m^2 permanent surfaces were separated for purpose of phenological observations and biometric measurements. Before harvest, for all the plants from permanent areas the structural elements of yield were determined in laboratory conditions. The received data were estimated according to the mathematical processing Dospechov [7]. Seed quality was determined in the samples collected from the total mass of yield according to GOST (GOST 9354–67*, 1977). The biological indicators of the variety, the structural elements of the yield and the technological and seeding parameters of the seed were studied.

3. Results and discussion

According to the obtained results carried out in the laboratory conditions, the optimal concentration for presowing treatment of winter wheat Syuniq was 0.07% of melanin. This concentration of melanin stimulated seed germination in 100% both in laboratory and field conditions, while according to Ghițău et al., [9], the highest percent of seed germination treated with stimulators of different origins, was no higher than 95.5%. Obtained results of melanin influence on winter wheat Syuniq are presented on (Table 3).

Table 3.– Influence of melanin treatment on winter wheat Syuniq in the laboratory conditions

Treatment	Energy of germination,%	Germination,%
Control	95.5	97.5
Melanin 0.03%	94	97
Melanin 0.07%	100	100
Melanin0.1%	84	90

Based on the obtained results carried out in the field conditions indicated that in the experimental variants treated with 0.07% of melanin germs grown comparable simultaneously and two days earlier in comparison with control variants. According to the obtained data, the germination of treated variants

was higher on 5.3% in contrast to control variants. Obtained results of influence of melanin treatment on biological indicators of winter wheat Syuniq are presented on (table 4).

Table 4.– Influence of melanin treatment on biological indicators of winter wheat Syuniq

Tratment	Field germination,%	Frost resistance,%	Viability,%	Plant height, sm	Roots dry mass on the end of vegetation, gr.
Control	66.9	92.3	90.7	105.5	10.38
Melanin 0.07%	72.2	94.8	94.9	108.9	12.56

The positive effects of melanin observed in early stages of onthogenesis have also been maintained at later stages of plant growth and development. Thus, in comparison with the control variants, the level of germination increased in 2.5% and the viability was increased in 4.2%. Biometric measurements have shown that in case of melanin treated variants the plants are higher in 3.4 cm and the root dry mass in 2.18 g more in comparison with control variants.

The yield of winter wheat is forming due to the preserved plants in $1m^2$ area and to the quantity of effective stems at the end of the vegetation Adhikary et al., [1]. The results presented on (Table 5) approved that in melanin treated variants at the end of vegetation in comparison of control variants are preserved more plants leaded to the effective tillering of plants.

Table 5.– Influence of melanin treatment on common and effective tillering of winter wheat Syuniq

Treatment	Plants quantity at the end of vegetation, pcs	Stems per $1m^2$		Tillering, pcs	
		common	effective	common	effective
Control	33.0	105.8	94.3	3.2	2.9
Melanin, 0.07%	39.5	144.4	133	3.7	3.4

Melanin has also shown a positive stimulating influence on the structural elements and yields of winter wheat Syuniq (Table 6). In melanin treated variants the number of spiklets in spikes (20.2), as well as the number of grains (56) and weight (3.1 g) were higher in comparison with control variant. As a result, a high yield was obtained, which exceeded the control variants for 13.6%.

Table 6.– Influence of melanin treatment on the structural elements of winter wheat Syuniq

Treatment	Height of spike, sm	Number of spiklets per spikes, pcs	Number of grains per spike, pcs	Grains mass per spike, gr.	Mass of 1000 grains, gr.	Yield, c/ha	Additive yield, c/ha
Control	7.8	19.6	50.9	2.8	47.6	48.4	–
Melanin0,07%	8.2	20.2	56.0	3.1	54.0	55.0	6.6
The smallest Average Difference (SAD_{05})	0.4	0.3	3.4	0.01	3.8	2.8	

It is well known that many factors as varietal, climatic and agrotechnical affecting the quality of wheat seeds Ernst, et al. [8], Sidlauskas & Bernotas [12]. Obtained results of the presented study approved, that besides the above mentioned factors, the presowing treatment of seeds with 0.07% of melanin has shown stimulating influence on winter wheat cultivation.

Table 7. – Influence of melanin treatment on technology and quality of cultivation indicators of winter wheat Syuniq

Treatment	Gluten,%	Volume weight, g/l	Vitreousness.%	Fractional content. g			
				3.0 mm	2.6mm	2.4 mm	2.2 mm
Control	25.0	763.1	65.5	696.9	280.6	19.5	3.0
Melanin, 0.07%	29.5	774.6	73.5	902.2	79.3	15.4	3.1

Based on the obtained results, in melanin treated variants the content of gluten was 29.5%, vitreousness was 73.5% and the mass was 774 g/l, in control variants the same parameters were 25%, 65.5% և 763.1 g/l respectively. The nutritional value of winter wheat is due to high content of gluten and vitreous. It should be underlined, that the important argument in the use of biological compounds is the fact, that these substances have a potential to effect on the quality of the yield of winter wheat, increasing the content of proteins and reducing the content of heavy metals in the grains. In the frame of presented study the effect of melanin on the main indicator parameters characterizing the quality of winter wheat Syuniq was revealed.

Thus, according to the results obtained in the laboratory conditions, on the third day of cultivation the germination energy of control variants was 95.5%, in comparison with melanin treated variants, where the germination energy was 100%, which approved the positive impact of melanin treatment on the viability of grains. In the field conditions, viable grains have provided more than 5.3% of field germination. The study of fraction content of grains (in per kg) revealed that in two variants the large fraction of grains (3.0 mm) dominated, but in the melanin treated variants the grains were more homogenous.

4. Conclusions

The presowing treatment of seeds of winter wheat Syuniq using 0.07% of melanin solution positively influenced on the initial phases of ontogeny and further development of plants, promoting the improvement of biological and qualitative indicator parameters and increasing the yield. The key factors in our experiments were the selected correct concentration (0.07%) of melanin and treatment time (24 h.). It was revealed that selected concentration of melanin promoted the simultaneous germination of seeds, detected 2 days earlier in comparison with control variants.

In the filed conditions, for the melanin treated variants comparable higher germination and frost resistance were determined. Biological simulator effected also on the quantity of the preserved plants in the field at the end of vegetation, promoted to increase the quantity of effective spikes and productivity of yield. Additive yield was 6.6 c/ha. In melanin treated variants of winter wheat Syuniq the indicator parameters as germination energy, germination in the laboratory conditions, mass of 1000 grains and homogeneity characterizing the quality of cultivation of seeds also were improved after melanin treatment.

References:

1. Adhikary S. K., Alamandn M. Z.& Paul N. K. Variation of grain growth of wheat cultivars. Bangladesh J. Agril. Res. 34(3), 2009.– P. 351–359.
2. Avdeenko A. P. Influence of modern growth factors of efficiency of Hordeum vulgare in the conditions of the Rostov region. International Research Journal, 7(38), 2015.– P. 103–106.
3. Azaryan K. G., Popov Yu. G., Pogosyan G. S., Gulamiryan R. S., Vardanayn G. G. Stimulation of rhizogenesis of grapevine cuttings. Vinodelie i vinogradarstvo, 1, 2007.– P. 34–35. (in Russian).

4. Azaryan K. G., Popov Yu. G., Hovsepyan A. S., Avetisyan S. V. Perspectives of Natural Stimulators Application in Plant Cultivation. Proceedings of the Eurasian Symposium on Vegetables and Greens. Acta Horticulture, 1033, 2014.– P. 65–75.
5. Calvo P., Nelson L. & Kloepper J. W. Agricultural uses of plant biostimulants, Plant Soil, 383, 2014.– P. 3–41.
6. Chojnacka K. Innovative bio-products for agriculture. Open Chemistry, 13, 2015.– P. 932–937.
7. Dospekhov B. A. Methods of field experience. Kolos, 1985.– P. 225–226. (in Russian).
8. Ernst D., Kovar M., Cerny I. Effect of two different plant growth regulators on production traits of sunflower. Journal of Central European Agriculture, 17(4), 2016.– P. 998–1012.
9. Ghiţău C. S. & Donţu G. D. Effect of biostimulators on some biological features of winter wheat. Seria Horticultură, 53(1), 2010.– P. 557–562.
10. Popov Yu. G., Azaryan K. G., Petrossyan M. T., Agadjanyan J. A., Shcherbakova E. N. Hormon-like influence of bacterial melanin on the cultivated plants. Revue of Cytology et Biology vegetales – Le Botaniste, 28(s.i.), 2005.– P. 252–259.
11. Pravin V., Rosazlin A., Tumirah K., Abdullah K., Salmah I., Amru N. B. Role of Plant Growth Promoting Rhizobacteria in Agricultural Sustainability. Molecules, 21(5), 2016.– 573 c.
12. Sidlauskas G. & Bernotas S. Some factors affecting seed yield of spring oilseed rape (Brassica napus L.). Agronamy Research, 1(2), 2003.– P. 229–243.

Tukhtaeva Khabiba Toshevna,
Head of the Department,
Ph. D., Bukhara Branch of the Tashkent Institute
of Irrigation and Agricultural Mechanization Engineers
E-mail: Habiba1078@mail.ru
Juraev Sharafiddin Babakulovich,
Second year student at the Bukhara branch of the Tashkent Institute
of Irrigation and Agricultural Mechanization Engineers
Rakhimova Diyora Kakhramon kizi,
Second year student at the Bukhara branch of the Tashkent Institute
of Irrigation and Agricultural Mechanization Engineers
Yusupov Hamid Hasan ugli,
Second year student at the Bukhara branch of the Tashkent Institute
of Irrigation and Agricultural Mechanization Engineers

STUDY OF LOCAL IRRIGATION SYSTEMS AND SELECTION OF THE MOST APPROPRIATE FEATURES FOR THE EFFICIENT USE OF WATER AND LAND RESOURCES

Abstract: The article analyses efficient water management methods and prospects for irrigation systems improvement for the region. Scientific and practical proposals and recommendations for the creation of local irrigation systems based on the use of local water resources for desertification control are given.

Keywords: desertification, water and land resources, atmospheric precipitation, runoff, local irrigation, yield.

Introduction. The subject of research is the desert rangeland of the Central Kyzylkum – an extra-arid region with annual precipitation of 90–180 mm and annual evaporability of 1400–1600 mm. Due to its high agro-climatic potential it is possible to cultivate heat-loving crops, and with sufficient moisture the rangelands of the region can reach high productivity.

Firstly, reliable information on all types of water resources is collected for the area under consideration, including groundwater, discharge water, wastewater and temporary surface runoff. Plastic relief mapping method and water balance of the territories were used to assess the temporary surface runoff. On the basis of this, regionalization of the Central Kyzylkum was carried out according to the conditions for the annual formation of temporary surface runoff over the seasons with their quantitative assessment.

For a good understanding of the situation, assessments of water resources that are formed in desert rangelands and, for the most part, do not participate in run-off of the river systems were carried out.

As a rule, desert regions have potential sources of water of different quality: groundwater, wastewater, precipitation moisture. In addition, the dryland desert zones have significant reserves of valuable mineral and other resources that can be used in fertile lands for the development of local irrigation arrays.

Water supply problem of the region can be solved by development of the areas rich in natural

resources, increasing rangeland productivity, and desertification control.

Our observations and calculations of watershed have shown, there is water in the desert, but it returns to the atmosphere very quickly and is lost due to seepage.

Therefore, these major issues of desert regions require technical intervention.

Aims and objectives. The aim of the research is the scientific development of proposals for the rational use of local water resources for desertification control in the Central Kyzylkum region.

Main body. The article describes developed methods for determining the size of the watershed areas of the drainage basin, the redistribution of the runoff within them, methods for the conservation and rational use of accumulated moisture, and assess temporary surface runoff resources in the macro-, meso- and micro- watersheds.

A survey of suitable for irrigation of land in Konimex area based on the use of local waters was performed. Plots were determined, conditions for the accumulation and preservation of precipitation moisture were studied; and field experiments were carried out on those plots. Research was carried out on forage crops. Alfalfa seeds sown in experimental plot in April with the standard of 12–15 kg/ha, with seeding depth of 3–5 cm, satisfactory seedlings were obtained (according to the previously washed soil the norm of 1.5–2 thousand/ m^3 ha). With many years of alfalfa sowing, the yield of feed per hectare of irrigated soil is about 100 metric quintals/ha. 0.868 l/sec of water is needed to obtain this yield [1].

The productivity of plant life in the desert is directly dependent on the amount of atmospheric moisture and its seasonal distribution. Under optimal temperature conditions, moisture causes the most important biochemical and physiological processes to occur. With sufficient reserves of moisture in the soil, the plants grow to their full potential, and with a lack of it – go into a low-active state, all their functions slow down. The direct reaction of desert plants to a lack of moisture is the partial loss of their leaves and shoots and, consequently, a reduction in water consumption.

Knowledge of the water regime of desert plant life is a reliable basis for selection of the most drought-resistant forage plants to improve desert rangelands.

In increasing the desert forage reserve, further irrigation and development of new massifs is of great importance. Of the 30 million hectares available in Uzbekistan, only about 12 million hectares of desert and semi-desert rangelands are used.

Development of water supply for all rangelands (excluding Ustyurt) will provide year-round forage for 9.1 million sheep as a result of improved livestock numbers on rangelands and the actual increase in feeding rates, which naturally will have a positive effect on the productivity of pastoral industry.

The yield of desert rangelands ranges from 2 to 5–6 metric quintals/ha, decreasing in some unfavourable years to 0.5–1 metric quintals/ha of forage. Research by the Institute of Botany has shown that sowing semi-shrub and shrub plants with the use of appropriate agricultural techniques can improve the productivity of rangelands of clay desert by 2–3 times. For example, by the end of the first year of the growing season, the yield of plants reaches 2–3 metric quintals/ha, by the end of the second year – 5–7 metric quintals/ha, and in the third and subsequent years – 8–12 metric quintals/ha of air-dry weight.

The calculations found that the biological potential of cultivated plants in Uzbekistan is very high. So biologically potential yield of basic grains, calculated by the measurement of solar radiation, is 352–412 metric quintals/ha, legumes (soybeans) – more than 300 metric quintals/ hectares, potatoes – 2290 metric quintals/ha, sugar beets – 4100 metric quintals/ha, cotton – 265 metric quintals/ha. Biologically potential yield of cultivated plants is calculated on the average photosynthesis efficiency of 8% (Photosynthesis and bio-based products, the average for the growing season photosynthetic active radiation

in Uzbekistan is 210 kJ/cm^2, the average caloric content of dry plant mass is 19 kJ/g).

The quantitative correlations of the rangeland vegetation yield with environmental factors are established. For example, the average yield (air-dry weight) of the crop coverage of natural rangelands depending on precipitation over October-May can be determined from the (Table 1).

Table 1.– The dependence of the yield of rangeland vegetation on the amount of precipitation in October-May

Precipitation in October-May, mm	**Yield of rangeland vegetation, metric quintals/ha**	**Water-use ratio, m^3/metric quintal**
1	2	3
50	1.0	500
100	2.0	500
150	3.0	500
200	4.0	500
1	2	3
250	5.0	500
300	6.2	484
350	7.8	449
400	9.7	412
450	11.5	391
500	12.75	392
550	14.0	393

The data shows increase of the rangeland vegetation yield with increasing precipitation, while the water-use ratio decreases. It is important to note the fact that the water-use ratio of rangeland vegetation (391–500 m^3/metric quintal) is significantly less than the water-use ratio of cotton when cultivated under rain-fed conditions (450–630 m^3/metric quintal). This indicates that the biological potential of rangeland vegetation in relation to the water factor is greater than cotton. However, this statement requires additional analysis.

The yields of forage crops, when treated with mineral fertilizers, increases by 1.5–2.5 times in comparison with those indicated in the Table 1.

The long-term average resources of temporary surface runoff from watersheds in the lowland and foothill zones of Uzbekistan (local water resources) amount to 704 million m^3 per year [2]. Without significant reduction of regular river flow, soil and groundwater, these water resources can be used to increase the biological productivity of desert regions in four main areas:

1) creation of regular perennial irrigation systems. With an average irrigation rate of 12 thousand m^3/ha per year (gross), the resources of temporary surface runoff (determined in this article) will allow the development of 58.8 thousand hectares of new land;

2) creation of inundation irrigation systems and other methods of accumulation, storage and economic use of local water resources for the cultivation of food grains and forage crops. With an average irrigation rate of 9.0 thousand m^3/ha per year (gross), 78.2 thousand hectares of new land can be developed;

3) creation of inundation irrigation systems for the cultivation of food grains, orchards and vineyards. With an average irrigation rate of 7 thousand m^3/ha per year (gross), 100 thousand hectares of new lands can be developed on the basis of local surface runoff;

4) creation of inundation irrigation systems for the cultivation of cucurbitaceous food and fodder crops.

With an average irrigation rate of 5 thousand m^3/ha year (gross), using the resources of the local surface runoff, 140 thousand hectares of new land can be developed.

Based on local conditions, these methods can be applied individually or in combinations. Approximate assessment indicates that their implementation will increase biological yield.

References:

1. Гаевская Л. С., Сальманов Н. С. Пастбища пустынь и полупустынь Узбекистана,– Ташкент: Фан, 1975.
2. Лешинский Г. Т. Ресурсы временного поверхностного стока пустынь Средней Азии и Западного Казахстана, – Ашхабад. Ылым, 1970.
3. Махмудов М. М. Теория и практика фитомелиорация пастбищ Кызылкум. // Проблемы пастбищного животноводства и экологии пустынь.– Самарканд, 2000.– С. 138–140.
4. Справочник по климату. 1989.

Section 6. Technical sciences

Allaniyazov Davran Orazimbetovich,
researcher at the laboratory of chemistry of Karakalpakstan
Scientific Research Institute of Natural Sciences,
Academy of Sciences of the Republic of Uzbekistan
E-mail: dauran_1985@mail.ru

Bauatdinov Sali,
Ph.D., Head of the Laboratory of
Chemistry of Mineral Fertilizers. Karakalpakstan
Scientific Research Institute of Natural Sciences,
Academy of Sciences of the Republic of Uzbekistan,
E-mail: dauran_1985@mail.ru

Bauatdinov T. S.
Karakalpakstan Scientific Research Institute of Natural Sciences,
(Academy of Sciences of the Republic of Uzbekistan), Nukus

Erkaev A. U.
Tashkent Chemical Technological Institute
of the Republic of Uzbekistan, Tashkent

Talipov S. A.
Institute of Bioorganic Chemistry,
named after Academician A.S. Sadykov,
(Academy of Sciences of Uzbekistan), Tashkent

STUDYING BY THE MODERN PHYSICAL AND CHEMICAL METHODS OF MINERALOGICAL COMPOSITIONS OF RAW MATERIALS AND CONCENTRATES OF THE GLAUKONIT OF THE KRANTAU ORIGIN

Abstract: Has been established that the glauconitic of Krantau field is represented in the form of micro aggregate grains ranging in size from 0.01 to 0.8 mm, associated with quartz sand; high content of iron in it is revealed, which sharply prevails over aluminum and above kali. Almost all type of irons are present in the oxide form Fe^{3+}, its content averages 43,2%. X-ray analysis of samples of glauconitic sands that were enriched by the method of fine-meshed sieves made it possible to establish the existence of characteristic peaks indicating the amount of glauconite in the sample. Using the TG-DSC method, it has been established that in the glauconitic of the Krantau field there is no

phase transition characteristic of clay rocks in the temperature range 200–220 °C, which indicates the transition of iron from Fe^2 to Fe^3. The thermoanalytical and IR spectrometry studies of glauconite allowed us to reveal some features of its fine structure.

Keywords: Karakalpakstan, mineral, glauconitic, Cranta-powder diffractograms, thermogravimetric, differential scanning microcalorimetric, Highly effective solution chromatography -mass spectrometry, chemical analysis.

Introduction. Glauconite — (from the Greek. Glaukos — bluish-green) — the most common mineral in nature of green color, exist as a pigment. Glauconit is a group of kali of iron aluminosilicate type [1] with general formula of (K, Na) (Fe, Al, Mg) $_2$ (Al, Si) Si_3O_{10} $(OH)_2$. The mineral was first described by Kerferstein in 1828. According to the structure, glauconites are close to hydromica and clays of montmorillonite composition. Due to its structural features, glauconite has absorbing character and accordingly, high oil absorption, tends to coagulate. Pure glauconites contain: 5–9% K_2O, 9–30% Fe_2O_3, 40–53% SiO_2. The mineral does not form monomineral excretions, and considered as a sedimentary mineral: sandstones, aleurolites, clayey aleurolites, and marls — which formed in marine conditions. In addition to the minerals of the glauconite group, in these rocks contain a large amount of quartz, heavy minerals, clay minerals and carbonate admixture [2].

Several glauconite locations have been found on the territory of Karakalpakstan. The most promising among them is the Krantau field, which is located on the right bank of the Amudarya River, near the village of Krantau and belongs to the sandy-clay mines of the Upper Cretaceous. The presence of a large supply of glauconite in the territory of Karakalpakstan, their availability dictate the need for their use as microelement-containing mineral fertilizers. Regard this, it is of great interest to study the composition of the glauconitic sands of the Krantau field, methods for their enrichment and the establishment of some features of its fine structure. The studied glauconitic sands from the Krantau mine were processed by sieving through a sieve of various sizes in order to enrich with glauconite.

Scanning of powder diffractiongram. The quantitative and qualitative X-ray phase analysis of polycrystalline samples of glauconite-containing sands was carried out on an XRD-6100 powder diffractometer (Shimadzu, Japan). The study of CuK_a (β-filter, Ni), the scanning angle for diffractometric studies varied from 2 to 80°. The qualitative and quantitative identification of the phases of the samples presented was carried out using the MATCH! ®Phaseidentification from Powder Diffraction program (CrystalImpact, GbR, Bonn, Germany, 2015) [3].

Combined Thermogravimetric and differential scanning Microcalorimetric analiz. Termical behavior of investigated glauconite sands pure glauconite, and red and white clay of Kranta origin determined on the instrument Netzsch Simultaneous Analyzer STA 409 PG, with K-type thermostream (Low RG Silver), with aluminum crucibles. All measurements were carried out in an inert nitrogen atmosphere with a nitrogen flow rate of 50 ml / min. The temperature range of measurements was 25–600 °C, the heating rate was 5K / min. The amount of sample per measurement is 8–15 mg. The measuring system was calibrated with a standard set of substances KNO3, In, Bi, Sn, Zn, CsCl. Results analyzes and computer graphics was carried out using the NETSCH Proteus Thermal Analysis® software package [4].

Carrying out Elemental analysis. Elemental analysis of glauconite from the Krantau deposit was carried out using optical emission spectroscopy with inductively coupled argon plasma on an OPTIMA 2100DV instrument from Perkin Elmer (USA). Sample preparation was carried out using a Berghof SPEEDWAVE MWS-3 + DAP-60 + microwave decomposition system.

The Highly effective solution chromatography -mass spectrometry method was used to study the component composition of acetone extract of glauconite. The separation of the extract into fractions was carried out on Highly effective solution chromatography (Agilent Technologies-1260, USA) using a column with a reversed phase of 2.1 x150 mm (3.5μ) Eclipse XDB (Agilent technologies, USA). A mixture of A-0.05% buffer solution of formic acid B-acetonitrile and C-isopropanol with a 0-min gradient of 18% B + 2% C, 15 — min 72% B + 8% was used as an eluent. 18-min 18% B + 2% C. The flow rate is –0.25 ml / min.

ESI mass spectrometric studies were carried out on a 6420 Triple Quad L C / MS mass spectrometer (Agilent Technologies, USA). The mass spectra of the samples were recorded with negative and positive ionization. The parameters of the mass spectrometer were as follows: the desiccant gas flow rate is 3 l/min, the gas temperature is 300 °C, the gas pressure on the needle is 20, the evaporator temperature is 300 °C, the capillary voltage is 4000 V. *Classification of the elemental composition of glauconite of Krantau mine.* Studies using a LEICA polarizing microscope showed that glauconite in samples is presented in the form of microaggregate grains associated with quartz sand. The accretion of glauconite with montmorillonite is observed with its gradual transition through the stage of mixed-layer minerals to almost pure swelling montmorillonite. The size of the grain of glauconite varies widely — from 0.01 to 0.8 mm. The color of fresh glauconite grains varies from olive green to black green (Figure 1).

Elemental analysis of glauconite from the Krantau mine was carried out using optical emission spectroscopy with inductively coupled plasma. The results of elemental analysis are shown in table 1.

Table 1. – Optical emission spectrometry results with inductively coupled argon plasma

Revealed concentration мg/dm^3									
As	Ca	Cd	Co	Cu	Fe	Li	Mg	Mn	Se
0,9864	5106,36	1,5725	29,5741	24,8085	88155,7	20,8785	12932,655	360,0987	–
Revealed concentration mg/dm^3									
Pb	Zn	K	Al	Hg	Ag	Na	Rb	Ti	V
6,3564	105,102	≥8500	33230,2	–	0,0975	8697,65	313,254	–	144,142
Revealed concentration mg/dm^3									
Cr	Ni	Ga	Si	Pd	Pt	Sr	Cs	In	Tl
92,312	35,9751	70,717	9410,55	120,129	3,57676	76,9949	52,3906	45,9860	1,2477

Table 2. – The chemical composition of glauconite on the basis of elemental analysis data is characterized by the following data

	SiO_2	**Al_2O_3**	**Fe_2O_3**	**MnO**	**MgO**	**K_2O**
(%)	**42,89**	**–6,3**	**–43,2**	**–0,03**	**–2,11**	**5,1**

The chemical composition of monofractions of glauconite shows a great similarity in all samples. They are characterized by a high iron content, which sharply predominates over aluminum and over potassium. Almost everything is present in the oxide form, its content averages 43,2%. Thus, the iron form of glauconite dominates in this deposit.

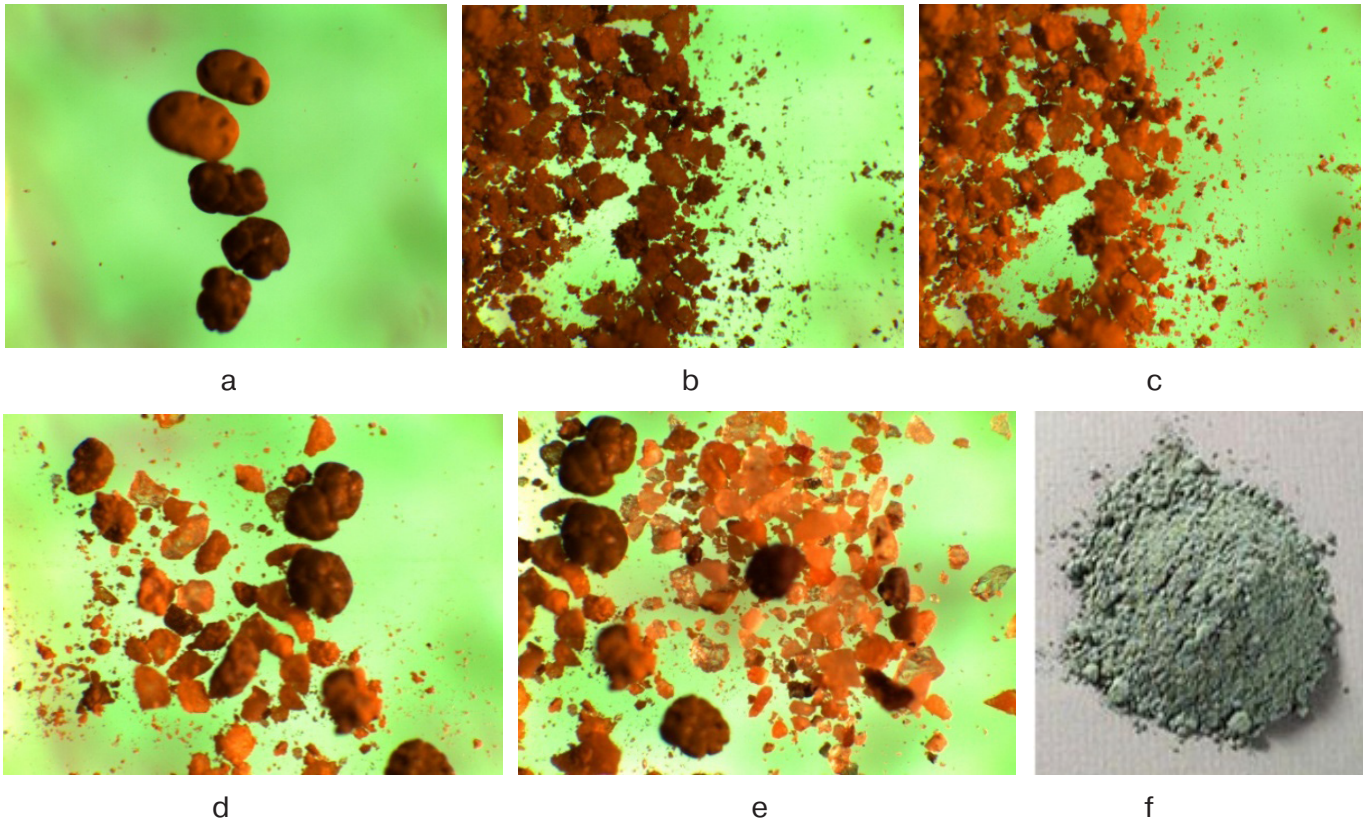
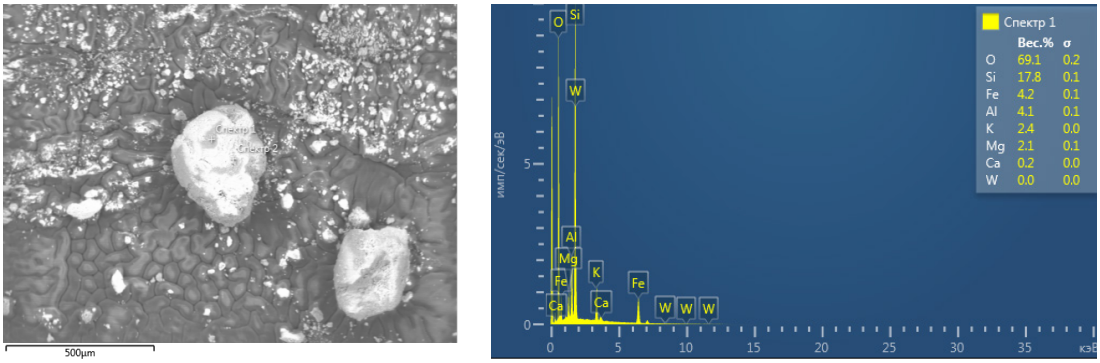


Fig. 1. Micrographs of glauconite samples: grains of glauconite (a), glauconitic sands (b) and (c), enriched glauconitic sands (g) and (e), crushed glauconite (e).

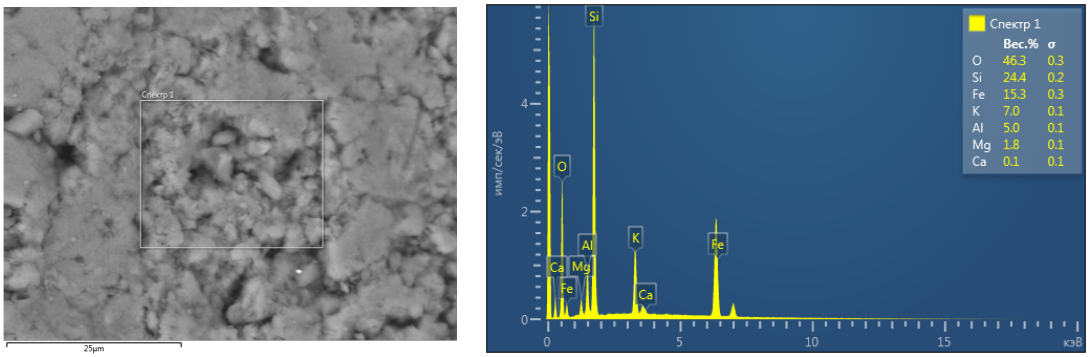
In the investigated samples there are various in shape and size of the grain of glauconite. In the studied rocks (sandstones with different content of glauconite), glauconite is represented by grains of dark green color, mostly round and isometric in shape, from medium to well rounded. During the reporting period, electron microscopic images of glauconitic crystallites and their powder were obtained using a scanning electron microscope (SEM) Evo MA10 (Zeiss, DE). In fig. 1,2. The image of the powder is shown, where particles of different sizes ~ 5-100 mkm are visible. Using a microscope and energy dispersive analyzer (Inca, Oxford Instruments, UK) (EDR analysis), the elemental composition of these samples was simultaneously determined. The results of the EDR analysis showed the following elemental composition: O — 68%, Si — 17,8%, Fe —5,2%, Al — 3,9%, K — 2,5%, Mg — 2,1%, Ca — 0,3%; on the basis of these values, the total composition of glauconite samples was estimated: SiO_2 – 38,91%, Al_2O_3 – 15,21%, Fe_2O_3 – 15,7%, CaO – 0,28%, MgO – 3,65%, K_2O – 6,22%. Images of the surface of samples of glauconite grains at different magnifications (Fig. 1,2.) Taken with a Zeiss EVO®MA10 scanning electron microscope show the shape and structure of the surface of the glauconite grains of the Krantau deposit. Using electron microscopy, various structures of chemical corrosion were detected on the surface of the grains, which were accompanied by the removal of iron compared to fresh chipped grains.

(Fig. 1, 3.). Overgrowing of glauconite grains by newly formed mineral phases, in the composition of which Ca is present, is also widely manifested.

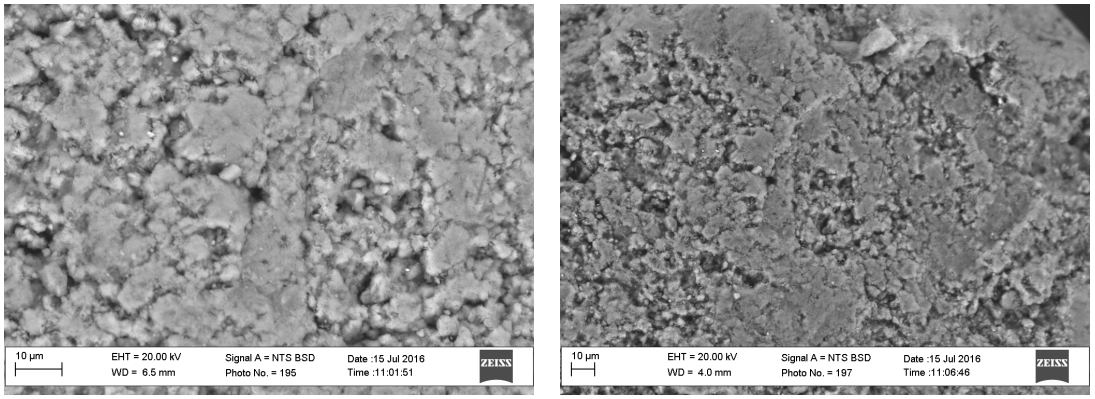


a b

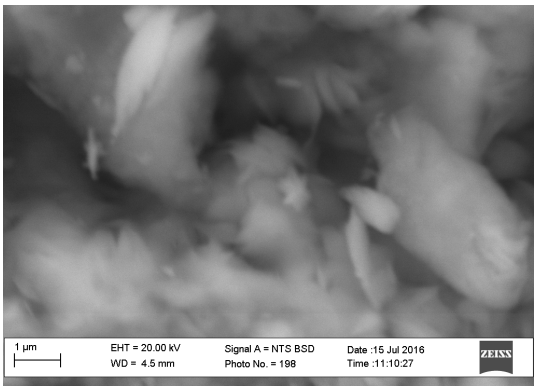
Fig. 2. Electron micrographs (a) and EDR analysis (b) of glauconitic powder



a b



c d



e

Fig. 3. Electronic micrographs of the surface of glauconitic grains with different magnifications

References:

1. Andronov S.A. Glauconite – the future mineral / S.A.Andronov, V.I.Bikov // Mat. First International. conf. "The value of industrial minerals in the global economy: origin, technology, economic evaluation." – M.: GEOS, 2006, p. 79–83.
2. Formozova L.N. Glauconite. M., 1949.
3. MATCH! ® Phase identification from Powder Diffraction (Crystal Impact, GbR, Bonn, Germany, 2015).
4. NETSCH Proteus Thermal Analysis®. Drits, V. A., Zviagina, B. B., McCarty, D. K., Salyn, A. L., American Mineralogist (2010), 95, 348.

Rasulov Fuzuli Rasul,
PhD, Deputy dean of the Metallurgy,
Azerbaijan Technical University
E-mail: resulovfr@gmail.com

İMPROVING THE PROPERTIES OF THE SURFACE OF THE CAST IRON BY ABSORBING INTO THE LIQUID METAL IN THE CASTING MOLD

Abstract: The article was devoted to the study of improving the surface characteristics of castings by impregnating powder of the composition of liquid iron in the casting process. Researched mechanical properties and improvement of corrosion resistance of surface alloyed castings small quantities of chromium and nickel.

Keywords: surface alloying, powder composite, casting, foundry mold, spread.

Introduction:

At present, it is sufficient to fully disclose the mechanism of corrosion of metals and alloys, and effective methods have been developed to prevent it. Despite this, nowadays the loss from corrosion is very high. Therefore, the fight against corrosion is a serious scientific and technical challenge [1].

In this case, as a rule, the bulk alloying of metals and alloys is uneconomical. Therefore, in recent years, increasing attention of researchers and manufacturers has been paid to various methods of surface alloying of the working surfaces of gadget [2; 6]. Surface alloying of products can be carried out by various methods: diffusion metallization, spraying, impregnation with liquid alloys, surfacing, electrospark alloying, etc. All these methods have their advantages and disadvantages. In our opinion, the most effective method of surface alloying can also be the saturation of the surface of castings with composite spreading directly during the process of pouring the liquid metal into the casting mold.

There are known methods [2; 3] of providing the necessary complex of characteristics of the surface layer of castings by establishing the laws of their formation and structure formation in the process of impregnation of the paste from the powder composite with liquid iron directly in the mold.

A smear is applied in advance on the working surface of the mold, and then the melt is poured into it. When the interaction occurs between liquid metal and surface, which has a porosity of coating about 32–43%. It is impregnated through the pores of the spreading and, as a result of crystallization, a mixed metal-spreading framework is formed on the surface of the casting and thus not only provides corrosion resistance, but also significantly improves the quality and surface properties of the workpiece.

Content and results of the work: The work is devoted to the study of the effect of impregnation in the form of liquid iron of a layer of powder paste from an alloy based on nickel,%: 0.2–0.3 C, 1.0 Si, 0.7–1.2 Mn, 0.7–0, 8 P, 15–17 Cr, 3.0 B, ≤ 5Fe on the formation of the structure and properties of metal castings from gray cast iron and composite coating, as well as the development of the technological process of manufacturing high-quality cast iron castings with composite coatings, obtained in single molds.

The main task of obtaining iron castings with a composite coating is to establish the optimal parameters for the impregnation of a layer of porous powder spread applied to the working surface of the mold cavity, ensuring the formation of a high-quality composite coating of the required thickness and properties.

For research, gray cast iron of CH15 brand and powder from PG-XH80CP3 alloys were used. The granulometric composition of the powder corresponded to the fractions: + 50–63; + 63–100; + 100–160; 160–200 and 200–315 μm.

For this purpose, spreads with small (30–50 micron), medium (50–100 μm) and large (<1 00 μm) powders and liquid glass with densities ρ = 1.29, 1.35 and 1.42 g/cm^3 were taken.

Investigated the relationship between the depth of impregnation with the melt of powder spread, the density of the metal of the composite coating and the pouring temperature of cast iron at various fractional and chemical compositions of the powder particles [4].

When increasing the thickness of the powder paste coating from alloy XH80CP3 from 5 to 8 and 12 mm when impregnated with liquid iron with a pouring temperature of 1380 °C, the near-surface zone is heated to 1060–1070 °C, 930–970 °C, 760–780 °C, respectively. The thermal state of the composite coating depends on the alloy of the powder and the pouring temperature, as well as on the amount of cast iron poured into the mold.

To obtain a more uniform structure in castings with composite coatings, it is advisable to increase the pouring temperature. With an increase in the thickness of powder spreads from alloy XH80CP3 from 3 to 12 mm with an interval of 3 mm (when the ratio of the thickness of spreads to the total wall thickness of the casting is 0.07 to 0.3), it is fully impregnated with liquid cast iron when the pouring temperature rises to 1440 °C.

Regardless of the thickness of the porous spreading from the powder of alloy XH80CP3, when pouring iron with a temperature below 1350 °C, its penetration is 0.5–1.5 mm. This layer is formed as a result of the penetration of liquid iron into the pores of the surface of the powder paste, covers individual powder particles and after solidification forms a composite crust, which has a very strong adhesion to the casting.

At the same time, the coefficient of hardening (C.h. = 3.22 mm/s$^{1/2}$) of the casting with powder spread based on nickel alloy is slightly higher than when solidifying the casting in the form without spreading (C.h. = 2.93 mm/s$^{1/2}$).

It was established that with an increase in the temperature of cast iron casting from 1360 °C to 1420 °C, the impregnation depth increases, the proportion of non-soluble powder particles in the "XH80CP3-gray cast iron" composite coating structure decreases from 67–65% to 44–47%, which is associated with an increase in the solubility of powder particles spreading in cast iron ligaments. At the same time, the porosity of the composite coating decreases by 0.91–1.33 and the interlayer between non-soluble particles increases from 0.10–0.12 mm to 0.22–0.28 mm, which contributes to the improvement of the strength properties of the material of the composite coating of iron casting.

When reducing the powder coating layer thickness from 15 to 10 and 5 mm, as well as increasing the pouring temperature from 1360 to 1440 °C, the degree of dissolution of powder particles in the cast iron of the bond increases and the segregation of Ni, Cr, Si and P over the cross section of the composite coating of the casting decreases.

Chemical analysis of the metal over the cross section of the composite coating revealed that the smaller the thickness of the powder coating, the greater the degree of homogeneity of the distribution of Ni, Cr, Fe and C across the coating thickness of the iron casting.

By raising the temperature of the cast iron from 1320 to 1440 °C, it is possible to achieve an increase in the rate of its filtration by 2–3 times. So, with an increase in the thickness of the spreads from the powder of the alloy XH80CP3 from 5 to 10 and 15 mm, the content of elements changes from surface to depth in the contact zone; namely: nickel decreases from 45.1; 55.1 and 60.2% to 44.0–44.2%, and chromium from 11.0; 14.5 and 15.2% to 9.4–9.8%, the iron content increases from 44.5–40.2

and 38.5% to 46-–46.7%, and carbon content with 1.47; 1.29 and 0.96% to 1.75–1.80%.

As can be seen, the nature of the dissolution of particles and the diffusion of Ni; Cr; Si and P in the cast iron of the ligament at the surface of the composite coating of the casting significantly depends on the thickness of the powder spread, and the content and distribution of these elements in the zones varies significantly. Thus, in experimental castings with a total thickness of 50 mm in the surface zone of the composite coating, an increase in the thickness of the powder spreads from 5 to 10 and 15 mm resulted in a decrease in the content of elements of the XH80CP3 alloy in thin interparticle interlayers of cast iron; namely: for nickel – from 9.64% to 4.38 and 6.51%; for chromium, from 2.2% to 0.25 and 1.31%, and also for silicon, from 2.2% to 0.34 and 0.36%. Whereas the phosphorus content in the pig iron, soaked in a porous spread, increases from 0.43% to 0.59 and 0.63%. At the same time, in all cases of casting with impregnation of powder spreading, the metal of the contact zone of base iron with a composite coating is considerably more saturated with Ni, Cr and P compared to the peripheral zone.

At the same time, the solubility and diffusion of elements from solid particles of the powder alloy into the cast iron solubility is much greater than in the surface zone of composite coatings. However, with an increase in the thickness of the spread, the content of elements that pass into the cast iron solubility is also reduced, as in the metal surface areas of the composite coating: when the thickness of the spread is increased from 5 to 10 and 15 mm, the Ni and Cr content decreases by 2.79 and 3.71%, 0.26 and 0.40%, respectively.

Regardless of the thickness of the powder paste in the metal of the contact zone, the silicon content remains almost unchanged; while the phosphorus content in comparison with the initial amount (0.7–0.8%), decreases almost 2 times and is 0.33–0.38%.

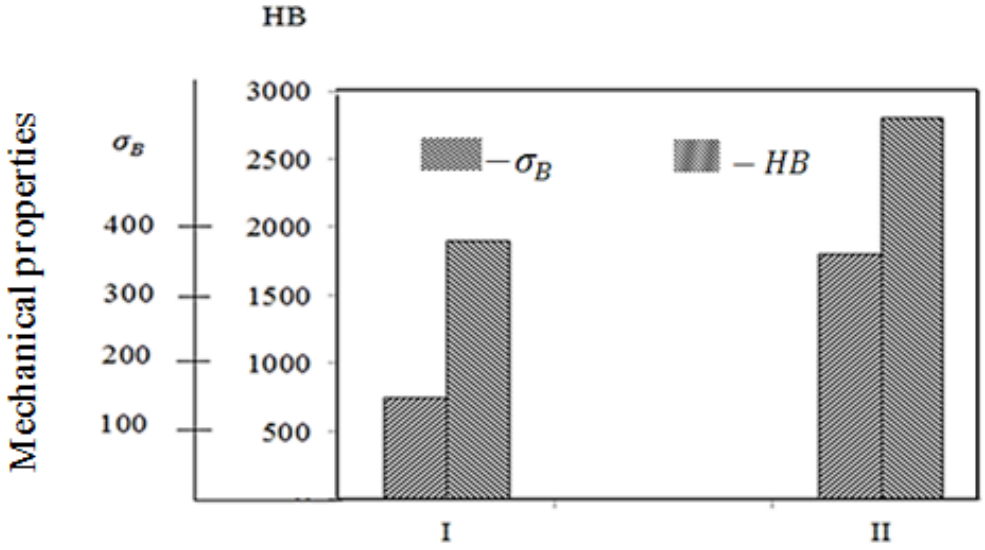


Figure 1. Comparative mechanical properties of cast iron and composite coating of castings: I – cast iron without coating; II – composite coating XH80CP3- gray cast iron

On the basis of the research performed, a technological process was developed for the production of castings of the type of bushings with hardening of the working surface with a composite coating.

The test results of composite coating materials "XH80CP3 gray cast iron" showed that their mechanical properties (σ_B and HB) are significantly higher than those of cast iron castings (Fig. 1.)

The maximum strength properties of the material of the composite coating "XH80CP3 gray cast iron", while σ_B and HB increase 1.90–1.96 and 1.25–1.28 times as compared to cast iron.

To determine the qualitative changes occurring in the abrasion surface layers of metal samples from the composite coating of castings, in laboratory conditions, methods were used, a metalworking analysis, determination of the metal microhardness of the friction surfaces, speed and weight loss of the samples.

The resistance of the specimens to abrasion was tested in tandem with a diamond wheel during rotational motion on an MT-66 machine (sliding speed of 0.5 m/s; load 48H), as well as at a constant pressure of 0.015 N/m^2 and sliding speed of 1.25 m/s.

Compared the wear resistance of samples cut from the body of the wall of gray iron casting, with the structure consisting of a perlite-ferritic metal base with lamellar graphite; and from a composite coating based on XH80CP3 gray cast iron and austenitic nickel-chrome-plated iron, such as nirezist (monometallic).

The speed against abrasion of samples in pairs with a diamond wheel was evaluated during rotation on an MT-66 machine (sliding speed of 0.5 m/s, load 48 N). The results of testing samples cut from the reverse surface area of castings without composite coating showed high wear rates.

It is known that the wear resistance of materials depends on hardness and with its growth, the wear rate decreases.

With an increase in the thickness of the powder coating, the resistance of the metal of the composite coating to wear increases. Thus, an increase in the coating thickness from 3 to 5 and 10 mm contributes to a decrease in the wear rate from 783 μm/min to 741 and 718 μm/min, respectively.

The study of the rate of wear of the samples, depending on the conditions of formation of the composite coating of the castings, the composition of the material of the powder composites and the sliding speed (1.25 m/s) was carried out in laboratory conditions.

In the process of friction in a pair, the reference sample is a sample of a composite coating of austenitic cast iron of the nirezist type on the surface of the latter, the composite metal particles are pulled out, some of which stick to the conjugate surface, and the rest are wear products.

The destruction of the friction surface of a sample of composite coatings "XH80CP3- gray cast iron" has a local character [5]. It occurs in the cementite-ice buc-ryth phases of the cast iron of the bond (metal of the bond), and not in the much less durable metal of the composite coating of the brand XH80CP3, since the cementite-ledeburit phase contains less plasticity.

The metal of the composite coating "XH80CP3-gray cast iron" is characterized by spalling particles during friction, as in the process of impregnation of the spread with liquid iron in the surface zone of the powder particles are welded together particles but the area of true contact between them is significantly less than the total contact area between the metal bond and the same powder particles. Therefore, in the course of friction of samples, partially welded particles of material are cleaved from a composite coating and dyed.

Comparison of the relative wear resistance of samples from the composite coating "XH80CP3-gray cast iron" with samples from mono-castings of highly wear-resistant bulk- alloying austenitic nickel-chrome copper (nirezist) showed that the wear of the composite coating materials "XH80CP3 is 3.86 times less than in the standard sample from cast iron Fig. 2).

Thus, studies of the resistance of specimens made it possible to establish that this method of producing cast-iron castings with a composite coating can be recommended for the manufacture of parts operating under friction conditions. The use of wear-resistant composite coatings on gray iron castings will not only increase the service life of fittings, but also recommend replacing high-chromium-nickel austenitic nirezist type cast iron (with a chemical composition of 18–36% Ni, 1–4% Cr and 3% Cu) in necessary cases cast iron and steel type 12X18H9TL.

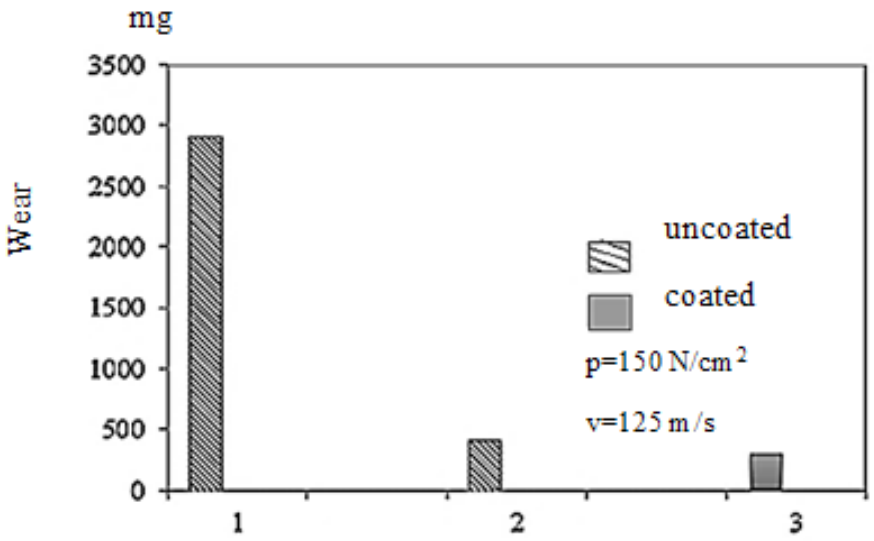


Figure 2. Comparative wear resistance – composite coating of iron castings:
1 – gray cast iron CH15; 2 – nirezist; 3 – XH80CP3 – gray cast iron

It is known that in the powder from alloy XH-80CP3-chromium is an important nickel alloying element, while nickel also has the ability to dissolve many elements in large quantities, such as iron and silicon. The main advantage of nickel-chromium alloys is their high corrosion resistance in a wide range of oxidative and reducing media. The properties of nickel significantly depend on the content of impurities such as carbon, sulfur, phosphorus and oxygen.

With the thickness of composite coatings of casting "XH80CP3- gray cast iron" of 5 and 10 mm, corrosion damage spreads evenly from the peripheral surface into the sample. In a sample of composite coatings 5 mm thick, corrosion is local in nature and is localized on surface areas where it is in contact with the thin ledeburite-cementite phase of cast iron and the sintered mass of the powder composite of XH80CP alloy in the form of individual points or spots.

Since corrosion destruction always starts from the surface, there is no need to increase the thickness of the composite coating in castings.

Tests for corrosion resistance were carried out at room temperature in open glasses according to the standard technique [1]. Test time ranged from 5 to 100 hours. Corrosion resistance was estimated by weight loss per unit of the original surface area of the samples.

It is known that iron-carbon alloys are unstable in dilute aqueous solutions of hydrochloric and sulfuric acids. The exceptions are high silicon cast iron and nickel chromium steel. Due to their high hardness, brittleness and sensitivity to temperature fluctuations, they have very limited application.

Comparative data on the corrosion resistance of the metal of the composite coating "XH80CP3- gray cast iron" castings of different thickness to the action of diluents of sulfuric and hydrochloric acids are given in the table.

From composite coatings "XH80CP3 – gray cast iron" with a thickness of 3, 5 and 10 mm, coatings with a thickness of 5 and 10 mm have the highest corrosion resistance in environments of diluted sulfuric and hydrochloric acids. At the same time, in aqueous solutions of sulfuric acid with a concentration of 15 and 20%, the corrosion rate of the material of the composite coating decreases by an average of 15 times as compared with the base iron, and in aqueous solutions of hydrochloric acid in the above concentrations, an average of 42 times.

Table 1.– The change in the corrosion resistance of cast iron, depending on the thickness of the composite coating "XH80CP3-CH15" and medium

Material	Coating thickness, mm	Corrosion rate, g / m² · h					
		The concentration of sulfuric acid at 20 °C,%					
		1.0	3.0	5.0	10.0	15	20
CH15	–	47.8	105.8	121.8	98.98	71.97	42.9
CH15	3	0.030	0.103	0.171	0.215	0.109	0.082
CH15	5	0.001	0.024	0.032	0.091	0.005	0.004
CH15	10	0.006	0.030	0.082	0.105	0.002	0.007
Cast iron nirezist	–	0.001	0.003	0.47	1.831	1.455	1.481
The concentration of hydrochloric acid at 80 °C							
CH15	–	81.989	498.969	224.885	309.863	276.983	300.785
CH15	3	2.095	2.596	2.885	3.196	3.387	3.597
CH15	5	1.806	2.029	2.065	2.179	2.194	2.396
CH15	10	1.966	2.299	2.483	2.801	2.966	2.900
Cast iron nirezist	–	3.717	4.892	4.776	4.611	4.705	4.601

The results of testing the corrosion resistance of the composite coating materials "XH80CP3- gray cast iron" showed that from an economic point of view it is advantageous to produce castings with the smallest thickness (~ 5 mm) of composite coating, which makes it possible to reduce the consumption of scarce powder XH80CP3 per item. However, it should be borne in mind that, with a decrease in the thickness of the spreads in the material of the composite coating, the content of cementite-ledeburitic components increases.

The conclusion: Defined rational technological parameters for the manufacture of cast iron castings with composite coating "powdered nickel alloy XH80CP3 – gray cast iron СЧ15" with increased strength, wear resistance and corrosion resistance. It was established that σ_B and HB material of composite coating "XH80CP3 – gray cast iron" in comparison with cast iron increases by 1.90–1.96 and 1.25–1.28 times, wear resistance – by 1.55 times, and corrosion resistance in the medium of 10% aqueous solution of sulfuric acid 42 times.

References:

1. Romanov V. V. Methods of investigation of corrosion of metals.– M.: Metallurgy, 1965.– 332 s.
2. Bukhtoyarova V. N. Review of methods of joint spraying and hardening of coatings.– Voronezh, State Forestry Academy. 2001.– 9 p.
3. Rasulov F. R. Formation of composite coating in casting by impregnation of the powder composite with liquid metal. – M. // the Bulletin of mechanical engineering. 2018.– No. 2.– C. 52–55.
4. Rasulov F. R., Babaev A. I. Features of surface alloying of castings in the mold. – M. // the Bulletin of mechanical engineering. 2017.– No. 4.– C. 86–88.
5. Rasulov F. R.– Baku // Mechanics-mechanical engineering 2010.– No. 1.– P. 70–75.
6. Rasulov F. R. Improving the material properties of the surface layer of iron castings. – Baku // Mechanical Engineering. 2005.– C. 41–42.

Timoshkin Andrey Ivanovich,
candidate of physical and mathematical sciences,
National Metallurgical Academy of Ukraine
Ukraine, Dnepr
E-mail: timoshkin1964@gmail.com

TESTABLE DUAL-CHANNEL CIRCUITS OF DIGITAL COMPARATORS

Abstract: The article presents testable dual-channel logical circuits of digital comparators. These circuits intend for implementation as printed circuit board assemblies.

Keywords: testability, dual-channel digital comparators, printed circuit board assembly.

It is known fact that the functional testing and diagnosis of faults in printed circuit board assembly of communications electronics (CE) is one of the longest and most labor-intensive stages of their production and operation [1]. The issue of duration of functional testing of printed circuit board assemblies and CE units, as well as labor intensity can be alleviated by increasing their testability.

A prospective approach in the testability improvement of digital printed circuit board assemblies and CE units is described in [2]. This approach is based on the modification (as a rule, the complication) of basic logic gates and the synthesis of testable logic circuits using those gates.

This article presents two testable dual-channel (paraphase) logical circuits of digital comparators, synthesized according to the considered approach and intended for implementation as the printed circuit board assemblies. AND, OR, IDENTITY and XOR special functional gates of two-channel logic are used to draw these circuits, which are implemented as separate monolithic [3] integrated circuits. Special dual-channel functional gates AND and OR are gates of dual-channel tree-structured circuits S_1 and S_2, enclosed in rectangles 1, 2, …, $n-1$ (where n is an even number), respectively in (Fig. 1 and Fig. 2).

EQUIVALENCE and XOR special dual-channel functional gates, enclosed in rectangles, are shown respectively in (Fig. 3 and Fig 4).

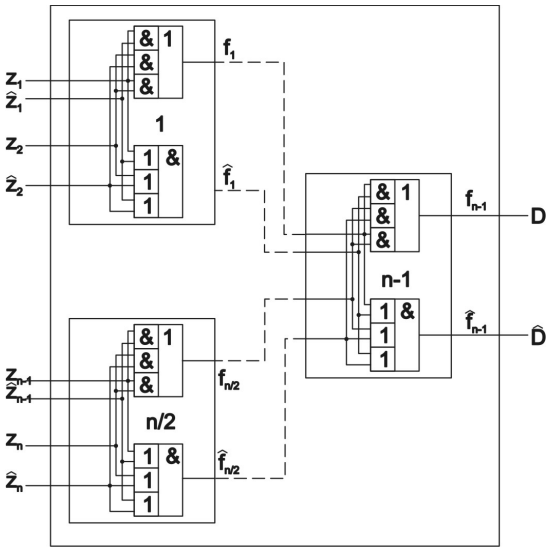


Figure 1. S_1 diagram

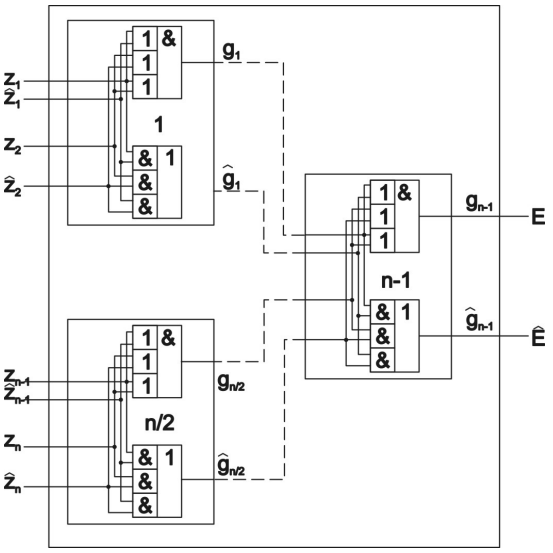


Figure 2. S_2 diagram

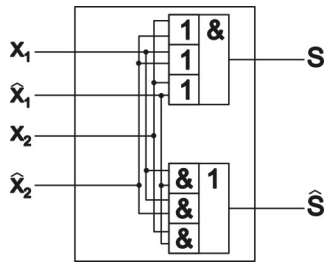


Figure 3.
EQUIVALENCE gate

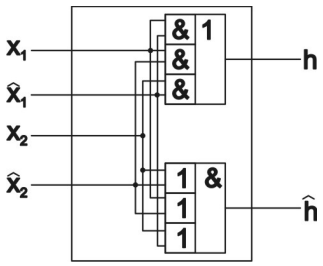


Figure 4.
XOR gate

The main feature of these four types of gates, which distinguishes them from ordinary gates of dual-channel logic architecture [4], is that they possess fault detection tests with a sequence length 2 for single and multiple stuck-at-faults at their inputs and outputs. The structure of these tests for AND and OR gates is the same and is shown in (Table 1).

Table 1.– Fault detection test for AND and OR gates for single stuck-at faults at their inputs and outputs

z_1	z_1	z_2	z_2	f_1	f_1	g_1	g_1
0	1	0	1	0	1	0	1
1	0	1	0	1	0	1	0

The structure of the above mentioned tests for EQUIVALENCE and XOR gates is also the same and is shown in (Table 2).

Table 2.– Fault detection test for EQUIVALENCE and XOR gates for single stuck-at faults at their inputs and outputs

x_1	x_1	x_2	x_2	h	h	S	S
1	1	0	0	1	0	0	1
0	0	1	1	0	1	1	0

For brevity sake, hereinafter these functional gates will be called 2-testable. Full fault detection tests for these functional gates for single stuck-at faults contain five vectors each, and are shown in **Table 3 and Table 4** respectively.

Table 3.– Full fault detection test for AND and OR gates for single stuck-at faults

z_1	z_1	z_2	z_2	f_1	f_1	g_1	g_1
1	0	0	1	0	1	1	0
0	1	1	0	0	1	1	0
1	1	0	0	1	0	0	1
0	0	1	1	1	0	0	1
1	0	1	0	1	0	1	0

Table 4.– Full fault detection test for EQUIVALENCE and XOR gates for single stuck-at faults

x_1	x_1	x_2	x_2	h	h	S	S
0	1	0	1	0	1	1	0
1	0	1	0	0	1	1	0
1	1	0	0	1	0	0	1
1	0	0	1	1	0	0	1
0	1	1	0	1	0	0	1

Necessary and sufficient conditions for 2-testability of functional gates of dual-channel logic structure for single stuck-at faults at their inputs and outputs, as well as tree-structured circuits for single stuck-at faults of signaling lines, were discussed in [5]. Tree-structured circuits S_1 and S_2, that implement AND and OR functions of dual-channel logic structure dependent on n pairs of variables (Z_1,Z_1); (Z_2,Z_2); ...; (Z_n,Z_n) are 2-testable for single and multiple constant faults of signaling lines not belonging to their dual-channel gates according to these conditions. (AND and OR dual-channel gates of these circuits, as already noted, are enclosed in rectangles). These signaling lines ate the interconnections of the printed circuit board assemblies.

Testable dual-channel logical circuits of digital comparators are shown in (Fig. 5 and Fig. 6).

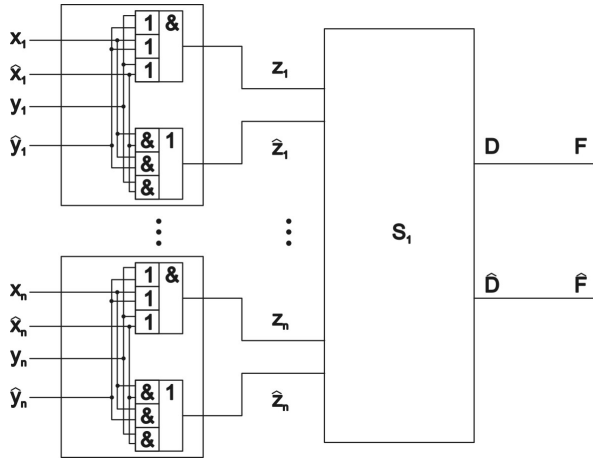


Figure 5. Testable dual-channel logic circuit of a digital comparator. Option 1

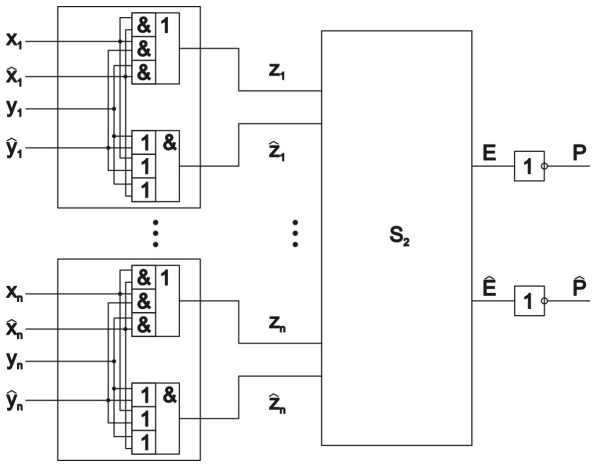


Figure 6. Testable dual-channel logic circuit of a digital comparator. Option 2

They are created by connecting the inputs of the tree-structured circuits S_1 and S_2 to the outputs of parallel units from the dual-channel EQUIVALENCE and XOR gates, respectively.

Fault detection tests for testable dual-channel digital comparator circuits for single and multiple stuck-at faults of signaling lines corresponding to printed circuit board assemblies interconnections, consist of two vectors and are shown in (Table 5).

These tests also detect faults of more than half of AND- and OR-conduits of interconnections of the printed circuit board assemblies under consideration.

Table 5.– Fault detection tests for testable dual-channel digital comparator circuits for single and multiple stuck-at faults in their signaling lines

x_1	x_1	y_2	y_2	...	x_n	x_n	y_n	y_n	F	F	P	P
1	1	0	0	...	1	1	0	0	1	0	1	0
0	0	1	1	...	0	0	1	1	0	1	0	1

Finally, it should be noted that the presented testable logical circuits of digital comparators are self-testable for single and unidirectional multiple of interconnect faults of their printed circuit boards assemblies, since all of the noted faults occur at F, F or P, P outputs as pairs of values of 00 or 11. (Unidirectional multiple stuck-at fault is a multiple fault, in which all its components are single stuck-at faults of the same type: "1" or "0".)

Список литературы:

1. Лихтциндер Б. Я. Внутрисхемное диагностирование узлов радиоэлектронной аппаратуры.– К.: Техника, 1988.
2. Горяшко А. П. Синтез диагностируемых схем вычислительных устройств.– М.: Наука, 1987.
3. Мурога С. Системное проектирование сверхбольших интегральных схем.– М.: Мир, 1985.
4. Апериодические автоматы / Под ред. В. И. Варшавского.– М.: Наука, 1976.
5. Тимошкин А. И. О реализации некоторых функций двухканальной логики 2-проверяемыми древовидными схемами // Радиопромышленность. 1994.– № 4.– С. 52–58.

Timoshkin Andrey Ivanovich,
candidate of physical and
mathematical sciences, professor
National Metallurgical Academy of Ukraine
Ukraine, Dnepr
E-mail: timoshkin1964@gmail.com

TESTABLE LOGICAL CIRCUIT OF A BINARY ARRAY MULTIPLIER IN NONSTANDARD BASIS

Abstract: In the information processing systems LSIs with regular structure (adders, substractors, array multipliers, array dividers and so on) perform increasable part. A testable functional – logical circuit of a binary array multiplier in nonstandard basis has been elaborated. The circuit being represented possesses a fault detection test of the length of three and a small hardware complexity.

Keywords: logical circuits with regular structure, stuck-at fault, fault detection test.

It is easier to design testable digital integrated circuits with a regular structure, including adders, multipliers, substractors, dividers, and various memory circuits, than integrated circuits with an irregular structure. The article [1] presents a testable functional logical circuit of a binary array multiplier with a fault detection test with a sequence length 5 for single stuck-at faults. However, its implementation requires a significant amount of hardware resources, which is a major flaw. This article proposes a testable functional logical circuit of a binary array multiplier with a fault detection test with a sequence length 3 of the same fault class and with less hardware complexity.

Layers of 1-bit adders combined within each layer into parallel adder with serial transfer are the basis of this circuit. At the same time, the construction of a testable 1-bit adder circuit that underlies the multi-bit adder of each layer is based on the representation of the sum S and transfer P functions of a full 1-bit adder as polynomials dual to the Zhegalkin polynomials [2, p. 24] (since the sum S and transfer P functions are self-dual) and also on the fact that these polynomials for sum S and transfer P functions of a 1-bit adder are simple:

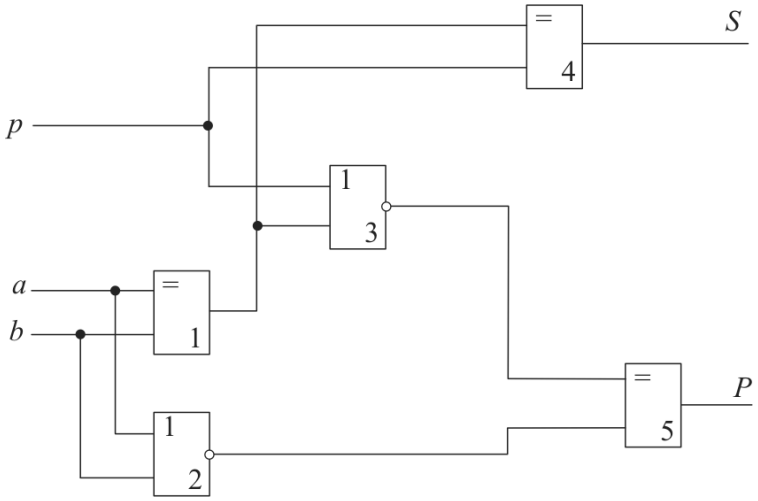
$$P = (a \vee b) \odot (a \vee p) \odot (b \vee p),$$
$$S = a \odot b \odot p, \qquad (1)$$

where a and b are the values of the original 1-bit operands; p and P are the values of the input and output transfer signals, respectively, S is the value of the sum signal, $\vee$ is the symbol of the disjunction operation, $\odot$ is the symbol of the biconditional operation (equivalence).

The formula for the transfer function P from (1) can easily be converted to convenient form:

$$P = (a \vee b) \odot \left[p \vee (a \odot b) \right] = (a \vee b) \odot \left[p \vee (a \odot b) \right] \qquad (2)$$

Then the testable logical circuit of the 1-bit adder can be implemented in a logical basis consisting of NOR and EQUIVALENCE two-input gates. This diagram is shown in (Fig. 1). At the same time, a rather simple schematic diagram of EQUIVALENCE gate on MOS transistors, containing only 3 transistors [3, p. 196], is known. This scheme is shown in (Fig. 2). The fault detection test for the 1-bit adder circuits in the selected basis for all single stuck-at faults contains 3 vectors and is described in table shown in (Fig. 1). Stuck-at-0 fault at the inputs of the EQUIVALENCE gate 5 are tested using the input vectors that feed the inputs of this gate with sets of «01» and «10», i.e. on the first and second input test vectors.



	p	a	b	S	P
1	0	0	1	1	0
2	0	0	0	0	0
3	1	1	0	0	1

Figure 1. Testable 1-bit adder circuit and its fault detection test

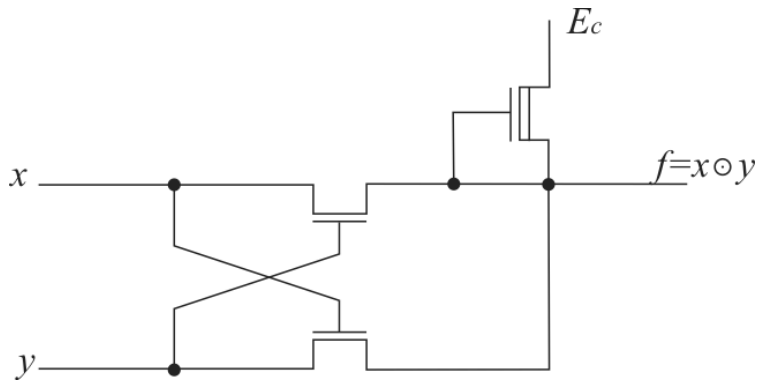
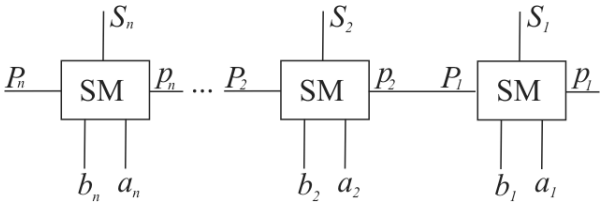


Figure 2. Schematic of EQUIVALENCE gate in MOS transistors

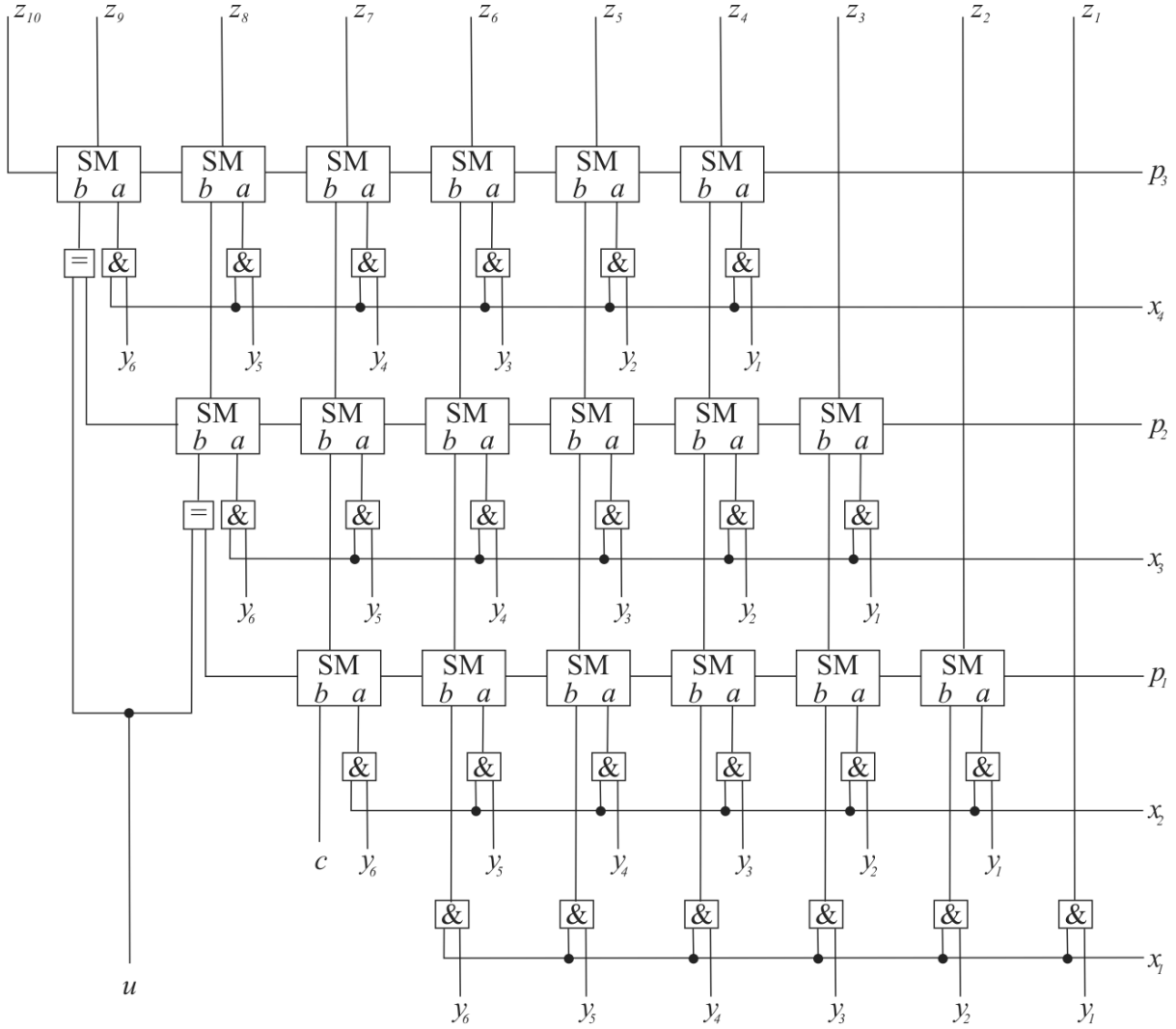
The testable n-bit (n is a positive integer) circuit of the binary adder of each layer of the array multiplier is composed of n testable circuits of a full 1-bit adder connected in a regular manner, i.e. by connecting the transfer output of i-th circuit with the transfer input of $(i+1)$-th circuit, where $1 \le i \le n-1$. This circuit diagram is shown in Fig. 3. A fault detection test for a testable circuit of n-bit binary adder for all its single stuck-at faults is conducted by simply iterating the test shown in (Fig. 1).

The testable functional-logical circuit of a single-contact $n \times m$ bit array multiplier (where n is the number of multiplicand bits, m is the number of multiplier bits) for array with $n = 6$, $m = 4$ is shown in (Fig. 4). This circuit, as well as the circuit of a conventional 6 × 4-bit array multiplier, contains three layers of adders and four layers of conjunctors. However, adder circuits are implemented using the above formulas. In addition, the considered circuit contains two additional two-input EQUIVALENCE gates and one additional input u. In this case, in the operating mode, the logical(0) signals are fed to the inputs c, u, p_1, p_2, p_3. The fault detection test for all single stuck-at faults of this circuit contains 3 vectors and is described in table shown in (Fig. 4).



p_1	b_1	a_1	b_2	a_2	b_3	a_3	...	S_1	S_2	S_3	...
0	1	0	1	0	1	0	...	1	1	1	...
0	0	0	0	0	0	0	...	0	0	0	...
1	0	1	0	1	0	1	...	0	0	0	...

Figure 3. Testable n-bit adder circuit and its fault detection test



	u	c	y_1	y_2	y_3	y_4	y_5	y_6	x_1	X_2	x_3	x_4	p_1	p_2	p_3	z_1	z_2	z_3	z_4	z_5	z_6	z_7	z_8	z_9	z_{10}
1	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0
2	1	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	1	1	1	1	1	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1

Figure 4. Testable circuit of 6 × 4-bit array multiplier and its fault detection test

The synthesis of the test sequence for the considered testable circuit of binary array multiplier can be carried out on the basis of a combination of formal and heuristic methods. First, a fault-detection test is created for the 1-bit adder circuit using formal methods (for example, using D - algorithm [4, p. 236]), and then, using this test as a basis, a general test sequence is built for the array multiplier circuit using heuristic methods. It is easily seen that in general, when n and m – are arbitrary positive integers, then testable functional logical circuit of a single-contact array multiplier contains $m-1$ adders with serial transfer, m, layers of conjunctors, as well as $m-2$ additional two-input EQUIVALENCE gates. The number of additional inputs will not change and will remain equal to one.

The fault-detection test for the general case also contains 3 vectors and is constructed as follows:

– the sequence 1,0,1 ($j \in \{1,2,...,n\}$) is fed to each y_j input;

– the sequence 0,1,1 ($i \in \{2,3,..., m\}$) is fed to each x_i input;

– the sequence 1,1,0 is fed to each x_1 input;

– the sequence 0,0,1 ($k \in \{1,2, ..., m-1\}$) is fed to each p_k input;

– the sequence 0,1,0 is fed to u input, and the sequence 1,0,0 is fed to c input.

The study found that the algorithm for constructing of a fault detection test for the proposed circuit is much simpler than the algorithm for constructing a fault detection test for the circuit found in [1]. The testable circuit found in [1] is also requires significantly bigger amount of hardware resources for its implementation than the proposed testable circuit.

Список литературы:

1. Тимошкин А. И. Контролепригодная схема матричного двоичного умножителя // Электроника: Наука, Технология, Бизнес, 2004.– № 4.– С. 56–57.
2. Яблонский С. В. Введение в дискретную математику.– М.: «Наука». Гл. ред. физ.-мат. лит. 1986.– 384 с.
3. Мурога С. Системное проектирование сверхбольших интегральных схем. Кн. 1.– М.: Мир, 1985.– 288 с.
4. Киносита К., Асада К., Карацу О. Логическое проектирование СБИС. Пер. с япон.– М.: Мир, 1988.– 309 с.

Timoshkin Andrey Ivanovich,
candidate of physical and mathematical sciences, professor,
National Metallurgical Academy of Ukraine
E-mail: timoshkin1964@gmail.com

ON ONE XOR CIRCUIT

Abstract: The article analyses the topological realization of the XOR circuit, which allows detecting all its stuck-at faults by fault detection test with two test-vectors.

Keywords: Basic-circuit arrangement, stuck-at fault, fault detection test.

The article [1], at the functional-logical level, describes the method of realization of linear Boolean functions that essentially depend on all its variables [2, p. 11], in the form of tree-structured circuit, 2-verifiable (i.e., possessing verification tests with sequence length 2 for single stuck-at faults on their signaling lines. At the same time, 2-testable tree-structured circuits were built from three-input XOR gates, which are 2-testable for single stuck-at faults at their inputs and outputs.

However, the 2-testability of the functional gate for stuck-at faults at the inputs and the output (or external signaling lines) does not guarantee its 2-testability for all its stuck-at faults. An analysis of the basic-circuit arrangement of the three-input XOR gate showed that stuck-at faults in most of its internal signaling lines are not detected by a test with sequence length 2 for stuck-at faults on external lines. All this creates a problem of finding such constructive realization of the XOR gate, which would ensure its full 2-testability (for single stuck-at faults), and therefore complete 2-testability of tree-structured circuits using it as basis.

This article proposes a circuit diagram of the XOR gate, 2-testability for all its single stuck-at faults. The proposed 2-testability for all single and multiple stuck-at faults of the three-input XOR gate is based on S_1 basic-circuit arrangement with n -MOS-transistors as its basis, described in [3, p. 177]. Its diagram is shown in Fig. 1. At the paraphase output of the considered circuit, the values of functions $x_1 \oplus x_2 \oplus x_3$ and $\overline{x_1 \oplus x_2 \oplus x_3}$ are simultaneously formed, which allows building multilevel tree-structured circuits with implemented linear Boolean functions without using inverters.

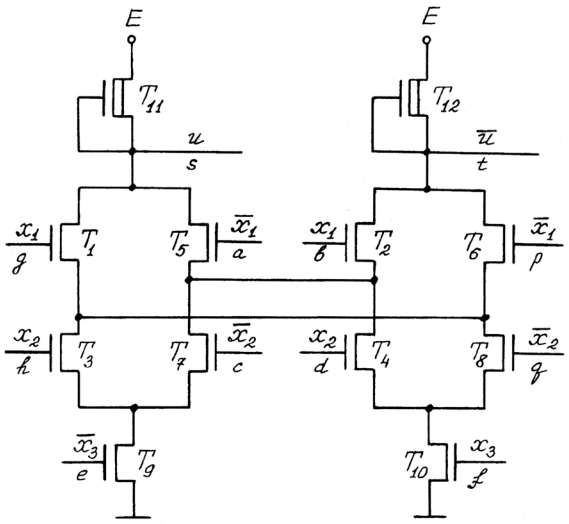


Figure 1. S_1 diagram

Q_1 test of sequence length 2 shown in Table 1 detects singular stuck-at 0 and 1 faults (i.e., stuck-at "$\equiv 0$" and "$\equiv 1$" faults) at the input lines a, b, c, d, e, f and on the output lines s and t of this circuit. In addition, this test detects a single stuck-at 1 fault at the input lines g, h, p, and q. The single stuck-at 0 fault at the input lines g, h, p, and q is not detected by this test. Therefore, in order to solve the problem denoted in this article, it is necessary to modify the original circuit in such a way as to ensure that the stuck-at 0 faults on the g, h, p, and q lines are detected by the test.

Table 1.– Q_1 test

x_1	$\overline{x_1}$	x_2	$\overline{x_2}$	x_3	$\overline{x_3}$	u	$\overline{u}$
1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1

If we combine transistor gates T_1 and T_2 into one gate at the constructive (topological) level, and related input signaling lines b and g into one signaling line, then stuck-at 0 and 1 faults on this line will be detected by the test Q_1, shown in Table 1. Topology of circuit S_2 shown in Fig. 2 is created by executing the aforementioned procedure for transistors T_3 and T_4, T_5 and T_6, T_7 and T_8, and, by replacing a part of metal couplings with diffusive couplings. In this case, we advise to use polysilicon as a material for transistor gates T_1 and T_2, T_3 and T_4, T_5 and T_6, T_7 and T_8.

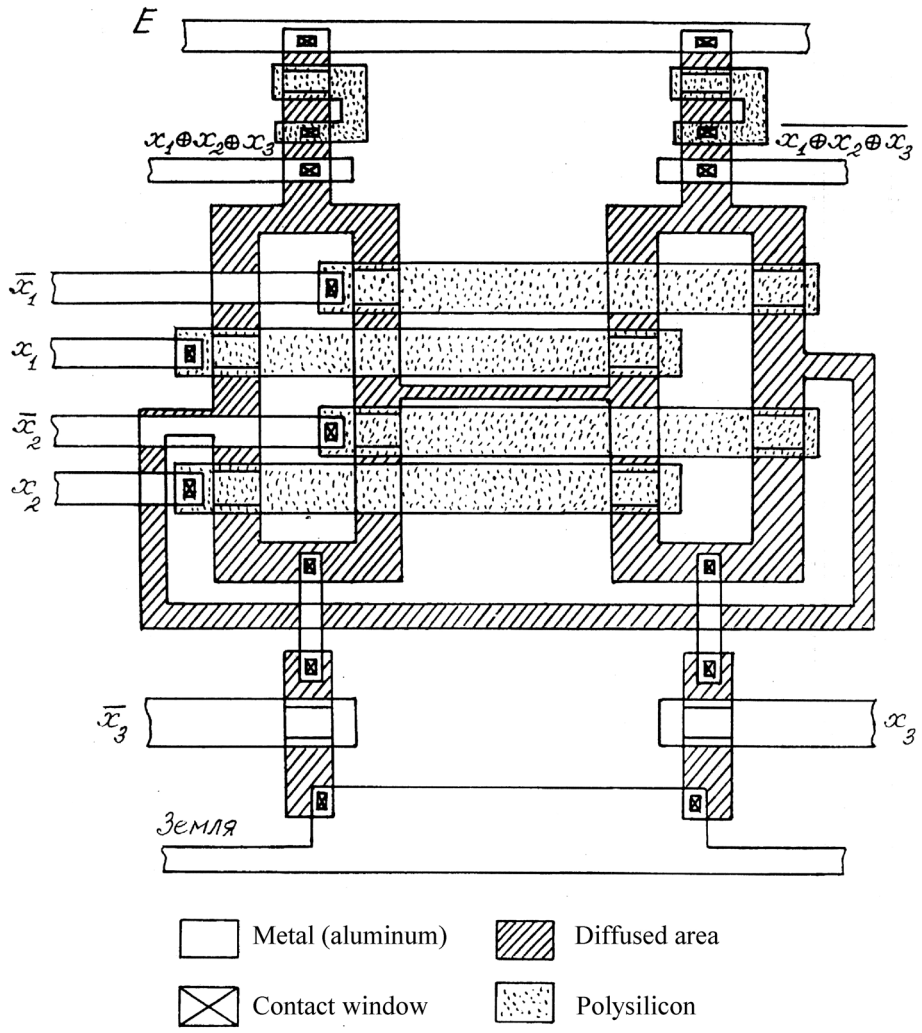


Figure 2. S_2 diagram

All physical defects of circuit S_2, shown in the single stuck-at faults model are detected by the test Q_1. The test also reveals some typical MOS-circuit faults such as source-drain short circuiting [4] of all functional transistors of the considered circuit.

Table 2. Q_{21} test

x_1	$\overline{x_1}$	x_2	$\overline{x_2}$	x_3	$\overline{x_3}$	u	$\overline{u}$
1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1
1	0	1	0	1	0	1	0

Replacing metal couplings with diffusive couplings allows one to significantly reduce the likelihood of such faults as open fault in the sources and drains of transistors T_1, T_2, T_3, T_4, T_5, T_6, T_7 and T_8. Open faults in drains and sources of transistors T_9 and T_{10} are consistently detected by Q_2 test, consisting of 3 vectors and described in (Table 2). This test also detects all single ac fault (delays) at the inputs and outputs of S_2 circuit.

References:

1. Тимошкин А. И. О реализации линейных булевых функций 2-проверяемыми древовидными схемами // Радиопромышленность. 1995.– № 3/4.– С. 90–95.
2. Яблонский С. В. Введение в дискретную математику.– М.: Наука, 1986.– 384 с.
3. Мурога С. Системное проектирование сверхбольших интегральных схем. Кн. 1.– М.: Мир, 1985.– 288 с.
4. Вейцман И. Н., Кондратьева О. М. Тестирование КМОП-схем // Автоматика и телемеханика. 1991.– № 2.– С. 3–34.

Khuseynov Arslonnazar,
candidate of chemical sciences, Senior researcher
Tashkent Chemical Technological Institute
Rakhmonberdiev Gappar,
doctor of chemical sciences, professor,
Tashkent Chemical Technological Institute
Malikova Mavjuda,
candidate of chemical sciences,
Ibragimova Kamola,
Senior researcher,
Tashkent Chemical Technological Institute
E-mail: Ulug85bek77@mail.ru

INFLUENCE OF OBTAINING CONDITIONS OF ACETATEINULIN ON THE STRUCTURE AND ITS MICROBIOLOGICAL ACTIVITY

Abstract: Results of obtaining inulin acetates have been presented in two ways. The quantity of acetyls groups has been defined. The structure inulin acetate was investigated by IR-spectroscopy, X-ray crystal analysis was conducted. The sensitivity characteristic of microbes to acetates of inulin was studied.

Keywords: topinambour tubers, inulin, acetateinulin, IR-spectroscopy, diffraction pattern, sensitivity to microbes.

Inulin – plant polysaccharide-polyfructosan – consists of D-fruktofuranose residue bound β-1,2-glucoside ties, the end residue is presented by sucrose. The key source of inulin is *topinambour*-Helianthus tuberosus. *Topinambour* tubers, thanks to the unique biochemical composition, manifest powerful medical and preventive effect.

Topinambour serves as raw materials for obtaining the products widely applied in medicine and the food-processing industry which are based on inulin. As it is known, inulin has rather wide spectrum of biological activity and its modification can lead to obtaining of the compounds possessing new properties which are not characteristic for most inulin. The hydroxyl groups of this polysacharide are sufficiently reactive and define its basic chemical properties.

From the above-stated follows that inulin ethers can be used as biologically active compounds.

Experimental part. The work is devoted to the obtaining of acetateinulin (AI) in various conditions.

1. 1g of inulin was dissolved in 10 ml formamide, then 5 ml of pyridine and 10 ml of acetic anhydride were added. Heated up at 80–90 °C within 2.5 hours. During the reaction colour of a mixture changed from yellow to dark brown colour. Then the mix was cooled and added in the capacity with 200 ml of distilled water. It was left for 24 o'clock for precipitate formation, then the precipitate was washed with water until all reagent residues were completely removed, exsiccated at room temperature. Output of 1.15 – AI-1. The high yield of AI-1 is due to the fact that full acetylation of inulin occurs, as shown by IR-spectroscopic data – the absence of the absorption band of the OH groups (3200–3600 cm^{-1}).

2. 1g of inulin was acetylated as described above, but at room temperature for 24 hours, precipitated

with water, the precipitate was washed with water until complete removal of the reagents, dried at room temperature. Output of 0.44 g.– AI-2. In this case, there is a partial acetylation of inulin.

Quantitative determination of acetyl groups. 0.1 g of acetateinulin was suspended in 10 ml of water, then added 10 ml of 0.5H NaOH, left for saponification for 20–22 hours. Then titrated with 0.5H HCl, indicator: phenolphthalein. At the same time a control experiment was conducted [1].

Consumption of 0.5N HCI was:

– control experiment – 10 ml(v1)
– worker – 1–7.1 ml (v2)
– worker – 2–6.5 ml (v2)

$$\%OA_c = \frac{(V_1 - V_2) \cdot F \cdot 0.0295 \cdot 100}{g}$$

V_1 – the volume of a 0.5 n solution of HCI consumed for the titration of a control sample, ml.

V_2 – the volume of a 0.5n solution of HCI consumed for the titration of a working sample, ml.

F – correction factor 0.5n solution of HCl.

0.0295 – the number of acetate groups corresponding to 1 ml of exactly 0.5n solution of HCl, g

g – a portion of inulin acetate, g

Table 1.– Physical-chemical characteristic of acetateinulins

Experimental Conditions	Yield,%	Quantity of acetyl groups,%	IR, sm^{-1}
1 g of inulin, 10 ml of formamide, 5 ml of pyridine, 10 ml of acetic anhydride 24 hours at 20 °C	74	39	3600–3200, 1750, 1427, 1375, 1332, 1240, 1134, 915, 874, 817.
1 g of inulin, 10 ml of formamide, 10 ml of acetic anhydride, 5 ml of pyridine, 2.5 hours at 80–90 °C	115	59–60	1750, 1427, 1375, 1332, 1240, 1134, 915, 874, 817.

It should be noted that in the first case acetateinulin is an amorphous powder readily soluble in acetone. According to the analysis, the quantity of acetyl groups is 85.5%.

Acetateinulin, obtained at room temperature with a yield of 44%, is a white crystalline powder, also well-soluble in acetone. The number of acetyl groups is 59%.

The synthesized inulin esters were characterized using IR-spectroscopy (Figure 1).

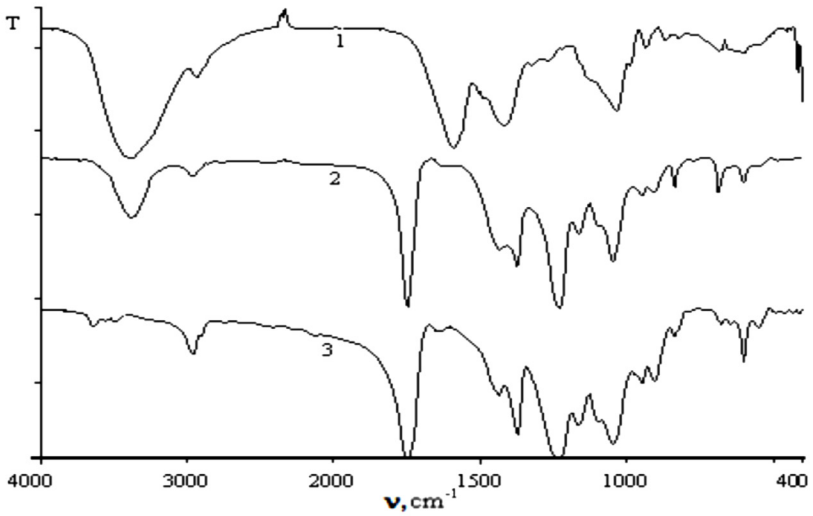


Figure 1. Infra-red spectra of inulin (1), AI-1 (2) and AI-2 (3)

The IR-spectra of the samples were taken on a Fourier transform infrared spectrometer System 2000, Perkin-Elmer (USA production), in tablets with KBr infrared range of 4000–400 cm^{-1}.

The figure shows the IR spectra of inulin, AI-1 and AI-2. As it can be seen from the figure, in the IR spectrum of inulin there is a wide absorption band of the hydroxyl group in the region of 3600–3200 cm^{-1} and other absorption bands in the regions of 1427, 1332, 1250, 1134, 915, 874, 817 cm^{-1}, characteristic of fructans type of inulin [2; 3].

As a result of esterification with acetic anhydride, the band of the hydroxyl group in the region of 3600–3200 cm^{-1} AI-1 practically disappears, which indicates the acetylation reaction, while new intense absorption bands appear in the regions of 1750 cm^{-1} (C = O), 1375 cm^{-1} (C–CH_3) and 1240 cm^{-1}(C–O) related to bond vibrations in acetate groups.

In the IR spectrum of AI-1, there is no absorption band of the hydroxyl group, since acetylation is complete; in the case of AI-2, acetylation occurs partially.

Absorption bands are present in AI-1 and AI-2, which characterize the presence of acetyl groups: 1748, 1241 cm^{-1}.

X-ray phase analysis was performed using a DRON-3M diffractometer (Russia production) [4]. CuKα radiation extracted by nickel filter with a wavelength λ = 1.542 Å was used. The operating voltage was 22 kV, the anode current strength was 12 mA.

As it can be seen from the experimental data, samples of inulin obtained from tapinambour have a crystal structure, which is visible from X-ray diffraction patterns which is in accordance with the literature data. X-ray phase analysis showed that the samples of inulin AI-1 and AI-2 are observed, the crystalline peak at 2θ = 22.5 °, while at AI-1 the crystal reflexes have a wider shape(Fig. 2). This is due to the fact that in powder samples the distribution of crystallites in various modifications leads to line broadening.

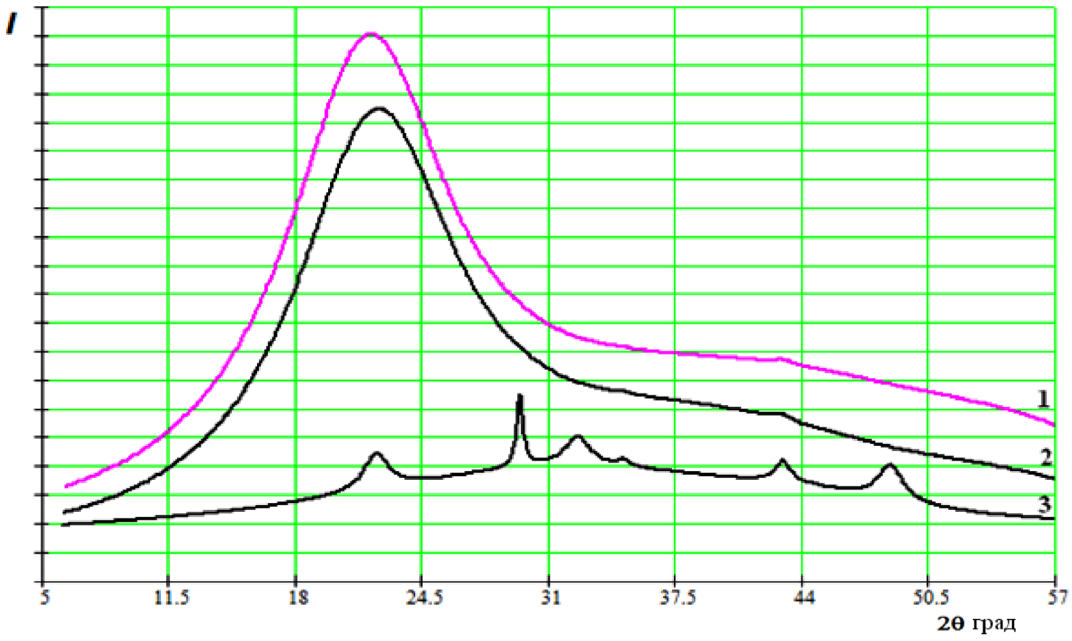


Figure 2. Diffractogram of inulin samples and inulin acetates obtained under different conditions AI-1, AI-2, 3-inulin

The received X-ray diffraction patterns show that the samples of acetateinulins differ in their crystal structure depending on the preparation conditions and are characterized by different packing of the elementary units in the crystal cell.

As it can be seen from X-ray phase analysis, inulin is observed crystal reflections at 20 = 22.1 °, 29.5 °, 31.9 °, 43 ° and 48.5 °, associated with X-ray diffractions from different planes, which have an interplanar distance d = 3.995 Å, 3.028 Å, 2.818 Å, 2.103 Å and 1.877 Å.

In the samples of inulin acetates, a more amorphous structure and an amorphous halo are observed with a broadening X-ray diffraction angle over the whole region, which have a maximum at 20=22.1 °, associated with changes in the interplanar spacing of inulin crystals.

Currently, the creation of medicinal agents with antibacterial action is a very promising direction, since it allows not only to prolong the effect of the antibacterial drug due to its long-term deposition, but also to change the effect on cellular inflammatory factors.

According to the latest literature data [5; 6; 7], the sensitivity of microorganisms to chemical preparations is determined in two ways:

1. Disk-diffusion method is a method of diffusion in agar using paper disks saturated with chemical preparations.

2. The method of serial dilutions of chemicals in dense or liquid nutrient media with the introduction of microbes into them.

Among these methods for determining the sensitivity of microbes to chemicals, the disco-diffusion method is the most common. The frequency of using this method can be explained by its advantages such as technological accessibility of testing, low cost, flexibility – that is, the ability to determine the sensitivity to the drugs that are required in this clinical situation, high reproducibility of the results while observing the conditions of testing and preparation of consumables.

Considering the above, we carried out studies on the sensitivity of some microorganisms that are most commonly found in various biotopes of the human body to acetateinulin according to the first method (Table 2.).

Table 2. – Characteristics of the sensitivity of microbes to the acetateinulin preparation(AI-1)

№	Groups of microbes	Acetateinulin /M + м/		
		10 mg	50 mg	100 mg
1	Staphylococcus aureus	13.0 ± 0.2	17.0 ± 0.3	20.0 ± 0.4
2	Staphylococcus epidermidis	10.0 ± 0.1	12.0 ± 0.2	15.0 ± 0.3
3	Staphylococcus saprofiticus	10.0 ± 0.1	12.0 ± 0.2	15.0 ± 0.3
4	Streptococcus pyogenes	20.0 ± 0.4	17.0 ± 0.3	20.0 ± 0.4
5	Escherichia coli	17.0 ± 0.3	12.0 ± 0.2	10.0 ± 0.2
6	Proteus vulgaris	10.0 ± 0.1	12.0 ± 0.2	12.0 ± 0.2
7	Klebsiella	17.0 ± 0.3	25.0 ± 0.5	25.0 ± 0.5
8	Pseudomonas aeruginosa	20.0 ± 0.4	10.0 ± 0.1	10.0 ± 0.2
9	Candida albicans	0	0	0
10	Actinomycetae	12.0 ± 0.2	20.0 ± 0.4	22.0 ± 0.4

Note: units are given in mm of microbes growth inhibition zones

From (table 2) it can be seen that acetateinulin in low concentrations of 10 mg, had an antibacterial effect on the strains of such microbes as: streptococci, Escherichia, Klebsiella and Pseudomonas, all other microbial strains taken in the experiment were poorly-sensitive.

The same drug, only in medium concentrations of 50 mg, had an antibacterial effect on staphylococci, streptococci, Klebsiella and actinomycetes. At the same time, all other microbes were poorly sensitive.

AI-1 at an enhanced concentration of 100 mg, had a significant antibacterial effect on most mi-

crobes and only gram-negative flora proteus and pseudo-manas turned out to be weakly sensitive.

It is interesting to note that the culture of Candida albicans showed insensitivity to acetateinulin in all tested concentrations. Apparently, this is due to the fact that the fungi of the Candida genus in their structure belong to eukaryotes and their cell wall does not contain pectidoglycane.

Thus, based on the conducted microbiological studies, it can be concluded that the acetateinulin preparation, especially in high concentrations of 50 mg, can be used for the treatment of purulent-inflammatory diseases of coccine aetiology, as well as for diseases in which Klebsiella and actinomycetes prevail.

Conclusion:

Acetateinulins were obtained and their physico-chemical properties were investigated. It is shown that the temperature regime influences on the yield of acetateinulin and the amount of bound acetyl groups. The resulting product was investigated by IR-spectroscopy and the presence of absorption bands of 1241, 1748 cm^{-1} indicates the presence of acetyl groups. And also shows the sensitivity of some microbes to acetateinulin.

References:

1. Toroptseva A. M., Belgorodskaya K. V., Bondarenko of Century of M. The laboratory practical work in chemistry and production engineering of high-molecular compounds. – L., Chemistry, 1972.– P. 136–137.
2. Rahmanberdiev G. R., Kadirov O. Sh., Husenov A. Sh. Obtaining inulin from tubers of topinambour and characteristic IR-bands // Republican scientific practical conference "Actual problems of chemistry of high-molecular compounds" – Bukhara, 2010.– P. 62–64.
3. Rakhimov D. A., Filippov M. P., Shepel D. F., Khusenov A. Sh., Kadirov O. Sh., Rahmanberdiev G. R. Study of topinambour tubers by an infra-red spectroscopy method // Chemistry and chemical technology.– Tashkent, 2009.– No. 3.– P. 69–72.
4. Martynov M. A., Vylegdjanina K. A. X-radiograph of polymers.– M.: Chemistry, 1972.– 94 p.
5. Bondarenko V. M. Early stages of development of infectious process and a role of normal microflora // the Bulletin of The Russian Academy of Medical Science.– M.: 1997.– Vol. 42.– No. 10.– P. 46–48.
6. Vorobev A. A., Krivoshein A. I. Medical and sanitary microbiology.– M: 2004.– 462 p.
7. Tsarev V. N. Microbiology, virology and immunology.– M.: 2010.– 543 p.

Rakhmonberdiev Gappar Rakhmonberdievich,
doctor of chemical sciences,
professor, Tashkent Chemical Technological Institute
Khuseynov Arslonnazar Shernazarovich,
candidate of technical sciences,
Tashkent Chemical Technological Institute, Senior researcher
Ibragimova Kamola Sadritdinovna,
Senior researcher,
Tashkent Chemical Technological Institute
Baltabayev Ulugbek Narbaevich,
The doctor of philosophy on technical science(PhD)
Tashkent Chemical Technological Institute
E-mail:Ulug85bek77@mail.ru

RESEARCH OF TUBERS OF A PLANT OF TOPINAMBOUR (HELIANTHUS TUBEROSUS L.)

Abstract: Polymerisation degree of inulin is equal, approximately 35 monosaccharide residua. In tubers topinambour contains inulin from 15 to 35% which in the course of a metabolism turns to fructose and does not demand for the mastering of insulin that is very important for sick of diabetes. Thus, complex research of topinambour for the purpose of obtaining inulin from tubers and cellulose from its components is suitable for the further chemical processing, gives possibility as the whole to obtain import substitution products and to creation of nonwaste technology. Samples of cellulose have been studied by methods of sorption of water steams, IR-spectroscopy, roentgenography (X-ray photography), also electronic and light microscopy.

Keywords: Topinambour, raw materials, Earthen part, Glycoinuvite represent, powder, extraction, definition of crystallinity.

Introduction. Topinambour or an earth apple (Helianthus tuberoses L.) – perennial largely grassy plant of the family of Asteraceae is cultivated in many countries of the world [1], including in Uzbekistan.

Topinambour is valuable raw materials for obtaining inulin – natural polysaccharide, consisting of 95% from the fructose which links in furanose form in a polymeric chain are connected among themselves 2 → 1 by linking [2]:

$$\beta\text{-D-Fruf-2} \rightarrow (1\ \beta\text{-D-Fruf-2} \rightarrow)_n 1\text{-Fru}$$

Polymerisation degree of inulin is equal, approximately 35 monosaccharide residua. In tubers topinambour contains inulin from 15 to 35% which in the course of a metabolism turns to fructose and does not demand for the mastering of insulin that is very important for sick of diabetes. Inulin obtained from tubers topinambour is sugarlowering preparation and differs from others sugarlower ones that it operates on all kinds of a diabetes.

The other topinambour stalks are valuable raw materials for reception of many important products, in particular, cellulose and its ethers. Thus, complex research of topinambour for the purpose of obtaining inulin from tubers and cellulose from its components is suitable for the further chemical processing, gives possibility as the whole to obtain import substitution products and to creation of nonwaste technology. Earthen part (tuber) of topinambour

grown up in Kibray district of Tashkent area and in Beruni district in the Republic of Karakalpakistan serves as the object of research.

At obtaining glycoinuvite the tuber of topinambour is peeled with knife or the special device. The cleared raw materials are subjected to cutting and dried at temperatures 55–65 °C in a current of hot air or under vacuum at 1–5 mm of a mercury column. Glycoinuvite represents a powder of white colour with the cream shade, passing through a sieve with diameter of apertures 0.1 mm; has earthy smell and sweetish mucous taste.

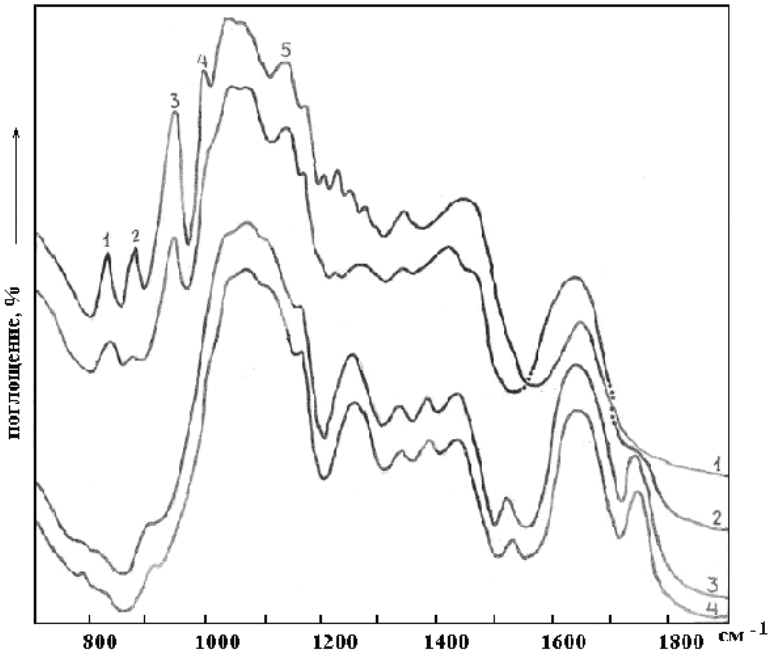
Inulin obtained from glycoinuvite by dissolution of the last in hot water with the subsequent sedimentation inulin from a water solution acetone addition in the ratio 1.0 : 1.0. As process of acetone addition (within 15–20 minutes) the white voluminous powder begins to drop out, which precipitating to cooling at temperatures 5–10 °C within 4 hours.

Then a deposit is separated filtering, washed out acetone, dried up, crushed and passed through a sieve with diameter of apertures 0.1 mm. Obtained inulin makes 14(14% from weight glycoinuvite) which subjected to various analyses.

By IR – spectroscopy components of topinambour tubers have been investigated: juice, extracts from tubers, cellular walls after inulin extraction. At discussion of results only the most informative area ("a print of fingers") a spectrum 700–1900 sm^{-1} [3–6] has been considered.

400–700 sm^{-1} – area has been presented by group of strongly blocked weak strips against absorption of sorption waters and has not been carried for studied substances of the essential information.

In area above 1900 sm^{-1} characteristic strips of valence fluctuations $\nu_{(CH)}$(2600–3000 sm^{-1}) and $\nu_{(OH)}$(a wide and difficult strip 3300–3500 sm^{-1}) have been located. These frequencies are not specific and are not the individual characteristic of studied substances as they are observed in spectra of all organic connections containing these groups.



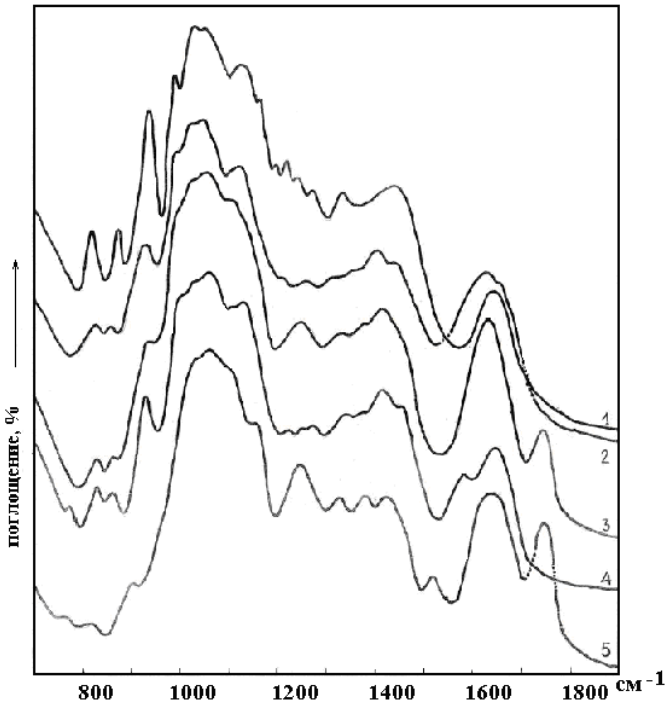
Fugure 1. Infra-red spectra of tuberous topinambour: 1 – inulin, 2 – tuber flour, 3 – after extraction of cold water, 4 – after extraction of hot water

In (figure 1) inulin spectra (a spectrum 1.1 are resulted.), tuber flour (1.2) and residuum mass after inulin extraction (1.3 and 1.4). The greatest distinction of inulin spectrum from spectra of cellular walls

of a tuber are observed in the field of 800–1200 sm^{-1} where difficult strips of polysaccharide are located, including-SS – and-CO – fluctuations of carbohydrate rings [2; 3; 5]. This area is characteristic for every polysaccharide and can be an individual spectral sign [4].

Apparently from fig. 1 in spectrum 1 inulin strips 1.1 are observed.– 820 sm^{-1}, 1.2.– 875 sm^{-1}, 1.3.– 940 sm^{-1}, 1.4.– 990 sm^{-1} and 1.5.– 1135 sm^{-1} which are absent in spectra 3 and 4. All these strips are to some extent shown in a spectrum of flour 2. From group of strips 1.1.– 1.5. it is necessary to note a strip 940 ± 2 sm^{-1} of average intensity on which it is convenient to estimate the maintenance of inulin in topinambour tuber.

Therefore on this strip the presence of inulin has been judged at research of various parts of topinambour tubers



Fugure 2. Infra-red spectra of tuberous topinambour: 1 – inulin, 2 – juice, 3 – the pulp which has been squeezed out from juice, 4 – extraction of cold water, 5 – pulp after cold water extraction

Proceeding from spectra in (figure 2) it is possible to draw following conclusions: in a free condition inulin contains in juice of tubers (spectrum 2), its residual quantities – in squeezing (a spectrum 3), in water extract pass the residua of unsqueezed out inulin (a spectrum 4), the pulp after water extraction practically does not contain inulin (spectrum 5).

After obtaining pure inulin it is subjected to various reactions of etherification for the purpose of obtaining its derivatives, nitrate, acetate and carboxymethylinulin have been obtained.

Nitrate inulin has been obtained by nitration of inulin nitrated mixture of following structure: HNO_3–21%; H_2SO_4–70%; H_2O – 9% which is usually used for cellulose nitration [7]. The module of nitration 1:20, temperature of nitration in the range of temperatures 10–20 °C, and at time of nitration – 10 minutes.

The obtained nitrate inulin has humidity of 2.0%, temperature of fusion 210–212 °C at the maintenance of nitrogen of 10.24%.

In IR – nitrate inulin spectra there are absorption strips in areas of 1542 sm^{-1} for CH_2 – ONO_2 groups and 1032 sm^{-1} – for-ONO_2 primary groups, accordingly. Nitrate inulin has had molecular weight 850–10500.

It has been investigated hypoglicemic activity of nitroinulin. Research has shown, that nitroinulin in equal doses on sugarlowering activity is more effective than inulin.

Also, acetate and carboxymethylinulin have been obtained while pharmo-toxicological researche is proceeding.

After the use of topinambour fruits remained stalks (aerial) part are considered as a waste till now and, not finding of practical application are burnt, polluting environment. However, by preliminary researches it is shown, that in topinambour stalks is available more than 40% of cellulose.

In connection with this experiments on the obtaining cellulose from topinambour stalks by alkaline cooking have been spent [8; 9]. On the basis of research the optimum regime of cooking of topinambour vegetative part has been chosen:

Concentration NaOH – 20 g/l;

Temperature – 150 °C;

Cooking time – 20 minutes.

At an optimum regime of cooking the yeild of cellulose from topinambour made 43%, humidity 3.0–3.1%, ash percentage 0.86–0.87%, maintenance α – cellulose 90–91% and the degree of polymerisation 1250–1260. Samples of cellulose have been studied by methods of sorption of water steams, IR-spectroscopy, roentgenography (X-ray photography), also electronic and light microscopy [10].

Definition of crystallinity degree (CD) of samples of cellulose from topinambour has shown, that value of CD is much less than cellulose from wood of poplar, cotton lint, that it testifies to its more porous structure in comparison with other samples of cellulose. It means that cellulose from topinambour more retrograde to various etherification reactions and is also suitable for the further chemical process.

References:

1. Shain S. S. "Topinambour" ZOA «Phyton».– M. 7, 2000.– 128 p.
2. Kochetkov N. K., Bochkov A. F., Dmitriev B. A., Usov A. I., Chijov O. S., Shibayev V. N. "Chemistry of carbohydrates" Pub. «Chemistry»,– M., 1967.– 567 p.
3. Jbankov R. G. "IR spectra of cellulose and its derivatives". Pub. "Science and practice",– Minsk, 1964.– 123 p.
4. Sherbukhin V. D. "Application of IR spectroscopy in the research of carbohydrates". Achievement in bio. sci., 1968.– V. 9.– P. 198–219.
5. Sivchik V. V., Filippov M. P., Jbankov R. G. "Theoretical study of vibrational spectrum of pectine". Magazine of applied spectroscopy. 1986.– V. 45.– No. 3.– 513 p.
6. Filippov M. P. Practical Infrared Spectroscopy of Pectin Substances. Food Hydrocolloids, 1992.– V. 6.– No. 1.– P. 115–142.
7. Ragovin Z. A., Shorigina N. N. " Chemistry of cellulose and its satellites". – M–L., 1953.– 678 p.
8. Rakhmonberdiyev G. R., Ibragimkhodjayev A. M., Arslanov Sh. S. "Obtaining cellulose from stalks of annual plants "Topinambour"" Col. res. International theoretical and practical conf. Resource and energy conservation in the cellulose-paper industry and city communal services.– Sankt-Peterburg, 2005.– 68 p.
9. Ibragimkhodjayev A. M., Rakhmonberdiyev G. R., Murodov M. M., Kodirov O. Sh. "Influence of ripening process of cellulose from topinambour on its fractional composition. Chemistry and chemical technology.– Tashkent, 2009.– No. 4.– P. 57–58.
10. Ibragimkhodjayev A. M., Rakhmonberdiyev G. R., Sidikov A. S., Khuseynov A. Sh. "Characteristics of permolecular structure of cellulose obtained from topinambour (Helianthus tuberosus L) and poplar wood". Chemistry and chemical technology.– Tashkent, 2008.– No. 2.– P. 40–43.

Section 7. Physics

Shukurlu Yusif,
Sheki Regional Scientific Center of the
National Academy of Sciences of the
Republic of Azerbaijan Sheki, Azerbaijan
E-mail: shrem@science.az

THE THIRD STAGE OF THE DIFFUSION PROCESS OF FISETIN MOLECULE IN THE FIBROIN FIBER

Abstract: The previous article stated that the diffusion of the dye continues until it reaches an equilibrium concentration in the entire volume of the fiber. This period was mentally divided into three stages: 1) adsorption of fisetin molecules on the surface of fibroin fibers; 2) moment when fisetin molecules reach the center of the fibroin fiber. Since the first stage occurs almost instantaneously, it is almost impossible to separate this stage from the second stage during which the actual dyeing occurs. We combined the first and second stages of diffusion and devoted a previous article to them. The third stage begins after the completion of the second and continues until the equilibrium concentration is restored in the entire volume of the fiber. This article is focused on the third stage of diffusion of flavonoid fisetin molecules in the fibroin fiber. This article also uses a three-dimensional physical model of the diffusion of dyes in the fiber. We established mathematical relations that describe the kinetics of dye diffusion at the third stage of the dyeing process.

Keywords: dye solution temperature; electrolyte concentration in the solution; diffusion kinetic parameters; physical model of distribution; kinetic characteristic of diffusion.

Results and discussion (continuation of [1])

By using the three-dimensional model and carrying out simple mathematical calculations, it can be shown that at the moment when the dye reaches the center of the fiber, the concentration of penetrating dye molecules is equal to $2C_\infty / 3$. The model uses figure with volumes equal to $2\pi r_0^2 / 3$ (Fig. 6) to express the concentration. As one can see during the third stage, the remaining volume with concentration: C_t^{III} is equal to $\pi r_0^2 / 3$, and in this volume the maximum concentration should be equal to one third of the concentration of the dye at the fiber edges: C_∞, which is equal to $C_\infty / 3$. Consequently, the dye diffusion intensity in the fiber at the third stage of the process is determined by the first Fick's law, the difference in concentration potentials at the edges and in the center of the fiber, can be composed as the following equation:

$$dQ_{III} = \mathrm{D}\frac{\frac{1}{3}C_\infty - C_t^{III}}{r_0} S m_0 dt, \qquad (21)$$

where dQ_{III} is mass quantity of fiber transported over time dt, inside the fibers at the third stage of diffusion; C_t^{III} is the concentration of dye molecules penetrating during an arbitrary period of time t, that has passed since the beginning of the third stage; D is the diffusion coefficient; S is the active area of the fiber.

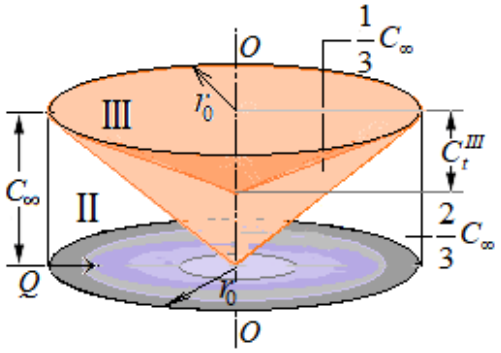


Figure 6. Three-dimensional physical model of the dye diffusion in the fiber at the third stage of dyeing

In order to make sure that S, which is used in the formula (21), and determines area of the active fiber, is equal to $S = 2\pi r_0$, we shall take note of three-dimensional model of fiber (Fig.6) In this model, the height of fibroin fiber shown as a transparent cylinder, equals to one. Taking this into account, the formula (21) can be written as:

$$dQ_{III} = D\frac{\frac{1}{3}C_\infty - C_t^{III}}{r_0}2\pi r_0 m_0 dt = \quad (21\text{ a})$$

$$= 2\pi D\left(\frac{1}{3}C_\infty - C_t^{III}\right)m_0 dt.$$

Figure 6 shows that the mass quantity of the transported dye at the third stage of diffusion can be expressed by the following formulas:

$$Q_{III} = \frac{1}{3}\pi r_0^2 m_0 C_t^{III}. \quad (22)$$

By differentiating (22) with respect to C_t^{III}, the following equation is obtained:

$$dQ_{III} = \frac{1}{3}\pi r_0^2 m_0 dC_t^{III}. \quad (22\text{ a})$$

By comparing (21a) and (22a) with respect to dQ_{III}, the following eqaution is obtained:

$$\frac{dC_t^{III}}{\frac{1}{3}C_\infty - C_t^{III}} = 6\frac{D}{r_0^2}dt. \quad (23)$$

By integrating right-hand side of (23) to C_t^{III}, and left-hand side to dt, we obtain the following:

$$-\ln\left(\frac{1}{3}C_\infty - C_t^{III}\right) = 6\frac{D}{r_0^2}t + c_3. \quad (24)$$

By accepting the end of the second stage and beginning of the third stage as check time, we determine the value of the integration constant – c_3. The third stage of the diffusion process begins at $t_{III} = 0$. At that moment C_t^{III} is equal to 0. Considering that (24):

$$c_3 = -\ln\frac{1}{3}C_\infty.$$

By adding c_3 – (the constant of integration) to (24), we obtain the following equation:

$$-\ln\left(\frac{1}{3}C_\infty - C_t^{III}\right) = 6\frac{D}{r_0^2}t - \ln\frac{1}{3}C_\infty,$$

$$6\frac{D}{r_0^2}t = \ln\left(\frac{\frac{1}{3}C_\infty}{\frac{1}{3}C_\infty - C_t^{III}}\right) \quad (25)$$

or

$$\frac{C_t^{III}}{C_\infty} = \frac{1}{3}\left[1 - \exp\left(-6\frac{D}{r_0^2}t\right)\right]. \quad (26)$$

(26) is the kinetic equation for the concentration of dye molecule that penetrates the fiber at the third stage of the diffusion process.

The kinetic dependence of the relative concentration of fisetin molecules in the fibroin fiber at the third stage of the diffusion process, which is shown in (Figure 7), was constructed based on this equation.

The kinetic equation for the diffusion of dye molecules into fibers (26) at the third stage of the process is especially significant due to the fact that by applying these equations at a given temperature and concentration of the dye, the diffusion coefficient D can be determined. The results of our measurements were used to determine D.

As shown in Figure 1 (in previous article), molecules of fisetin dye that penetrate fibroin fibers introduced into the dye solution at boiling point (373 K) have the maximum concentration equal to

$C_{max} \approx 0.56 g/kg$. This concentration is established in 30 minutes. The comparison shows that the concentration of penetrating dye molecules in the fiber in the second and third stages of diffusion is equal to $C^{II}:C^{III} = 2:1$. Using this dependence and knowing that $C = C^{II} + C^{III}$, we can construct the following equations:

$$C^{II}_{max} \approx 0.37 g/kg \text{ and } C^{III}_{max} \approx 0.19 g/kg.$$

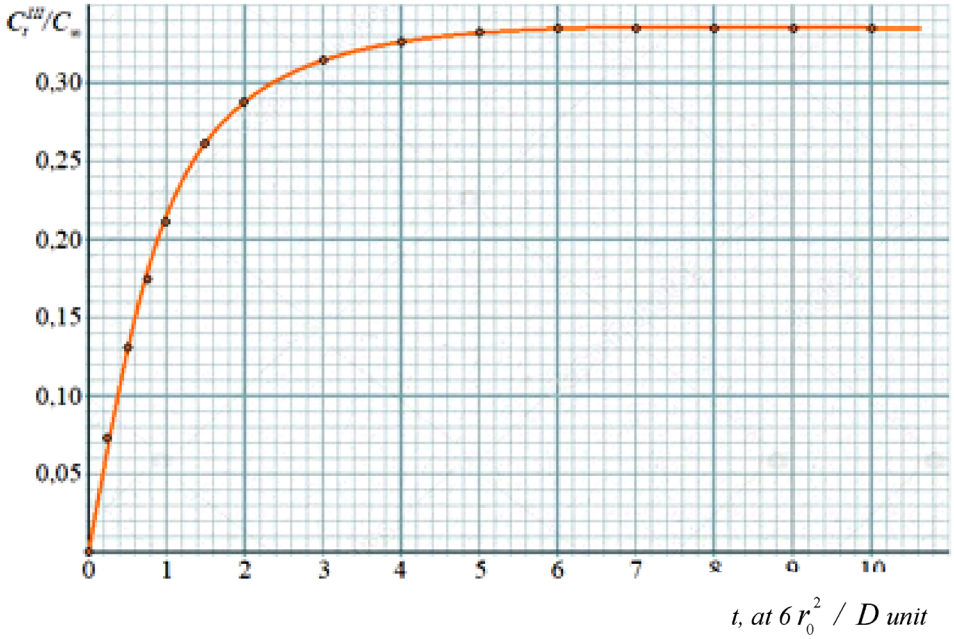


Figure 7. Kinetic curve of the relative concentration of the fisetin dye molecules in fibroin fiber at the third stage of diffusion

We used 4g of fisetin to prepare an aqueous solution of the fisetin dye for each 100g of fibroin. Consequently: $C_\infty = 40 g/kg$.

To caculate average value of D, we use the ratios of the volumes of the second and third stages equal to 2:1, consequently, the ratios between the time of fiber dyeing at the second and third stages is also 2:1. Therefore, by inserting the values of the duration of the second stage: $t_{II} = 20 \min utes$ and the duration of the third stage: $t_{III} = 10 \min utes$, the cross-sectional area of the natural silk fiber is ~370 μm^2 and by accepting the shape of the fiber as a cylinder, we obtain the value for the radius of the cylinder $r_0 = 10.8 \cdot 10^{-6} m$.

To calculate D by (25), we use the following values:

$$D = \frac{r_0^2}{6t} \ln\left(\frac{C_\infty}{C_\infty - C^{III}_{max}}\right) = \frac{118 \cdot 10^{-12}}{6 \cdot 600} \ln\left(\frac{40}{40 - 0.19}\right) \frac{m^2}{s} = 1.56 \cdot 10^{-16} \frac{m^2}{s} = 1.56 \cdot 10^{-12} \frac{cm^2}{s}.$$

By comparison, for a rough safety assessment, diffusion coefficients were measured for 13 radioactive elements in clay media. Authors have found that D values range from $5.0 \cdot 10^{-11} m^2/s$ for *I* and *Tc* (under oxidation conditions) to $5.0 \cdot 10^{-14} m^2/s$ for *U*, *Np* and *Pu* actinides (under reducing conditions) [2]. This shows that the fibroin fiber exhibits viscosity to fisetin molecules hundreds of times higher than clay media to radioactive elements.

We use Nernst-Einstein equation that established relationship between mobility, diffusion, and temperature of the medium to calculate the mobility of the fisetin dye molecule in the *fibroin+water* medium [3]: $D = ukT$,

where u is the mobility of molecules, k is the Boltzmann factor, T is the temperature of the medium. Consequently:

$$u = \frac{D}{kT} = \frac{1.56 \cdot 10^{-16}}{1.38 \cdot 10^{-23} \cdot 373} \frac{m^2}{s} \cdot \frac{K}{J} \cdot \frac{1}{K} = 3.03 \cdot 10^4 \, m/(N \cdot s).$$

Consequently, the mobility of fisetin molecules in the *fibroin+water* medium at the temperature of 373 K is $3.03 \cdot 10^4 \, m/(N{\cdot}s)$.

Due to the fact that in dye-fiber system, the relativity properties of diffusion and sorption determine the color formation rate [3] and correspond to the slow diffusion of the fisetin dye molecules into natural silk fiber $\left(D = 1{,}56 \cdot 10^{-16} m^2/s\right)$ and high-speed sorption $(u = 3.03{\cdot}10^4 \, m/(N{\cdot}s)$ demonstrate affinity between the fisetin dye and the fibroin protein.

As kinetic and thermodynamic parameters, there is a very complex relationship between the diffusion rate and the affinity between the dye and the fiber [4]. Textile materials have a specific requirement for the fiber and dye diffusion and sorption processes must simultaneously be active during interaction. Color cannot be formed if any of those conditions is not met.

Electrostatic forces are undoubtedly affect the diffusion process. It is generally believed that a moderately high concentration of a medium high concentration of low-molecular electrolyte, such as $NaCl$, will remove any such effects and it is confirmed by the fact that D at moderately high ionic forces, becomes virtually non-affected by the total charge [5]. However, the added electrolyte, apparently, will have minor effect if it (the added electrolyte) initially has the universally identical concentration [6].

Another important point is that, on the one hand, we are trying to create dyes with increased affinity for the fiber, since this provides high dyeing fastness to wet treatments, on the other hand, the increased dye affinity for the fiber reduces the diffusion rate, and, consequently, speed of dyeing process. This contradiction can be overcame in real conditions by building the technological process to ensure a decrease in the affinity of the dye at the time of the fiber entering the dye solution and to create conditions for the manifestation of this affinity after the diffusion is completed. Temperature changes, solvation of dye with auxiliary substances of hydrophilic solvents, etc. are used for these purposes.

References:

1. Shukurlu Y. H. Kinetic characteristics of the first and second stages of the diffusion processmolecules of fisetin in the fibroin filament // статья принята к публикации в журнал "Austrian Journal of Technical and Natural Sciences". – P. 9–10. 2018.
2. Michael J. Stenhouse, Thierry Merceron, Edouard Scott de Martinville. Provision of diffusion coefficients for argillaceous media in support of preliminary safety assessment within the French HLW disposal programme // Journal of contaminant hydrology,– Vol. 21.– Issues 1–4. 1996.– P. 351–363.
3. Tinker P. B., Nye P. H. Solute movement in the rhizosphere, 2nd edn. USA: Oxford University Press,– New York, 2000.– 370 p.
4. Мельников Б. Н., Виноградова Г. И. Применение красителей. Учеб. для вузов – М.: Химия, 1986.– 240 с.
5. Антропов Л. И. Теоретическая электрохимия (учебник).– М.: Высшая школа,1984. – 4-е изд.– 509 с.
6. Кричевский Г. Е. Роль химии в производстве текстиля. Эволюция и революции в текстильной химии // Рос. хим. ж. (Ж. Рос. хим. об-ва им. Д. И. Менделеева), 2002.– Т. XLVI.– № 1.– С. 5–7.

Section 8. Chemistry

Shernazarov Iskandar,
Lecturer at the Academic Lyceum
of Tashkent Pediatric Medical Institute
E-mail: shernazarov_iskandar855@mail.ru

USE OF PEDAGOGICAL, INFORMATION AND COMMUNICATION TECHNOLOGIES, AS WELL AS INTERACTIVE TEACHING METHODS IN CONSOLIDATING OF ORGANIC CHEMISTRY LESSONS

Abstract: The article discusses the use of pedagogical, information and communication technologies, as well as the use of interactive teaching methods in an academic lyceum on the topic: "Aromatic hydrocarbons and their homologues, production and properties".

The article is based on the integration of pedagogical, information and communication technologies. Using the chosen method, approach to learning the topic and improving learning experience is explained. The article uses animated colour schemes.

Keywords: aromatic hydrocarbons, homologues of aromatic hydrocarbons, toluene, o-xylene, m-xylene, p-xylene, cumene, vinylbenzene, 1, 2, 3 – trimethylbenzene, 1, 3, 5 – trimethylbenzene, 1, 2, 3, 4, 5, 6 – hexamethylbenzene, 2, 4, 6 – trinitrotoluene, animation.

Reform of the whole education system is the main task of "National Professional Training Programme" of the Republic of Uzbekistan. The major part of this reform is the introduction of information technology and advanced pedagogical technologies into the educational process. Due to the fact, that many students have difficulties in understanding organic chemistry, the introduction of information technology and the implementation of pedagogical technologies is a relevant task.

At the present time, science and culture are constantly developed, which leads to an increase in professional standards in the field of education. Development of the education system requires its raise to a new qualitative level.

Development of various areas of our country serves as an example of relations between solutions to the development issues of humanity and the achievements of science. Therefore, we can emphasize the importance of basic and applied research in the development of our Republic.

At present, the field of education in our country undergoes many changes. It is a known fact, that the development of education is a common trend of all developing countries and the field of education in our country is no exception, as it undergoes many changes at present. At this point, erudite, free-thinking, resourceful entrepreneurs and mature specialists are necessary for the national economy. This requires the independent mastering of the skills of implementation of theoretical knowledge in practice and new achievements of science. Large-scale reforms in the field of education and state efforts to improve the content of education requires to bring

education into different areas of life, to bring up a well-educated new generation for a rapidly developing society [1].

By using the Internet in lessons of organic chemistry, students learn to express their opinions in a group, independently think and work, become more resourceful and intellectual. It also increases their interest in the subject of organic chemistry and encourages students to be active. For this reasons, the introduction of innovative technologies in the organic chemistry teaching process and analysis of methods for its improvement is the study purpose.

The ongoing changes in the field of education, torrents of new information, the need for the rapid assimilation of knowledge requires integration of new elements in education. Also, the introduction of modern information technology is relevant [2].

The majority of teachers that participated in analysis of the situations on the introduction of modern information technology and pedagogical technologies in the organic chemistry lessons have said that lessons were more interesting and fruitful after introduction of aforementioned innovations. There are insufficient scientifically based instructions and guidelines for the introduction of information technology in lessons.

The use of information and communication technologies and pedagogical technologies in the organic chemistry lessons opens up new far-reaching and effective opportunities. Information technology opens new possibilities for the development of independent learning abilities and creates the necessary conditions for the intellectual development of students [3]. Implementation of information technology and pedagogical technologies and their use in organic chemistry lessons allows teachers to send homework to students (as well as check it) using the Internet. Information and communication technologies are the most convenient method for verifying knowledge of each individual student.

Improvement of the educational system through innovative pedagogical and information technologies generates interest and attracts attention of increasing amount of people every day.

Innovative information technology has the following features:

– innovative technologies always increase the interest of pupils and students to the subject;

– in the process of using innovative technologies, a culture of communication between pupils and students develops;

– innovative technologies assist teachers in discovering talent and attesting knowledge of pupils and students;

– develop other positive qualities of pupils and students.

Lessons with the use of Internet communications and data assist students in independent knowledge assimilation, develop analytical skills and influence their decision making process [4; 5; 6].

The highly-organized lessons with integration of pedagogical, information and communication technologies highly influence learning process and students' knowledge of the topic. Lessons with implemented information technology use computers, video projectors, overhead projectors, video machines, slides, animations to highlight the topic of lessons.

At these lessons, teachers use animated films or videos of chemical processes that are difficult to imagine and explain the topic with the help of pedagogical technologies. During lessons with animation, the slides should be interconnected, students should be more interested in the subject, and the slides should reflect formulas, types of reactions, properties of substances, reactivity, spatial structures of organic substances. Conducting lessons using modern information technology is considered the most effective method. By using animation, to introduce new information from the Internet on the topic, this method allows to explain topics that are difficult to explain with the usual approach.

Using information technology and Internet data, teachers demonstrate practical and laboratory classes, which increase interest of students in the

subject, increase understanding of chemical reactions, increase understanding of the qualitative content of chemical reaction products, their spatial structure.

Knowing that the significance of using information technology in the education process is increasing, it is necessary to intensively introduce information and communication technologies in the teaching and learning activities. It is necessary to use modern technology for professional training. Science and technology are in constant development, so by the effective implementation of their accomplishments in lessons, it is possible to achieve higher results.

The main objectives of the lessons that use information technology and Internet data:

– having laboratory classes, to explain to students how to obtain organic substances;

– to develop the skills and qualifications of students in practical classes and analyse their results;

– to teach students about the mechanisms of chemical reactions;

– to develop the ability of students to imagine the spatial structure of organic substances;

– based on the knowledge gained, teach student to self-evaluate.

For example, it is possible to use slides, animations and videos of laboratory processes to explain the topic "Natural sources of hydrocarbons: oil and petrochemical products" using information and communication technologies and Internet data. It is very difficult to perform these processes under laboratory conditions; therefore, the display of the technology for obtaining products in industrial conditions makes it easier for students to understand this topic.

We present an animated view of the refinery and its products, using the Internet data.

The process of oil refining can be partially shown in the laboratory. We present a video of laboratory experiment produced using the Internet data.

Due to the fact that the interactive teaching method serves to form independent thinking, great attention is paid to the use of interactive pedagogical technologies in the process of training and education. It is necessary for the teacher to recognize personality and way of thinking of the student, as well as to pay attention to the characteristics of the audience, all of which requires great pedagogical skills. In order to increase the activity of students, improvement of the quality of education during the organic chemistry lessons is a necessity for each field of education. The methods "I know, I want to learn, I learned" and "Insert" help students to learn how to think independently, form skills, work in team, how to plan tasks given by a teacher, and how to solve problems and discuss them independently.

– In the method "I know, I want to learn, I learned" – "I know" gives an opportunity to strengthen the basic knowledge gained in organic chemistry as part of a new topic.

– "I want to learn" gives students an opportunity to introduce new technologies in the production of chemical products and to produce high-quality and competitive chemical products on their basis. This gives opportunity to students to learn about other production technologies of the same organic chemicals and the teacher, based on the needs of the student, explains these topics more deeply in the next classes;

– "I learned" develops professional skills of students on the basis of knowledge. In this part of the method, the teacher learns the level of understanding of the topic by students, which makes teachers to work on themselves, work on their mistakes, and improve themselves using the thoughts of students.

In present-day conditions, the best method for improving the efficiency of learning is an interactive method. Organizing lessons in organic chemistry using an interactive method helps students develop the ability to analyse and discuss, exchange opinions, think critically, suggest their ideas, freely express their point of view, try to find solutions to problems, and resolve difficult situations.

The use of various pedagogical methods for each student individually, teaches them to think freely, research, to creatively approach each prob-

lem, feel responsibility, strengthens interest in their profession. Achieving such results requires the use of innovative and information technologies in the educational process. They are very different. Let us look on some of them:

– brainstorm method – the teacher designs a topic that the student must learn step by step, from simple to complex.

– method of networks – teaches students to think logically, to think outside of the box, to use literature independently.

– 3 × 4 method – teaches students to think freely, try different ideas, analyse and summarize, come to conclusions alone or in a small group.

– Blitz play method – teaches students to organize the sequence of actions correctly, to think logically, to choose the necessary information from various ideas.

– interview technique teaches students to ask questions, listen, answer correctly, write questions correctly.

To summarise the methods used, it can be said that they provide information in all areas of the topic. They are looked at and discussed from different perspectives. For example, their positive and negative sides, advantages, disadvantages, useful and harmful sides are determined. This interactive technology creates an opportunity for students to develop logical, critical, analytical thinking, to express their ideas in written and oral form, to protect their ideas.

On a final note, we can say that implementation of "I know, I want to learn, I learned" and "Insert" methods in lessons of organic chemistry improves the learning experience, increase the activity of students, teach them to freely express their thoughts and develops their skills.

References:

1. Каримов И. "Узбекистан на пороге независимости" – Ташкент.: "Узбекистан" 2012.– 8 с.
2. Холикова З. "Педагогическиеинновации и их специфические особенности" Проблемы образования № 1. 2010.– С. 48–49.
3. Авлиёкулов Н. Х. Современные технологии обучения. Методическое пособие.– Т. 2001.– 164 с.
4. Абдукодиров А., Пардаев А. Методика использования современных педагогических технологий в образовании и воспитании: – Ташкент: Истеъдод, 2014.– С. 5–105.
5. Бегимкулов У. Ш. Научно-теоретические основы внедрения современныхинформационных технологий в педагогическом образовании: – Ташкент. Фан, 2007.– 164 с.
6. Боровских Т. А. Индивидуализация обучения химии на основе современных образовательных технологий // – Москва. МПГУ. Виртуальная галерея, 2011.– 217 с.
7. Абдурахмонова У. К. «Место информационных технологий в преподавании химии». Гафур Гулям: Проблемы усовершенствования современной учебной, научной, воспитательной деятельности в высшем образовании. Сборник материалов республиканской научно-теоретической конференции.– Гулистан, 2006.– С. 60–61.

Contents