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## Section 1. Biology

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### **MODERN APPROACHES TO THE ASSESSMENT OF CHEMICAL SUBSTANCE TOXICITY ON HUMAN AND ANIMAL ORGANISM**

The article presents modern approaches and problems of toxicity study when determining toxicometric indicator values of chemical substances that increases the quality of hygienic rating and secures safety when using chemical substances in production and everyday life. There are methods offered to determine the threshold of acute and chronic exposure.

Toxicity studies are methodical base of hygienic rating and important part of pre-clinic testing of potential medicine substances. In this regard, standardization of approaches to conduct toxicity studies and determine values of toxicometric indicators characterizing hazard of chemical substances increases the quality of hygienic rating and hereby provides safety of using chemical substances in production and everyday life.

The main toxicometric parameter of chemical substance exposure on organism is median lethal dose or concentration. It is this parameter that is always used in any classifications. Its general advantage is opportunity of direct determination. There are certain differences in approaches to calculate medial lethal dose, but the basis of all approaches is probit analysis of the results in correlation of

the number of died animals to the survived animals by penetration of chemical substance doses different in amount into organism.

A certain problem is the difference of values which determine class of hazard and number of classes of hazard in Technical Regulations of the Republic of Kazakhstan on “Requirements to the safety of toxic and high-toxic substances” No. 1219<sup>1</sup> and State Standards 12.1.007 “Harmful chemical substances. Classification and general safety requirements”<sup>2</sup>. In particular, Technical Regulations divide hazard by median lethal dose by ingestion or skin absorption or concentration of substance content in the air into 5 classes, when State Standards 12.1.007 divide them into 4 classes.

Other parameters which serve the basis for toxicometry of chemical substances are thresholds of acute and chronic exposure. These parameters are the main to determine all hygienic standards regulating the content of substance in the air of working area and open air, allowed daily doses of chemical substance penetration into organism with food.

RK Technical Regulations No.1219 indirectly estimates this parameter by assessment of possible exposure on target organs or systems by acute and chronic exposure, State Standard 12.1.007 estimates this in the form of a criterion which is the basis to determine areas of acute and chronic exposure. State Standard 12.1.007 determines threshold for chemical substances exposing by penetration via respiratory organs. But it is evident that these parameters can be used to estimate hazard of substance in other ways of injection. In particular, safety assessment of potential medical substance is conducted in pharmacological studies where correlation of median lethal dose to minimum curative dose is evaluated.

Thus,  $\text{Lim}_{ac}$  and  $\text{Lim}_{chr}$  are the basis to establish hazard degree which includes presence of quantitative characteristics. Classification of hazard of chemical substance's general toxic exposure cannot be possible without its use.

Despite the fact that these determinations are given in CIS Interstate Standard, it should be noted that it is necessary to adjust a number of definitions without which it is difficult to evaluate these parameters as standardized quantitative criteria:

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<sup>1</sup> Technical Regulations “Requirements to the safety of toxic and high-toxic substances”. Regulation of the Government of the Republic of Kazakhstan of 19 November 2010, No, 1219.

<sup>2</sup> State Standard 12.1.007 “Harmful chemical substances. Classification and general safety requirements”.

- Diversification of biological indicators at the level of entire organism,
- Thresholds of adaptive physiological reactions,
- Harmful action,
- Conditions for conduction and adjustment of maximum period of chronic experiment by 4 hours five days a week during four months at least.

On the whole, unification of definitions and requirements to the methods for setting thresholds gives an opportunity to use this criterion more objectively.

Classification features of general toxic exposure which help characterizing hazard of a substance are estimate indicators. These indicators give a possibility in an integrated manner evaluate hazard of chemical substance. State Standard 12.1.007 uses index of potential inhalation toxicity — correlation of maximum potential concentration of harmful substance in the air by 20°C to average lethal concentration of substance for mice. This indicator determines quantitative dependence of substance volatility values and its inhalation toxicity. Correspondingly, the lower volatility of the substance and the higher value of  $CL_{50}$ , the lower index of potential inhalation toxicity and, correspondingly, the less hazard of intoxication.

Well-recognized indicator is cumulation coefficient ( $K_{cum}$ ). It is determined by median lethal dose (concentration) in intermittent administration and median lethal dose in single administration. The calculation methods for this indicator have been developed from the 1930's and gradually improved through to the 1960's. Calculation methods of cumulation coefficient have been analyzed by I. P. Ulanova and the colleagues<sup>1</sup>. In this case analysis of different approaches for assessment of cumulation made it possible to single out Yu. S. Kogan's method<sup>2</sup> providing simultaneous use of different doses from 1/5 to 1/100 from median lethal dose to determine cumulation coefficient and giving opportunity to determine extreme dose by which cumulation is maximum. However the authors highlight advisability of using traditional method of Lim and co-authors. This

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<sup>1</sup> Ulanova I.P., Sidorov K.K., Khalep A.I. Determination of cumulative properties in regular toxins// In the guidance "Methods to determine toxicity and hazard of chemical substances (toxicometry)"/edited by I.V. Sanotskiy. – M.: Medicine, 1970. – P. 101–108.

<sup>2</sup> Yu. S. Kagan, V. V. Stankevich. Determination of extreme cumulation dose in toxicology studies of harmful chemical production factors//In the collection "Topical issues of labor hygiene, industrial toxicology and professional pathology in oil and chemical industry". – M.: Medicine, 1964. – P. 67–70.

found its reflection in the Guidance edited by I. V. Sanotskiy “Methods for determination of toxicity and hazard of chemical substances (toxicometry)”, approved by the Presidium of USSR Academy of Medical Sciences which is still the methodical base for conduction of toxicological experiments to determine hygienic rates<sup>1</sup>. However Methodological guidance on studying general toxic influence of pharmacological substances<sup>2</sup> gives preference to Lim’s method<sup>3</sup>. Lim’s method also saves time in conduction of experiment<sup>4</sup>. On the whole, use of this criterion as a standardized indicator is possible. For this purpose it is necessary to work out evidential base for selection of the most suitable approach which can be used as a unified one in conduction of experiment and further calculation of cumulation coefficient.

All above toxicometric indicators are divided into basic ones which are directly determined via experiment and estimate ones for determination of which values of basic indicators are used. Basic indicators include median lethal doses or concentration of substance in the air and indicator of threshold of action. Determination of these definitions by itself does not include understanding of the nature of possible exposure of the substance on human.

However WASH requirements in the field of risks for human health classify hazard by nature of exposure on organism and includes the following signs:

- Acute toxicity,
- Skin cankering/irritation,
- Eye cankering/irritation,
- Respiratory and skin sensitization,
- Mutagenicity of germinal cells,
- Carcinogenicity,

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<sup>1</sup> Methods to determine toxicity and hazard of chemical substances (toxicometry)// Edited by I. V. Sanotskiy.– M.: Medicine, 1970. 343 p.

<sup>2</sup> Methodic recommendations for studying general toxic action of pharmacological substances/Authors Ye. A. Arzamastsev, T. A. Guskova, I. V. Berezovskaya and others in the Guidance on experimental (pre-clinic) study of new pharmacologic substances/edited by R. U. Khabriyev. – M., 2005.– P. 41–70.

<sup>3</sup> Lim R. K., Rink K. G., Glass H. G., Soaje-Echagua E. Calculation of cumulative effect from new pharmacologic substances // Arch.intern. Phar. Therapie.– 1961.–V. 130, No.3. – P. 336–339.

<sup>4</sup> Sidorov K. K. Application of Lim’s method for assessment of hazard in cumulation of industrial poisons //In the book “Toxicology of new industrial chemical substances.” – M., 1967.– Issue 9.– P. 54–57.

- Reproductive toxicity,
- Specific and selective toxicity affecting certain target organs by multiple exposure,
- Aspiration hazard.

These principles serve the basis for other classifications by toxicity types. It is apparent that the nature of substance exposure on human determines the methods to assess exposure level. In this case, the basis of quantitative assessment of exposure level shall include determination of basic toxicometric indicators.

To determine another basic toxicometric indicator — threshold of acute exposure — nature of chemical substance exposure on organism is fundamental. In particular, general toxic effect is stipulated by exposure on certain ferments in organism. Most of the ferments are available in various organs, but their level in organs is different that determines peculiarities of metabolism in each organ. In this connection the vast majority of chemical substances are characterized by multiple organ action. Nevertheless, the highest process reaction rate is characterized for nerve tissue. In this regard, single exposure is the most expressed on the indicators of nervous activity. But this does not exclude presence of specific target organs or certain systems which are exposed to the action of chemical substance more expressively that the other due to conditions of penetration into organism or due to presence of specific ferment systems.

Irritating action on skin and eyes can be stipulated by ability of substance to induce changes of pH medium or specific action on receptors in skin or mucous membrane. Peculiarities in the study of irritating action and its quantification are the problem in determination of hazard level by chemical substance exposure.

The study of sensitizing action in single exposure is impossible as detection of such action occurs only after secondary contact of organism with chemical substance.

Assessment of potential hazard of developing changes in organism due to changes of DNA structure is possible by single exposure by changes appearing in bone marrow tissue or epithelial cells of mucous membrane and skin. This may be manifested in appearance of micronuclei in erythrocytes, lymphocytes, buccal epithelium, and presence of chromosomal aberrations in lymphocytes and tissue structures of bone marrow. These changes can serve as quantitative criterion which determines the threshold of acute exposure.

Nature of the impact on reproductive function by single penetration of chemical substance into organism can also be assessed by condition of sperm

cells and condition of cells of young forms among males, condition of oocytes among females. However the main problem for quantitative assessment of the threshold of acute exposure by these signs is determination of observation time and peculiarities of oocytes maturation among females of experimental animals.

Thus, to establish requirements to quantitative assessment of values of acute exposure threshold it is necessary to determine minimum amount of measurement levels and amount of animals used for each exposure level. Besides, it is obligatory to determine methods to identify acute exposure threshold as a factor designating nature of exposure of chemical substance on organism.

In establishment of the threshold of chronic action for substances which action is defined as prevalently general toxic one, the main problem in determination of hazard rates is the amount of assessed exposure levels. Practically, the number of levels is limited to three as duration of experiment does not allow using big amount of experimental animals. To obtain maximum credible results, values of assessed exposure levels shall have minimum difference. Thus, for the purpose of objectivity it is necessary to have unified approaches to the determination of exposure dosage on experimental animals used to determine the threshold of chronic action.

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### TO THE ISSUE OF IODINE DEFICIENCY STATES

**Abstract:** Indicators of the quality of health of the child population are a reflection of the pathogenic effects on the body of ecological, social and endemic risk factors. The situation is aggravated by irrational nutrition in most families; inadequate prevention of diseases associated with micronutrient deficiencies, including iodine their regulation on the basis of a literary analysis.

**Keywords:** child, nutrition, perinatal, analysis, function, gestosis.

Iodine deficiency in the environment and health problems caused by it — iodine-deficiency diseases (IDD) — are a serious medical and social problem worldwide, due to the high prevalence and a wide range of clinical manifestations and consequences.

Analysis of the literature showed that in iodine deficient regions, reproductive function is impaired in women, the number of miscarriages and stillbirths increases, perinatal and infant mortality increases, and the risk of radiation-induced thyroid diseases increases. The presence of endemic goiter in children significantly increases the risk of developing chronic diseases.

According to statistics, 2 billion people in the world are at risk of developing IDD, in Russia the risk of developing IDD is 98 million, including 2% of children under the age of 2 years, 20–30% — children 7–10 years old, 30–50% — adolescents.

Domestic authors confirm that for the Russian Federation the problem of iodine deficiency is extremely relevant, due to the widespread prevalence throughout the country and the serious health consequences of the population, leading to an increase in the endocrine disease population and to a violation of reproductive function.

Indicators of the quality of health of the child population are a reflection of the pathogenic effects on the body of ecological, social and endemic risk factors. The situation is aggravated by irrational nutrition in most families, inadequate prevention of diseases associated with micronutrient deficiencies, including iodine.

As noted by the authors of the literature, the lack of iodine affects the health and development of the child particularly badly. In conditions of iodine deficiency, in addition to increasing the volume of the thyroid gland, the physical, intellectual and sexual development of children is disrupted.

In turn, the increase in the number of diseases of the reproductive system and somatic pathology, in particular endocrine, largely determines the increase in the number of complications during pregnancy and childbirth.

It is known that at the stage of gestation, only in the condition of adequate hormonal regulation, adaptive mechanisms are laid, which largely determine the state of human health at all stages of life after birth. A completely special and important role in endocrine maintenance of a normal course of pregnancy and gestation of a healthy child belongs to thyroid hormones.

The number of women with dysfunction of the thyroid gland before pregnancy and during gestation increased many times in the conditions of ubiquitous growth of the endometrium, in the areas with pronounced iodine deficiency the number of spontaneous abortions, the frequency of birth of children with low body weight and congenital malformations, significantly increased perinatal mortality, stillbirth

Specialists noted that pregnancy and childbirth in women with thyroid pathology are characterized by a high incidence of complications: early toxicosis, gestosis (54.5%), chronic intrauterine fetal hypoxia (22.7%), abnormalities of labor (35.2%), premature (18.2%), which significantly determines the indica-

tors of maternal, perinatal morbidity, negatively affects the physical and mental health of children.

Gestational metabolism of iodine and thyroid hormones has its own characteristics. Pregnancy is a powerful trigger factor for iodine “stealing” and can lead to the development of prenatal hypothyroxinemia.

Iodine deficiency in pregnant women, due to the high biological significance of iodine and thyroid hormones for the structural and functional development of the brain, really form a high risk of developing severe lesions of the central nervous system and a progressive decrease in intelligence in the population.

By feedback is meant a system in which the end product of the activity of this system (for example, a hormone, neurotransmitter and other substances) modifies or modifies the function of the components constituting the system aimed at changing the amount of the end product (hormone) or the activity of the system. Vital activity of the whole organism is a consequence of the functioning of numerous self-regulating systems (excretory, cardiovascular, digestive, respiratory and others), which are in turn under the control of the neuroendocrine-immune system.

Within the framework of the above, it is of great importance to create and improve the standards of conducting physiological and complicated pregnancies and births in women living in iodendemic territories that contribute to the improvement of perinatal outcomes.

The range of diseases caused by iodine deficiency includes pathological conditions associated with intrauterine, neonatal, pre and pubertal childhood periods. In regions with insufficient iodine supply, the risk of any chronic disease increases by 24–45%.

The native authors state that the presence of iodine deficiency in a particular group of the population — pregnant and lactating women; At the same time it is proved that children of the first year of life and children of pre and pubertal age are in a state of sufficient iodine supply. In this regard, it is extremely important and necessary to study the state of iodine availability of children of early and preschool age, since iodine deficiency in children of this age group, due to the physiological features of growth, preserves the real risk of physical and intellectual development disorders, immunity, somatic, endocrine morbidity.

According to the Endocrinology Research Center of the Russian Academy of Medical Sciences, among Russians, a decrease in consumption to an average of 60–80 micrograms was noted at an average daily rate of 100–200 micrograms.

Thus, summing up the literature review, it can be noted that it is with the goal of improving reproductive health indicators, reducing maternal, perinatal morbidity and mortality that a major medical and social task is needed — elimination of iodine deficiency diseases.

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## **GEORGIAN PROPOLIS: SOME ISSUES OF USING IN PHARMACEUTICS**

People have used natural compounds, plant or animal raw materials from time immemorial. Also, Georgian handwritten documents provide a wealth of material on the use of plant and animal raw materials. While working on folk handwritten doctor books (karabadini), we have discovered many interesting prescriptions for the use of bee proteins, particularly propolis, in medicine<sup>1</sup>. which raised our interest, and we started a scientific study of propolis. We have studied the works of many scientists.

Propolis, also known as bee glue, is a natural nontoxic resinous sticky substance produced by honeybees through mixing the secretions of their hypopharyngeal glands with the digested product of resins collected from leaves, flowers of plants, trees, and certain barks, which is used as a sealant and sterilizer in honeybee nests<sup>2</sup>. It is dark green or brown in color, and its chemical content depends on the geographic zone from which it comes<sup>3</sup>.

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<sup>1</sup> David Bagrationi. Iadigar Daudi. Tbilisi University publ. 2002, 178 p.; Cananeli. Ustoro Karabadini, Tbilisi, annals, 1997. 365 p.; Zaza Panaskerteli-Tsitsishvili. Samkurnalo Tsigni Karabadini ("Medical Text – Karabadini"). Published by M. Shengelia, Tbilisi, 1959.

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It has been established that a significant role in the creation of propolis is given to the honey-making worker bees. The types of bees differ in the ability to accumulate propolis. This ability is shown mostly by Caucasian bees, followed by Ukrainian, Italian, Turkish and so on<sup>1</sup>.

The term propolis comes from the Greek “pro”, in front, “polis” means town or city and relates to the protective properties of the substance<sup>2</sup>. Bees use it to protect and reinforce their hives, repair their structure, and cover honeycombs. It protects against rain and is a very sticky substance that prevents unwanted guests such as insects, rodents, and robber bees from entering the hive. It helps maintain aseptic conditions and appropriate temperature in the hive. In the hive, propolis acts as a biocide to kill invasive bacteria, fungi, or even larvae. The diversity of plants in the vicinity of the hive is the main factor in determining the chemical composition of propolis<sup>3</sup>.

Propolis is a complex mixture of different naturally-occurring constituents with more than 300 constituents identified to date. Among the chemical substances found in propolis are waxes, resins, balsams, aromatic and ethereal oils, pollen, and other organic matter<sup>4</sup>. Typically propolis is comprised of resin (50%), which is composed of flavonoids and related phenolic acids, generally called as the polyphenolic fraction, waxes (30%), essential oil (10%), pollen (5%), and other organic compounds (5%)<sup>5</sup>. However, this chemical composi-

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<sup>5</sup> Juliano C., Pala C.L., Cossu M. Preparation and characterisation of polymeric films

tion may change according to the plant source, which is related to the regional vegetation and to the season in which it is collected by the bees<sup>1</sup>. Therefore, the standardization of this product is difficult on account of the inherent difficulties associated with the analysis of complex mixtures from different vegetal sources<sup>2</sup>. Maria Graça Miguel and Maria Dulce Antunes have studied the works of scientists from various countries on the chemical compositions of propolis. Based on data comparisons, they note that propolis is a complex natural product with a great diversity of chemical structures and subsequent biological activities, nevertheless, it is not completely innocuous and care must be taken, mainly when such a product has a great diversity of origins. An absence of quality control may be pernicious to human health<sup>3</sup>.

Popova et al. have proposed to specify multiple standards for different propolis types according to their plant source and corresponding chemical profile. They have validated a spectrophotometric method for the quantification of prenylated flavanones in the 'Pacific' propolis from Taiwan<sup>4</sup>.

Vagish Kumar L. S. has examined the use of different types of in various branches of dentistry and its possible use in the prevention and management of oral cancer. Oral cancer is a public health problem. The use of natural substances such as propolis aims to search for chemoprevention with fewer side effects. Desirable effects of propolis on the treatment of oral cancer are regression of tumors by stimulating multicellular immunity, prevention of metastasis, speeding up apoptosis of cancer cells, mitosis-suppressing effect, anti-angiogenesis

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<sup>4</sup> Popova M., Chen C.N., Chen P.Y., Huang C.Y., Bankova V. A. validated spectrophotometric method for quantification of prenylated flavanones in pacific propolis from Taiwan. *Phytochem Anal.* 2010; 21: 186–91. [PubMed].



effect, immunomodulatory effect, and antioxidant effect. Propolis also has radio-protective effect. Flavonoid quercetin in propolis potentiates the growth-inhibitory activity on tumors<sup>1</sup>.

Prior to 2005, the attention of scientists was fastened on Brazilian propolis, but currently, there are studied samples of propolis from almost all countries. Despite fact that samples of propolis from several regions of western Georgia were studied by Makashvili in the sixties of the 20<sup>th</sup> century, and some of them were studied by us in 1997–2005, Georgian propolis remains still unknown to scientists. We have studied antimicrobial activity of the samples of western Georgian propolis. All samples of propolis are characterized by high antimicrobial activity<sup>2</sup>. Later, we have studied the relationship between optical density and antimicrobial activity of western Georgian propolis. It has been established that there exists a correlation between optical density and antimicrobial characteristic of Georgian propolis. Samples with high optical activity are characterized by high sensitivity toward microorganisms. Also, optical activity of samples is conditioned by flavonoids, flavanones in particular<sup>3</sup>.

In 2013–2014, we studied the hydrophilic and hydrophobic substances of the samples of western Georgia propolis (Tskaltubo, Tkibuli, Chiatura) by spectrophotometric (Chimazu, Japan) and chromate-mass-spectrometric (Clatus 600GG/MS) methods<sup>4</sup>.

In 2014–2015, there was studied the content of polyphenols in samples of propolis from western Georgia seasonally (late spring, autumn). Studies have shown that the samples of western Georgian propolis are characterized by high content of polyphenols and the content of polyphenols seasonally is higher in the spring samples<sup>5</sup>.

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<sup>1</sup> Vagish Kumar L. S. Propolis in Dentistry and Oral Cancer Management. *North American Journal of Medical Sciences*. 2014; 6(6); 250–259.

<sup>2</sup> Gabunia K., Chumberidze B., Kunchulia L. Antimicrobial activity of west Georgian propolis.. *J Georgian Medical News*. 2004;5:61–64.

<sup>3</sup> Gabunia K. Optical Density and Antimicrobial Characteristics of Georgian Propolis. *Journal of Pharmacy and Pharmacology*. 2016; v. 4; 3; 146–150.

<sup>4</sup> Gabunia K., Kubchulia L., Natriashvili V., Jokhadze M., Tushurashvili P, Standardization of hydrophobic and hydrophilic substances of Georgian propolis. 3 International conference on pharmaceutical sciences. 2015// <http://www.geokip.net/FILES/ICPS/ICPS-2015%20Abstract%20Book.pdf>

<sup>5</sup> Gabunia K. Determination of Polyphenols in Different Samples of West Georgian Propolis. The ninth European Conference on Biology and Medical Sciences. 2016.// <https://ppublishing>.

Studies have shown that the western Georgia propolis is characterized by high optical density and antimicrobial activity, and this, in our opinion, is due to a high content of phenolic compounds. We believe that Georgian propolis necessitates in-depth scientific studies.

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## **CLINICAL ASSESSMENT OF INTEGRATED TREATMENT OF NECK OF WOMB NONSPECIFIC CERVICITIS**

Inflammatory processes of female genitals are an extensive pathology and its rate does not trend to decrease. The neck of womb is involved in inflammatory process practically in case of any vaginal infection<sup>1</sup>. The treatment of the chronic inflammatory processes of the genital lower segments is frequently inefficient and requires significant endeavors of physician and patient due to increase of the number of antibiotic-resistant species of microorganisms, change of the infection process clinical progression with the trend to asymptomatic, subclinical, hyposthenic, chronic or recurrent progression and emergence of the local immunosuppression<sup>2</sup>.

The search of new efficient treatment patterns has been the crucial task so far. In this regards, the modern medicines based on the silver nanoparticles are of interest. When silver transforms into the nanoform its specific properties significantly intensify. The silver nanoparticles become several fold more active compared to its other forms and known antibiotic and biocide medicines<sup>3</sup>.

Given the above, Professor A. A. Sarymsakov from the Institute of Polymer Chemistry and Physics under the AS RUz developed a new medicine being a

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<sup>1</sup> Amidonova I. P., Ledina A. V., Gaydarova A. Kh., Bebnava T. N. "Efficiency of the Treatment of the Patients with HPV-Associated Cervicitis Caused by the Local Impact of Cavitated ("Voiced") Panavir Solution". // Russian Bulletin of Obstetrician-Gynecologist. – 2016. – N6. – P. 77–82.

<sup>2</sup> Rogozhina I. E., Neyfeld I. V., Stolyarova U. V., Skupova I. N. Optimization of Treatment of the Women with Recurring Nonspecific Vaginitis and Cervicitis // Infectious Diseases. News. Treatment. Training. – 2017. – N1. – P. 70–75.

<sup>3</sup> Antsiferova A., Buzulukov Yu., Demin V., Kashkarov P., Kovalchuk M., Petritskaya E. Extremely Low Level of Ag Nanoparticle Excretion from Mice Brain in In Vivo Experiments // IOP Conf. Series: Materials Science and Engineering. 2015, V. 98.

hydrogel with the silver nanoparticles (0.001%) and carbosimetilcellulose (CMC — 2.0%) — “Baxergel”. Baxergel is classified as low toxic medicine in terms of toxicity, it does not have dermato-resorptive local irritation of the skin and ocular mucosa; does not have allergenic and noncumulative properties; in animal experiments it is efficiently correcting simulated cervical intraepithelial alvus lesion. Obtained outputs serve as the ground for the deepened study of Baxergel clinical efficiency with its further introduction in clinical practice to diversify the topical treatment facilities for nonspecific diseases of the neck of womb.

**Research Objective** — studying of the clinical efficiency of nonspecific cervicitis integrated treatment with application of Baxergel and Vagilaxx medicines.

**Materials and Methods:** The present clinical research was accomplished in line with the evidence-based medicine principles for the period 2017–2018 on the basis of the 2<sup>nd</sup> Clinic under the Tashkent Medical Academy at the Female Health Centre. The integrated clinical and laboratorial examination of 147 female patients aged from 15 to 49 years old was conducted; they were split by three clinical groups: 1- control group; 2 and 3 — treatment groups. The directional selection method was used as the key methodological approach.

The control group comprised 30 practically healthy women (control group) without the neck of womb pathology as of the research date, with absence of the acute diseases over the recent 6 months and chronic genital infectious pathology as well as.

When the female patients requested gynecological aid they were questioned according to the specially developed questionnaire comprising the number of questions enabling to judge the presence of one or another risk factors. Obtained data were input in the data base for the further mathematical processing.

**Clinical Assessment of the Treatment Outputs.** The gynecological and medical examination was conducted before treatment along with appraisal of the general state, abnormalities; the clinical research was accomplished in dynamics every 3–4 days and the final assessment of the treatment efficiency was made after the treatment completion.

Assessment of the therapy efficiency was accomplished based on the data of the physical examination and cervicitis symptoms: female patients' complaints and physical examination data: hyperemia, hydrops, tissues painfulness, presence or absence of pathologic discharge. Assessment of the personal complaints and data of the physical examination was made based on the visual analog scale

supposing the scoring of disease subjective symptoms. Thus, the presence of excretion was classified as follows: 0 – absence, 2 – low-grade, 3 – moderate and 4 – profuse; excretion pattern: 1 – rheuma, 2 – purulent; 3 – tyroid and 4 – foamy; pain: 0 – absence, 1 – mild, 2 – moderate and 4 – severe; heat: 0 – none; 1 – mild, 2 – moderate and 4 – severe; hyperemia or hydrops: 0 – absence, 1 – mild, 2 – moderate and 4 – severe. The mean group score of each index was calculated before and after the treatment enabling to compare the results and make well-founded conclusions.

The assessment of the outputs of cytological research was fulfilled in line with Bethesda terminological system 2001<sup>1</sup>.

**Efficiency Criteria:** The following criteria were applied for the assessment of therapeutic effect: excellent effect — evident improvement (recuperation); absence of subjective semiology, clinical and laboratorial indices; objectively — absence of cervicitis symptoms; good effect — significant improvement: absence of subjective semiology, positive dynamics of the clinical and laboratorial indices; satisfactory effect — minor improvement: positive dynamics of subjective and clinical semiology, positive dynamics of the clinical and laboratorial indices; unsatisfactory effect — absence of the treatment effect or retrogression of subjective and objective semiology, retrogression of gynecology data; evident effect: evident improvement after the treatment.

**Mathematic processing and statistical analysis were made using the** “Statistika 6.0” software. Nonparametric methods were applied. All groups excluding comparisons of the physician’s and patient’s opinions were inter-linked. Multiple comparisons were not conducted.  $P = 0.05$  was considered as a threshold value.

**Outputs and Discussions.** It is important to notice that all female patients were examined in terms of sexually transmitted infections as of the referral moment and also had the negative takes of the bacteriological tests for the opportunistic pathogenic microflora, *M. hominis* and *U. urealyticum*.

The key complaints expressed by the patients were presented by complaints about emergence of pathologic discharge of various nature: pruritus, heat and pain in externalia, urination pain, dysuria and dyspareunia. The speculum examination demonstrated hyperemia of the neck of womb mucosa around

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<sup>1</sup> Frederiksen M. E., Lyng E., Reboli M. What women want. Womens’ preferences for the management of the low-grade abnormal cervical screening tests: a systematic review. // Internat. J. of Obstetr. and Gynecol. 2012.–119(1).– P. 7–19.

external oropharynx, and neck of womb was partially eroded. The cervical canal manifested profuse purulent or purumucous secretions, specifically obvious in case of acute type of endocervicitis.

It is necessary to note, that the most evident positive clinical dynamics was identified in the 3<sup>rd</sup> group. Thus, after the treatment the complaint rate reduced by 54.33% against the value before treatment; the rate of metryperemia — by 58.2% ( $P \leq 0.01$ ); heat — by 49.47% ( $P \leq 0/01$ ); dysuria — by 57.71% ( $P \leq 0.01$ ); vaginal discharge — by 70.20% ( $P \leq 0.01$ ); excretion pattern — 49.04% ( $P \leq 0.01$ ); neck of womb gyperemia — by 58.2% ( $P \leq 0.01$ ); neck hypostasis — by 70.94%; neck of womb gyperemia — by 58.2% ( $P \leq 0.01$ ) and neck excretion — by 67.21% ( $P \leq 0.01$ ); respective dynamics in the 2<sup>nd</sup> treatment group significantly ( $P \leq 0.01$ ) exceeded 1<sup>st</sup> group indices and was as follows against the pretreatment values: 67.20% ( $P \leq 0.01$ ); 67.54% ( $P \leq 0.01$ ); 70.42% ( $P \leq 0.01$ ); 86.71% ( $P \leq 0.01$ ); 56.87% ( $P \leq 0.01$ ); 70.79% ( $P \leq 0.01$ ); 82.22% ( $P \leq 0.01$ ) and 84.0% ( $P \leq 0.01$ ); in the 3<sup>rd</sup> treatment group the values of the indices under the study were lower than in the 1<sup>st</sup> ( $P \leq 0.05$ ) and 2<sup>nd</sup> ( $P \leq 0/05$ ) groups, and their decrease accounted for 84.33% ( $P \leq 0.01$ ); 85.07% ( $P \leq 0.01$ ); 87.34% ( $P \leq 0.01$ ); 95.12% ( $P \leq 0.01$ ); 90.65% ( $P \leq 0.01$ ); 93.51% ( $P \leq 0.01$ ); 95.45% ( $P \leq 0.01$ ) and 91.84% ( $P \leq 0.01$ ).

The HSIL cells were not present in case of cytological intraepithelial lesion and malignant transformation.

In assessing the clinical treatment efficiency after the treatment in the 1<sup>st</sup> comparison group the number of female patients with the treatment results classified as “excellent output” was equal to 20 ( $41.66 \pm 7.12\%$ ); respective number of female patients in the 2<sup>nd</sup> treatment group was equal to 30 ( $60.0 \pm 6.92\%$ ) and in the 3<sup>rd</sup> treatment group — 43 ( $87.76 \pm 4.68\%$ ), that statistically significantly ( $P \leq 0,05$ ) exceeded the 1<sup>st</sup> comparison group index.

The calculation of comparative efficiency of the various treatment methods' impact on the cervicitis clinical progression was made using Bayes' formula —  $(P_1 - P_2)/(P_1 + P_2) \times 100\%$ , where  $P_1$  and  $P_2$  —  $\Delta\%$  treatment efficiency in compared groups in comparison with pretreatment value. The sum of the rate of registration of the “excellent” and “good” treatment results was takes as the positive treatment output. The 1<sup>st</sup> group of female patients receiving the standard of care therapy.

The dynamic control over the patients during 6 post-treatment months also demonstrated the higher efficiency of the medicines under the study.

Baxergel introduction in integrated treatment leads to the credible reduction of the treatment duration from  $7.7 \pm 0.32$  days in the 1<sup>st</sup> comparison group to  $6.02 \pm 0.25$  days due to Baxergel application ( $P \leq 0.05$ ) (2<sup>nd</sup> group) and to  $5.04 \pm 0.16$  ( $P \leq 0.05$ ) in Vagilaxx introduction in integrated treatment (3<sup>rd</sup> group); respective dynamics of recurrence rate amounted  $3.5 \pm 0.12$ ;  $2.63 \pm 0.11$  ( $P \leq 0.05$ ) and  $1.82 \pm 0.07$  ( $P \leq 0.05$ ); and duration of recurrence treatment —  $6.30 \pm 0.28$  days;  $4.71 \pm 0.18$  ( $P \leq 0.05$ ) days and  $3.5 \pm 0.14$  ( $P \leq 0.05$ ) days.

Our obtained data give reasons for feasibility of Baxergel local application and Vagilaxx consistent use in gynecological practice in combination with the other treatment and prevention activities in the therapy of nonspecific neck of womb diseases accompanied with microbiocenosis abnormalities and requiring the long-term treatment. The complexity of integrated treatment pattern effect, its high efficiency, safety and convenience in application give the grounds for its application feasibility in integrated drug therapy of the neck of womb diseases.

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## **TO THE ISSUE OF TREATMENT OF SKULL FRACTURES IN CHILDREN**

**Abstract:** In modern medicine, craniocerebral traumas take a special place, since in most cases they lead to disability, and therefore in our work methods of treatment based on literary analysis are reflected.

**Keywords:** skull, children, trauma, complications.

Depressed fractures of the bones of the skull are a frequent component of severe CCT. They refer to closed fractures while maintaining soft covers of the head, if damaged, fractures are considered open, and if the dura mater is damaged, penetrating. Closed depressed fractures with a depression of bone fragments more than its thickness require surgical removal of the compression of the brain, as this leads to the development of focal neurological disorders, the formation of a cerebral cicatrix and the appearance of epileptic seizures. Only in young children, especially with fractures such as a tennis ball, can spontaneous decompression of the depressed fracture due to the elasticity of the bone and a significant increase in intracranial pressure. This justifies the wait-and-see tactics in them within a week, but in the absence of any focal neurological manifestations. In all other cases, surgical removal of the depressed fracture is indicated.

To approach the area of the depressed fracture, linear, S-shaped, or horseshoe-shaped incisions are usually used to cut out the skin-aponeurotic flap allowing revision of the entire depression zone. On the scalp, the incisions of the scalp are made directly above the fracture or next to it. In fractures of the frontal bones outside the scalp with a cosmetic purpose, incisions are made at the border of the hairy part, often forming a large bifrontal skin-apron flap for free vision and manipulation in the fracture region. More often such cuts have to resort to frontal-orbital, frontal-nasal fractures. The intact periosteum is carefully dissected

and exfoliates to the sides of the fracture site. Free bone fragments are removed. With their strong fixation, it becomes necessary either to cut the bone around the fracture region by superimposing the milling holes and carefully removing the entire block with the denting zone, or applying the milling hole, carefully separating the bone fragments from the dura mater and removing these fragments. It should be remembered that the inner plate of the bone often crackles, penetrates into the cavity of the skull both to great depth and to a large area relative to the outer bone plate, which requires special care when removing it. This position is especially important for depressed fractures in the area of venous sinuses, when bone fragments impose a defect in the sinus wall, and when they are removed, massive venous bleeding can occur. Bone fragments associated with the periosteum, after repositioning, should be used for the plasticity of the bone defect. The same applies to free large fragments of bone, which can be sealed by bone seams between themselves and the mother's bed. Dissection of the dura mater, revision of the subdural space and the brain is carried out with suspicion of the pathology of deeper structures if it was not possible to bring the preoperative intrascopy (CT, MRI). With a good pulsation of the brain, the absence of tension and prolapse of the envelope into the wound, the absence of translucence through the clot of blood clots in the subdural space, the dura mater is not opened. If there is a need for opening the shell, by the end of the operation it is sutured tightly, if necessary, its plastic is carried by an aponeurosis or an artificial dura mater. If possible, the bone defect is plasticized with bone fragments of the depressed fracture. Unfortunately, in children, it is not usually possible to carry out plastic surgery of the bone defect by splitting the bone into the outer and inner plates because of the poor development of the spongy layer.

With closed depressed fractures without damaging the skin and aponeurosis, it is possible to plasticize the defect with bone shavings or a crushed bone placed between the sheets of the hemostatic sponge, as well as plastic with the use of polymeric materials. The wound is closed tightly. Antibiotic therapy is prescribed for 3 days.

Practically only in children there are depressed fractures of the base of the anterior cranial pit in the region of the roof of the orbit. This is due to the slight development of the frontal sinuses in children, which makes the roof of the orbit more vulnerable. In case of damage to the dura mater, periorbital hemorrhage and even orbital cerebral hernias may develop. With a significant displacement of bone fragments into the orbit cavity, exophthalmos may appear and the mo-

bility of the eyeball may be limited. All these cases require surgical care aimed at eliminating the impression, the plasticity of the bone defect and the dura mater. An intracranial approach (frontal or pteryonal approach) with suturing or glue closure of the dura mater is used. Bone defect is closed by a fragment of the autostyle of the cranial vault or a polymeric graft. The need for combined use of the intracranial and extracranial (intraorbital) approach, which has been reported in the literature, is extremely rare.

According to the analysis of scientific literature, the occurrence of craniocerebral trauma (CCT) worldwide is extremely high. In the structure of the CCT, a significant proportion is child injuries. Children's traumatism in the overall structure of the CCT is 21–75 %, and in children's traumatology, the CCT occupies 40–50 %. In children, craniocerebral trauma ranks first among all traumas that necessitate hospitalization, and its prevalence ranges from 1.2 to 11.2%.

The outcome of treatment depends to a large extent on the timeliness and quality of medical care. When admission of victims with severe CCT primarily to specialized centers, lethality can be reduced by 15–25 %. Understanding the impact of the injury mechanism on the severity of these injuries, the adequacy of assessing the severity of the primary brain injury and the effect of secondary damaging factors on its course is of great importance for the effectiveness of treatment for head injury.

Despite the frequent occurrence of depressed fractures, until now there is no single concept of their surgery, especially in the acute period, and this issue in the world literature is devoted only to single reports. It should be noted that most studies on the development of methods for treatment of head injury are performed in adults. Issues of secondary brain damage of extra- and intracranial nature in children remain poorly understood.

The introduction of new therapeutic and diagnostic technologies, the development of dynamic diagnostic and treatment algorithms will significantly improve the quality of treatment, reduce the level of diagnostic errors and complications, which will ultimately lead to an improvement in the quality of life of children who have undergone craniocerebral trauma.

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## **SOCIO-DEMOGRAPHIC CHARACTERISTICS OF PATIENTS SUFFERING FROM CANDIDIASIS OF THE ORAL MUCOSA**

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## **СОЦИАЛЬНО-ДЕМОГРАФИЧЕСКАЯ ХАРАКТЕРИСТИКА ПАЦИЕНТОВ СТРАДАЮЩИХ КАНДИДОЗОМ СЛИЗИСТОЙ ОБОЛОЧКИ ПОЛОСТИ РТА**

В последние годы значительно увеличилось число заболеваний, вызываемых условно-патогенными микроорганизмами<sup>1</sup>. Здоровье населения

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<sup>1</sup> Толкунова С. Г. Влияние социально зависимых заболеваний на демографическую ситуацию нижегородской области. «Вестник Минского университета» 2015 – № 1.

выступает в качестве показателя, который интегрирует демографические, социальные и биологические процессы, отражающий уровень медицинской помощи. В качестве главных причин многих заболеваний выступают не столько возбудители, сколько социально-экономические условия<sup>1</sup>.

**Цель исследования.** Изучение социально-демографических характеристик пациентов с кандидозом слизистой оболочки полости рта (СОПР).

**Материал и методы.** Проанализировано социально-демографические причины 323 пациентов, обратившихся в поликлинику терапевтической стоматологии и на кафедру факультетской терапевтической стоматологии ТГСИ на основании результатов анкетирования проведенных в соответствии со стандартным алгоритмом сбора жалоб и анамнеза. В зависимости от состояния СОПР пациентов разделили на 2 группы: основную группу составили 173 пациента с клиническим, микробиологическим и иммунологическим подтвержденным диагнозом кандидоз СОПР. Контрольная группа включала 150 пациентов сопоставимого пола и возраста без клинических признаков кандидоза СОПР.

Статистическую обработку проводили с использованием программы Statistica 6.

**Результаты и обсуждение.** Большинство пациентов сравниваемых групп имели среднее профессиональное образование: 97 (56,07±3,77%) пациентов с кандидозом СОПР против 82 (54,67±4,06%) ( $P \geq 0,05$ ) в группе контроля. Но доля выпускников ВУЗов была достоверно ниже в группе с кандидозом СОПР по сравнению с группой сравнения: 43 (24,86±3,75%) против 82 (54,67±4,06%) ( $P < 0,05$ ); не было установлено статистически значимых межгрупповых отличий по доле опрошенных со средним образованием 5 (2,89±1,27%) и 3 (2,0±1,14%) ( $P \geq 0,05$ ) в основной и контрольной группах соответственно. В то же время с кандидозом СОПР в группе пациентов в 2,5 раза чаще регистрировались пациенты с начальным образованием по сравнению с их долей в контрольной группе: 27 (15,60±2,76%) против 7 (4,66±1,72%) ( $P < 0,05$ ) соответственно.

Низкий уровень образования ассоциируется с высоким риском развития кандидоза СОПР, что нашло подтверждения в полученных результатах.

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<sup>1</sup> Казеко Л. А. Грибковая инфекция ротовой полости: Часть I / Л. А. Казеко, Л. А. Александрова, А. Г. Довнар // Медицинский журнал. – 2014. – № 1. – С. 21–25.

По роду деятельности пациенты основной группы в  $54,91 \pm 3,78\%$  (95 случаев) ( $P \leq 0,01$ ) были заняты в сфере обслуживания против  $66,60 \pm 3,85\%$  (100 пациентов) в группе контроля. Среди служащих основной группы руководящие посты занимали  $3,15 \pm 1,33\%$  (3 пациента) анкетирруемых, в то время как  $71,58 \pm 3,43\%$  (68 пациентов) были представлены специалистами различного профиля (врачами, педагогами, бухгалтерами, учеными и т.д.). На долю собственно служащих, к которым относили исполнителей осуществляющих подготовку и оформление документации, хозяйственное обслуживание (секретари-машинистки, статистики, табельщики) в рассматриваемой категории приходилось  $25,26 \pm 3,30\%$  (24 пациента).

Удельный вес служащих среди пациентов основной группы был незначительно но статистически значимо ( $P < 0,05$ ) ниже доле занятых в сфере обслуживания пациентов группы контроля ( $66,60 \pm 3,85\%$ ; 100 пациентов). Структура контингента в пределах категории «служащие» среди условно здоровых пациентов несколько отличалось. Так, среди 150 пациентов группы контроля с руководящим различных уровней относились  $22,0 \pm 4,4\%$  (22) пациентов, что более чем в 6,9 раза превышало долю управленцев в основной группе ( $P < 0,001$ ).

Большая часть служащих ( $70,0 \pm 3,74\%$ ; 70 пациентов) была также представлена различными профилями. Однако, служащие с низкой квалификацией в контрольной группе встречались в 3,15 раза реже ( $8 \pm 2,71\%$ ; 8 пациентов) по сравнению с основной группой ( $P < 0,001$ ).

По результатам опроса не работали  $13,87 \pm 2,62$  (24) пациента с кандидозом СОПР. к неработающим относились лишь  $6,00 \pm 2,71\%$  (8) пациентов группы контроля ( $P < 0,001$ ).

Для пациентов занятых физическим трудом в группе с кандидозом СОПР составила  $15,61 \pm 2,76\%$  (27) пациентов, что почти в 3 раза превышает частоту «рабочих» среди условно здоровых  $5,33 \pm 1,83\%$  (8) пациентов ( $P < 0,001$ ).

Основная и контрольная группа были сопоставимы по доле учащихся которые составляли  $21,56 \pm 3,13\%$  (20) и  $20,67 \pm 3,31\%$  (31) соответственно ( $P > 0,05$ ).

Инвалидность имели  $5,78 \pm 1,77\%$  (10) основной группы, против  $3,33 \pm 1,46\%$  (5) пациентов группы контроля. Полученные при анкетировании сведения позволили определить наиболее значимые факторы развития кандидоза СОПР. К ведущим факторам определяющим характер клинического

течения кандидоза СОПР относятся: отсутствие высшего образования, работа связанная с физическим трудом, болезни системы кровообращения, анемия, эндокринные нарушения, заболевания пародонта.

При этом часть представленных факторов могут рассматриваться как полностью при частично модифицируемые, что является определенным резервом в снижении частоты развития кандидоза СОПР, при условии своевременного и эффективного чередования соответствующих диагностических и лечебно-профилактических мероприятий.

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## **LOCAL IMMUNE STIMULANT TREATMENT IN COMBINED THERAPY OF LICHEN PLANUS OF THE ORAL MUCOSA**

Lichen planus rubber is a chronic polyethological disease with papules rashes on the mucous membranes and skin. To date, the problem of treating lichen planus (LP) is one of the important and modern unsolved tasks of clinical dentistry<sup>1</sup>.

The most significant of the primary stages of complex therapy of LP is local conservative treatment, in addition to etiotropic and pathogenetic therapy.

Arsenal of drugs used in local therapy for LP is quite wide including solutions of antiseptics, enzymes, corticosteroids, immunomodulators, various combined biomaterials containing solcoseryl, proteolytic enzymes, vitamin drugs, etc<sup>2</sup>. According to various sources, the local treatment efficiency in this category of patients is lower<sup>3</sup>. Prolonged chronic course of OLP determines

<sup>1</sup> Grigoriev SS, Zhovtyak P.B. Assessment of the clinical efficacy of local treatment of patients with red flat mucous membrane deprive the mouth. Problems of dentistry . 2016; 12 (1): 25–30.

<sup>2</sup> Rusakova IV, Kharitonova MP, Akhdykhayeva EK, Kostenko KK, Karapetyan AV Evaluating the effectiveness of the treatment of lichen planus of the oral mucosa in patients paying experienced during the dental chair of used general practice Medical University UGMU // Innovative technologies in science and education. - 2015.– No. 2 (2). - P. 39–42.

<sup>3</sup> Papageorgiou V.P., Assimopoulou A. N., Ballis A. C. Alkannins and shikonins: a new class of wound healing agents // Current Medicinal Chemistry.– 2008.– Vol.15.– P. 3248–3267.

<sup>4</sup> Ribero S, Stieger M, Quaglino P. et al. Efficacy of topical tacrolimus for oral lichen planus: real–life experience in a retrospective cohort of patients with a review of the literature. JEADV. Article first published online: 12 OCT 2014.

the need to search for safe methods of pathogenetically justified treatment with drugs that have an immunotropic effect<sup>4</sup>.

An immune stimulant based on bacterial lysates IRS-19 enhances specific and nonspecific immunity leads to the rapid development of local immune response. Specific protection is due to locally formed antibodies of the class of secretory immunoglobulin of the type A (IgA), preventing the fixation and reproduction of pathogens of infection on the mucosa. Nonspecific immune protection is manifested in an increase in the phagocytic activity of macrophages, an increase in the content of lysozyme.

Research objective: Determination of the clinical efficiency of local therapy with IRS-19 in the treatment of patients with lichen planus of the oral mucosa.

Materials and methods. The material for the analysis and conclusions were the results of treatment of 139 patients with OLP aged 20–69 years received treatment in the clinic of therapeutic dentistry department of TMA and TSDI for the period from 2015 to 2018 years.

The diagnosis of OLP was based on the classification of E. V. Borovskiy, A. L. Mashkileyson, 2001. The treatment of OLP was interlinked with the clinical severity of its course. Patients with OLP formed representative groups of patients: the basic, receiving as a local treatment IRS-19 and the comparison control group receiving the standard treatment, including atypical form (36 patients – 18 basic, 18 – control group); exudative hyperemic (34 patients – 17 basic and 17 control group); erosive-ulcerous (42 patients – 21 basic and 21 control group) and bullous form (27 patients – 14 basic and 13 control group).

The comparison groups were randomized by sex, age and frequency of somatic pathology background, which ensured the representativeness of the data obtained during treatment.

The state of the oral mucosa was assessed, the nature and presence of specific damage elements, the severity of inflammatory-destructive processes in the epithelium of the oral mucosa, and the nature and frequency of specific complaints.

Patients of control groups were treated with proteolytic enzymes, keratoplastic agents, physiotherapy procedures were prescribed, antimicrobial agents (metronidazole), regenerating agents (solcoseryl dental adhesive paste) were widely used. It should be noted that, as a rule, one patient was applied 2 or more of the local impact.

In the main groups as local therapy, the use of IRS-19 according to the following scheme was recommended: typical form — 1 dose 2 times a day for up to 2 weeks; exudative-hyperemic form- 1 dose 3 times a day up to 2–3 weeks; erosive-ulcerous and bullous form: 1 dose up to 5 times a day for a month, with the repeat of the course every 3 months.

Results and discussion. As a result of the complex therapy, positive clinical dynamics was observed both in the basic group and in comparison group. With objective examination, the patients experienced a decrease in erythema, a decrease in the number of papular elements, a decrease in the inflammatory phenomena of the oral mucosa, a reduction in the area of erosions and their epithelization, a transformation of a heavier form into a less severe one.

The fastest regression of the local manifestations of OLP was observed in the basic groups ( $P < 0.05$ ). Thus, in a typical form, the regress of subjective sensations was registered on 3.81–6.11 days after the start of treatment (in the comparison group it was on 5.31–8.32 days); in exudative-hyperemic form, it was, respectively, on 5.51–7.82 and 7.32–11.31 days; erosive and ulcerative form it was on 7,51–12,11 and 12,46–21,81 days and in bullous form it was on 7,81–12–25 and 14,32–20,31.

In patients with a typical clinical form of OLP, in the basic group, remission was achieved in 16 ( $88.89 \pm 7.71$ ) patients, in the comparison group in 10 ( $55.56 \pm 11.71$ ) ( $P < 0.05$ ); the corresponding ratios in patients with exudative hyperemic form were 14 ( $82.35 \pm 9.25\%$ ) vs 8 ( $47.06 \pm 12.11\%$ ) ( $P < 0.05$ ); in patients with erosive-ulcerative form they were 13 ( $61.90 \pm 10.60\%$ ) against 6 ( $28.57 \pm 9.85\%$ ) ( $P < 0.05$ ); and in patients with bullous form they were 7 ( $50.0 \pm 13.36\%$ ) to 2 ( $15.38 \pm 10.0\%$ ) ( $p < 0.05$ ).

It should be noted that in the basic groups there were no patients who had no positive dynamics of local clinical symptoms (without effect), and in the comparison groups in patients with an erosive-ulcerative form, the number of such patients was 4 ( $19.05 \pm 8.17\%$ ) and in patients with a bullous form it was 2 patients ( $5.38 \pm 6.26\%$ ).

Inclusion of IRS-19 in the complex of therapeutic measures of patients with OLP of the oral mucosa promotes cessation of pain, disappearance of erythema and edema, rapid resolution or reduction in the number of papular eruptions and prevents the appearance of new ones, contributes to the epithelization of erosive ulcerous sites, accelerates the time of onset of remission, and prevents relapses.

The results of the studies make it possible to recommend the medicine in the complex therapy of patients with OLP.

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## **CYTOKIN STATUS IN PATHOGENESIS OF ORAL LICHEN PLANUS**

At the same time the peculiarity of the mucous membrane inflammation in oral lichen planus (OLP) is due to the interaction of at least two defensive mechanisms: local (particularly in the oral cavity) and systemic (whole organism) that are independent on one hand and perform the whole immune system defense on another. The intensity of the local processes depends on the integrity of the immunity agents and their inter action<sup>1</sup>.

In this connection, working out an OLP diagnostic method at various stages of clinical manifestations based on tissue resistance factors in the oral cavity and blood serum is seen to be actual<sup>2</sup>.

Undoubtedly, a complex study of local and systemic changes in cytokine net would clarify the picture of the illness pathogenesis, increase the opportunities in diagnostics and prognosis, so, prophylaxis and therapy.

Purpose of the investigation is to study the changes characteristics of local and systemic type of cytokines in patients with OLP to those changes with rising of the severeness of the problem.

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<sup>1</sup> Kisileva E. A. Comparative characteristics of immune factor models of chronic inflammation and neoplasms of mucous membrane of the oral cavity // cytokines and inflammation. – 2011.–T. 10, N 3. – P. 40–44.

<sup>2</sup> Xavier G. M. Investigation of functional gene polymorphisms interleukin-1 beta, interleukin-6, interleukin-10 and tumor necrosis factor in individuals with oral lichen planus // J. Oral Pathol. Med. – 2007.– Vol. 36, № 8. – P. 476–481.

Materials and methods. 33 patients with OLP have been seen. According to the clinic forms, the patients were divided into several groups: typical form (10 patients); exudative-hyperemic (10 patients); erosive-ulcerative (7 patients); bullous (6 patients). To diagnose OLP E. V. Barovskiy, A. L. Mashkilleison classification has been used. In all patients, the history data mostly reflecting the course of the disease have been studied. The findings were correlated to those of 20 healthy ones (control group). Patients with severe somatic illness at exacerbation stage have been excluded. Patients with cardiovascular, endocrine, nervous, immune, psychiatric disorders, pregnancy and lactation, blood diseases were assessed by doctors of other specialties. Criteria for exclusion was the remission stage of OLP. Patients with 3 — week immunotropic therapy were not included into the study.

Factors valuable for etiopathogenesis of OLP were taken into consideration. They are: beginning and development of the disease, suggested causes, working conditions, including harm, heredity, previous and accompanied illnesses, result of clinical and paraclinical investigations.

To estimate the immune response index of proinflammatory cytokine (FNO- $\alpha$ , IFN- $\gamma$ , IL-1, IL-6 and IL-8) to anti-inflammatory cytokine (IL-4, IL-10) (P/A). P/A index shows the correlation of pro- and anti-inflammatory cytokines<sup>1</sup>.

Results were statistically processed using the software package Statistica 6.1. A probability value of  $P < 0.05$  was the proof of statistical significance.

Results and Discussion. The findings of pro- and anti-inflammatory cytokines in blood serum and oral fluids in patients with OLP are given in table 1. In healthy persons (control group) cytokine content is higher in oral fluid than in blood serum ( $p < 0.05$ ). Obviously, it is due to specific mucous membrane of oral cavity, constant microflora and highly active local immunity.

Quantitative changes and content direction of cytokine depend on the clinic form of the illness. At this time both environment in patients with less severe clinical course of OLP (typical and exudative-hyperemic forms) the acceleration of pro-inflammatory mediators (FNO- $\alpha$ , IFN- $\gamma$ , IL-6 and IL-8) was noted with dynamic increase in anti-inflammatory mediator (IL-4 and IL-10).

Together with pro-inflammatory cytokinemia the increase in anti-inflammatory cytokines (IL-4, IL-10) activity has compensatory character and

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<sup>1</sup> Yamamoto T., Nakane T., Osaki T. The mechanism of mononuclear cell infiltration in oral lichen planus: the role of cytokines released from keratinocytes // J. Clin. Immunol.—2000.— Vol. 20, № 4.— P. 294–305.

is directed to lower production of pro-inflammatory cytokines to control the inflammation and severeness of mucous membrane damage.

Obviously, more favorable course of reticular and exudative-hyperemic form of OLP mostly depends on increased activity of anti-inflammatory factors.

The more severe the process in mucous membrane the more vivid dysbalance in pro- and anti-inflammatory cytokines which is characterized by decrease of anti-inflammatory cytokines content (IL-4, IL-10) with increase of pro-inflammatory cytokine production (FNO- $\alpha$ , IFN- $\gamma$ , IL-6 and IL-8).

It is necessary to note that in simultaneous direction of changes in cytokine profile higher concentration is seen in all cases with oral fluid. So, in all forms of OLP FNO- $\alpha$  concentration in oral fluid is 18.71 times ( $P < 0.01$ ) higher than in blood serum; IFN- $\gamma$  – 25.04 times ( $P < 0.01$ ); IL-1–22.01 times ( $P < 0.01$ ); IL-6–27.42 times ( $P < 0,01$ ); IL-8–18.58 times ( $P < 0.01$ ); Il-4–1.47 times ( $P < 0.01$ ) and Il-10–1.45 times ( $P < 0.01$ ).

The study of pro- and anti-inflammatory cytokines level in blood serum enables to estimate complex activity of lymphoid cells products and monocytes, macrophages, also cells of endothelium and some other cells which are activated in autoimmune damage. It seems to think that the condition of local barriers is determined by the level of proliferation and differentiation of immunocompetent cells in central organs of immunogenesis. The peculiarity of mucous membrane immune system functioning is mostly characterized by the direction of pathologic processes<sup>1</sup>.

In this case, it is significant to determine the interaction between local disturbances on mucous membrane level and abnormalities in the systemic level. Such kind of approach will clarify the peculiarities of the severeness in systemic immunity damage and possibly other homeostatic systems of the organism.

Therefore, it was determined that cytokines have key point in pathogenesis of various clinical forms of OLP. Both systemic and local changes in pro- and anti-inflammatory factors and their balance certify the immunologic disturbances, severe immune deviations, presence of chronic illnesses in patients.

### **Conclusion**

Results of investigation enable to improve traditional understanding of the systemic and local cytokine profile changes in patients with OLP.

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<sup>1</sup> Zagorognyaya E. B. Pathomorphologic, immunohistochemical and cytokine analysis of OLP of mucous membrane of oral cavity. Thesis. for Ph.D.-Novosibirsk, 2010. – 22p.

Pro-and anti-inflammatory cytokine content may be used as evaluative marker of the severness of the course and determination of OLP clinic form, as well as the base to correct systemic and local deviations in cytokine system.

Etiopathogenetic therapy of OLP are to include complex examination for determination and treatment of somatic pathology provoking the development of systemic cytokine dysbalance.

Vivid deviations in cytokine system of blood serum and oral fluid prove necessity of complex therapy with immunomodulatory of not only local but also systemic influence.

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## **ENZYMATIC ACTIVITY OF CANDIDA FUNGI IN PATIENTS WITH CANDIDAL STOMATITIS OF THE ORAL CAVITY**

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## **ФЕРМЕНТНАЯ АКТИВНОСТЬ ГРИБОВ CANDIDA У БОЛЬНЫХ С КАНДИДОЗНЫМ СТОМАТИТОМ ПОЛОСТИ РТА**

Одним из важных факторов кандидоза является способность грибов *Candida* противостоять защитным системам организма. Среди механизмов защиты от патогенов у человека существуют некоторые факторы есте-

ственной неспецифической резистентности, к которым в частности, относятся ферменты-лизоцим и лактофекрин, обладающие антимикробным действием. Антилактоферриновая (АНЛФ) и антилизоцимная активность грибов *Candida* (АЛА) являются важными биологическими свойствами среды широкого спектра персистентных характеристик<sup>1</sup>.

**Цель исследования.** Изучение количество и степени выраженности антилактоферриновой и антилизоцимной активности грибов *Candida*, у пациентов с различными клиническими формами кандидозного стоматита.

**Материалы и методы исследования.** При отборе в группу клинически значимых штаммов учитывались клинические проявления заболевания и выявление *Candida* в количестве, превышающем  $10^3$  КОЕ/мл. Группу клинически незначимых составили штаммы от пациентов без клинических признаков кандидоза, у которых выявлено менее  $10^2$  КОЕ/мл *Candida*. Всего протестировано 244 штамма грибов *Candida*, выделенных у пациентов с клинически диагностированным кандидозным стоматитом СОПР *Candida*, в том числе *S.albicans*. 153 штамма; *S.tropicalis* – 26, *S.globrata* – 24, *S.crusei* – 22 и *S. Gulermonde*- 19. Контролем служили 109 штаммов грибов *Candida*, выделенных у пациентов без патологии СОПР, в том числе: *S. 1albicans* 90 штаммов; *S.tropicalis* – 5, *S.globrata* – 5, *S.crusei* – 6 и *S. Gulermonde* – 4 штамма.

Изучено 353 штамма грибов *Candida*, из них 244 штамма, выделенных от больных кандидозом СОПР и 109 клинических штаммов, полученных у лиц группы сравнения. Исследованные штаммы получены при бактериологическом обследовании 173 больных кандидозным стоматитом, из них 15 острым вседомембранозным кандидозным стоматитом (В 37.00); 20-острым эритематозным кандидозным стоматитом (В 37.01); 47 – хроническим эритематозным кандидозным стоматитом (В 37.02) и 91 – хроническим эритематозным кандидозным стоматитом (В 37.03), 150 пациентов сопоставимого пола и возраста без признаков патологии слизистой полости рта составили группу сравнения. Диагноз кандидозного стоматита устанавливали по классификации, принятой Всемирной организацией здравоохранения, МКБ-10 (1997 г.).

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<sup>1</sup> Арзуманян В.Г., Шмелев О.А. Клинически значимые дрожжевые грибы – классификация, антигены и современные методы диагностики. В кн.: Микология сегодня. Т. Ю. Дьяков, А. Ю. Сергеев (ред.). Т. 3. М.: Национальная академия микологии, 2016: 120–123; Бухарин О.В., Гинцбург А.Л., Романова Ю.М. Механизмы выживания бактерий – М.: Медицина, 2005.– 367 с.

Пациенты обследованы микологическим методом, идентификацию выделенных культур проводили по морфологическим, тинкториальным, культуральным и ферментативным свойствам согласно руководству по микологическим исследованиям. Выделенные штаммы были отнесены к видам *Candida*, в том числе *C.albicans*. 153 штамма; *C.tropicalis* – 26, *C.globrata* – 24, *C.crusei* – 22 и *C. Gulermonde*- 19. штамма В качестве контроля были использованы 109 клинических штаммов идентичных по видовой и родовой принадлежности грибов, полученных в группе сравнения, в том числе: *C.albicans* 90 штаммов; *C.tropicalis* – 5, *C.globrata* – 5, *C.crusei* – 6 и *C. Gulermonde* – 4 штамма.

Изучение антилактоферриновой активности микроорганизмов (АЛФА) проводилось методом, основанным на определении остаточного количества лактоферрина в инкубационной смеси с помощью иммуноферментного анализа (ИФА)<sup>1</sup>. Антилактоферриновую активность выражали в абсолютных величинах (нг/мл) инактивированного микроорганизмами лактоферрина. Антилизоцимную активность микроорганизмов (АЛА) определяли фотометрическим методом<sup>2</sup>. Антилизоцимную активность микроорганизмов выражали в мкг/мл, оценивая остаточную активность фермента после инкубации супернатанта исследуемой культуры и раствора лизоцима в отношении тест-культуры *Micrococcus luteus*.

Статистический анализ данных выполнен на персональном компьютере с помощью программы STATISTICA (Data analysis software system, StatSoft) версия 6.0. Результаты исследований представлены в виде средней  $\pm$  стандартное отклонение ( $M \pm SD$ ). Сравнение непрерывных величин с нормальным распределением проводилось с помощью t-критерия Стьюдента. Различия между группами считались статистически значимыми при  $p < 0,05$ .

**Результаты исследования и их обсуждение.** Антилактоферриновая и антилизоцимная активность выявлялась у 92,31–100% штаммов *Candida* у больных кандидозом полости рта; у лиц группы сравнения антилактофер-

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<sup>1</sup> Бухарин О. В., Вальшев А. В., Харитонов Т. В., Чернова О. А., Киргизова С. Б. Способ определения антилактоферриновой активности микроорганизмов. – Патент РФ, 2156807. – 27.09.2000 г.

<sup>2</sup> Николаев А. А., Сухарев А. Е. Лактоферрин и его роль в репродукции (обзор литературы). Проблемы репродукции. – 2015. – №6. – С.25–30; Николаев А. А. Комплексообразование ингибина-А с лактоферрином человека. Успехи Современного Естествознания. 2015; 1: 401–405.

риновая и антилизоцимная активность обнаружена у 60,0–88,89% выделенных штаммов. При большей распространённости адгезивной способности у штаммов, выделенных при кандидозе полости рта различия по сравнению с группой контроля не были существенными ( $p > 0,05$ ).

При определении выраженности маркёров персистенции установлена различная величина проявления антилактоферриновой и антилизоцимной защиты изученных штаммов условно-патогенных грибов. Штаммы грибов, выделенные у больных кандидозным стоматитом, характеризовались существенно большей АЛФА, чем культуры данных микроорганизмов, полученные у лиц группы сравнения ( $P \leq 0,05$ ).

Штаммы *S.albicans* выделенные у больных кандидозным стоматитом, имели АЛФА в пределах  $23,72 \pm 1,01$ – $36,22 \pm 1,62$  нг/мл и существенно ( $P \leq 0,05$ ) превосходили активность данного фактора штаммов, полученных у лиц группы сравнения —  $16,32 \pm 0,70$  нг/мл. Культуры *S.tropicalis*, выделенные при кандидозном стоматите имели несколько меньшую АЛФА в пределах  $11,88 \pm 0,42$ – $20,32 \pm 1,02$  нг/мл, аналогичные штаммы в группе сравнения имели АЛФА  $8,71 \pm 0,42$  ( $P \leq 0,01$ ); соответствующие соотношения для *S.globrata* составили  $8,33 \pm 0,37$  нг/мл —  $14,51 \pm 0,66$  нг/мл против  $6,52 \pm 0,32$  нг/мл ( $P \leq 0,01$ ); *S.crusei* —  $8,56 \pm 0,40$  нг/мл —  $17,81 \pm 0,80$  нг/мл против  $6,77 \pm 0,34$  нг/мл ( $P \leq 0,01$ ) и *S. Gulermonde*-  $7,62 \pm 0,35$  нг/мл —  $12,33 \pm 0,52$  нг/мл против  $4,42 \pm 0,21$  нг/мл ( $P \leq 0,01$ ).

Антилактоферриновая активность культур *S.albicans* у больных кандидозом не только достоверно превосходила показатели активности АЛФА у лиц группы сравнения, но и была статистически значимо ( $P \leq 0,01$ ) выше показателей антилактоферриновой активности других видов кандиды. Штаммы грибов *S.albicans*, полученные у больных кандидозным стоматитом отличались более значительным ( $P \leq 0,01$ ) антилизоцимным потенциалом как по сравнению с аналогичными штаммами контроля, так и со штаммами *S.ponalbicans*. АЛА выделенных у больных штаммы *S.albicans* колебалась в пределах  $10,32$ – $16,82$ – $0,42$ – $0,71$  мкг/мл, а у культур, выделенных у лиц группы сравнения, этот показатель был равен  $4,32 \pm 0,21$  мкг/мл. Величина АЛА культур *S.tropicalis*, выделенные при кандидозном стоматите имели АЛА в пределах  $7,90 \pm 0,30$  мкг/мл– $13,81 \pm 0,53$  мкг/мл, аналогичные штаммы в группе сравнения имели АЛА  $3,61 \pm 0,14$  мкг/мл ( $P \leq 0,01$ ); соответствующие соотношения для *S.globrata* составили  $5,88 \pm 0,23$  мкг/мл —  $10,05 \pm 0,42$  мкг/мл против  $2,11 \pm 0,09$  мкг/мл ( $P \leq 0,01$ );

*S. crusei* –  $4,52 \pm 0,40$  мкг/мл –  $7,03 \pm 0,80$  мкг/мл против  $1,82 \pm 0,07$  ( $P \leq 0,01$ ) и *S. Gulermonde* –  $4,33 \pm 0,19$  мкг/мл –  $8,03 \pm 0,30$  мкг/мл против  $2,23 \pm 0,08$  мкг/мл ( $P \leq 0,01$ ).

Таким образом, при кандидозе полости рта выделяются грибы рода *Candida* отличающиеся выраженным персистентным потенциалом. Отдельные штаммы условно-патогенных грибов, полученные при кандидозном стоматите, имеют более выраженные персистентные характеристики по сравнению с клиническими штаммами, выделенными у пациентов без патологии слизистой оболочки полости рта<sup>1</sup>. У больных кандидозом слизистой полости рта оболочки колонизированы грибами, чаще проявляющими антилизоцимную активность и имеющими более выраженный антилактоферриновый потенциал, что может играть роль в патогенезе заболевания, снижая уровень лактоферрина и нарушая выживание нейтрофилов.

**Выводы.** При кандидозном стоматите существенно чаще выделяются условно-патогенные микроорганизмы, имеющие факторы персистенции: антилактоферриновую и антилизоцимную активность, при этом повышение активности факторов персистенции, наряду с *S. albicans* обнаруживается у штаммов *S. tropicalis*, *S. globrata*, *S. crusei* и *S. Gulermonde*, что определяет их патогенетическую значимость в развитии кандидозной инфекции полости рта.

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## **NOSOLOGICAL FORMS OF CANDIDAL STOMATITIS OCCURRING IN PATIENTS WITH DISEASES OF THE ORAL MUCOSA**

Candidosis of the oral mucosa (COM), whose share in the structure of the disease of the COM is 40,0–45,0%, remains one of the most important problems in dentistry<sup>1</sup>.

Prevalence and the etiology of candida-associated oral lesions of patients in Uzbekistan remains unexplored. Similar studies in the Republic Uzbekistan was not conducted.

**The purpose of the study.** About to limit the nosological forms of candidal stomatitis in patients in the Republic of Uzbekistan.

**Materials and methods.** The contingent surveyed included patients who applied to the dentist for the period from 2015 to 2017 in the clinic of therapeutic dentistry and the department of faculty therapeutic dentists TDSI. Total 452

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<sup>1</sup> Surkova S. A. Features of clinical and laboratory diagnosis of invasive candidal infection of the oral mucosa. Magazine «Dental Forum» – 2012.– № 3. – P. 94–95; Panchenko A. D. Combined treatment of oral candidiasis in patients with removable laminar dentures. Saratov – 2013.

patients were examined and the disease and periodontal COM, of which 173 (38.27±2,29%) according to the patients conducted clinical and laboratory diagnosis has been diagnosed as candidiasis of the oral mucosa (COM). The age of patients ranged from 18 to 65 years and more.

Depending on the possible etiological factors of disease occurrence were divided into 2 groups of patients:

**1 group** was characterized, by lack of connection with prosthetics and included 126 patients with typical clinical manifestations (including 71 women and 55 men) who were diagnosed with *Candida* candidiasis.

**2 group** included patients 47 patients (27 women and 20 men), who was diagnosed with candidiasis within 3 years after prosthetics and initially qualified as prosthetic stomatitis.

All patients were diagnosed according to the ICD-10 International Classification (WHO, Geneva, 1997): B37.0 “*Candida* stomatitis”. Clinical and laboratory methods — microscopic, cultural (mycological) and immunological — were used to confirm the diagnosis of candidiasis of the PRS.

Mycological research was performed, according to the traditional algorithm of medical mycology<sup>1</sup>. For statistical processing, parametric methods were used (mean value, error of mean value  $M \pm m$ , Student's t-factor, probability of differences) and non-parametric processing of results.

For relative values (the frequency of cases, the ratio of the number of strains to the total number, etc.), the frequency (%) was determined. For statistical processing of the results, the Excel computer program for Microsoft was used.

**Results and discussion.** During the examination, acute pseudomembranous oral candidiasis was diagnosed in 15 patients, which amounted to 8,67% from all of us surveyed; In 20 patients (11,56±2,43%) we detected acute erythematous atrophic candidiasis, in 47 patients (27,17 ±3,38%) — chronic hyperplastic candidiasis and 91 (52,60±3,80%)-chronic atrophic candidiasis was more commonly identified in elderly patients using removable dentures — 31 people (25% surveyed).

As a result of clinical examination revealed the prevalence of chronic forms of oral candidiasis, the total frequency of which was 79,77%.

An indicator of the persistent course of the disease is the duration of the pathological process.

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<sup>1</sup> Surkova S. A. Improving the methods of laboratory diagnosis and the rationale for the treatment of candidiasis of the oral mucosa: author. dis. ... Ph. D. M., 2013. – 24s.



By increase in age of patients it is associated with increase in prevalence of candidiasis of COM. At the same time, the main share in the total number of sick people falls on the age period from 34 years to 64 years and older (more than 135 patients) 78.03 + 3.15% of the diseased. It can be assumed that such a high incidence of the adult population is due to a higher frequency of background somatic pathology, frequent use of antibiotics and hormonal (steroid drugs).

A detailed analysis of the duration of candidiasis showed that in patients in the age groups of 18–22 years and 23–34 years, the maximum duration of the disease is up to 1 year, which was noted respectively by 9 (15,20±2,71%) and 12 (6,94 ± 1,94%) patients; while the duration of candidiasis from 1 year to 3 years was found respectively in 6 (3,47±1,39%) and 7(4,05±1,49%) and only 3 (1,73±0,99) and 1 (0,57±0,57%) had a disease duration of more than 3 years.

At patients in age groups 35–44 and 45–54 years prevailed candidiasis patients with duration more than 3 years of age: 20, respectively (2,43±11,56%) and 18 (10,40 ± 2,32%) and 32 (18,49 ± 2,95%); 1–3 years 18 (10,40 ± 2,32%) and 20 (11,56 ± 2,43%) and up to 1 year 4 (2,31 ± 1,14%) and 2 (1,16 ± 9,81%) patient.

Analytical distribution of different forms of nosologically candidiasis OMC age revealed a clear predominance of acute forms of the disease in young adults; and in patients ages 35–44 years of age and older — dominating of chronically x form of the disease.

**Conclusions.** So, in the age group of 18–24 years, the frequency of acute pseudomembranous candidiasis in the total frequency of candidiasis of OMC was 10 (5,78 ± 1,77%); and acute erythematous — 8 (4,62±1,60%); in the age group 23–34 years only in 3 (1,73±0,99%) patients had chronic pseudomembranous candidiasis: wherein the frequency of acute and pseudomembranous amounted candidate and matching 5 (2,89±1,27%) and 12 (6,94±1,94%).

In the age periods of more than 35 years, chronic forms of the disease prevailed. which accounted for 135 (78,03±3,15%), including chronic atrophic candidiasis found in 91 (52,60±3,80%) and chronic pseudomembranous — in 47 (27,17±3,38%). Candidiasis of the oral cavity and is a serious problem, due with wide prevalence recurrent Persistent character flow.

This view pathogen is discovered at cavities mouth about at 60% healthy in adults, more often at of women and smokers men who where concentration mushroom at cavities mouth much above at no of teeth (78,3%), than at their

the presence of (36,8%)<sup>1</sup>. In the modern structure of candidiasis of the PRD (in referring to the dentist), chronic forms take the leading place (hypertrophic candidiasis — in 28,4%; atrophic candidiasis — in 30,9%).

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## **Section 3.**

### **Technical sciences**

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#### **PROBLEMS OF RECONSTRUCTION OF THE RAILWAY TRACK PLAN AND APPROACHES TO THEIR SOLUTION**

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#### **ЗАДАЧІ РЕКОНСТРУКЦІЇ ПЛАНУ ЗАЛІЗНИЧНОЇ КОЛІЇ ТА ПІДХОДИ ДО ЇХ ВИРІШЕННЯ**

При введенні швидкісного руху основною складністю є реконструкція плану залізничної колії. Ця складність полягає у тому, що суміжні, тобто

розташовані близько одна до одної криві з короткими прямими вставками взаємопов'язані. Тому поліпшення характеристик хоча б однієї з кривих тягне зміну, а часто погіршення параметрів інших. Тому такі групи близько розташованих кривих передбачається розглядати, як єдине ціле, яке може бути представлено у вигляді модуля.

При реконструкції модуля зміни можуть відбуватися тільки усередині нього, не виходячи за його межі. Модулі поєднання кривих, які зустрічаються на практиці та містять до чотирьох суміжних кривих, можуть бути представлені у вигляді таблиці 1.

Модуль кривих розглядається у системі прямокутних координат і тому для кожної з вершин кута (ВК) відомі значення  $X$  і  $Y$ .

Реконструкція модуля полягає в тому, щоб знайти такі положення  $BK^n$ , а значить значення  $(X X^n; Y^n)$ , при яких виконувалися б наступні умови

$$S_{ij} \geq S_{ij}^n \text{ та } S_{ij} - S_{ij}^n \rightarrow \min \quad (1)$$

де  $S_{ij}$  — відстань між ВК кривих існуючого плану, яка знаходиться як

$$S_{ij} = \sqrt{(X_i - X_j)^2 + (Y_i - Y_j)^2}, \text{ м} \quad (2)$$

де  $(X_i; Y_i)$  та  $(X_j; Y_j)$  — координати положення відповідних ВК.

Таблиця 1. – Модулі сполучення кривих, які зустрічаються на практиці

Кількість кривих, які входять до блоку	Напрямок кута повороту			
	1	2	3	4
1. Дві криві	праворуч	праворуч	–	–
	праворуч	ліворуч	–	–
2. Три криві	праворуч	праворуч	праворуч	–
	праворуч	ліворуч	праворуч	–
	праворуч	праворуч	ліворуч	–
	ліворуч	праворуч	праворуч	–
3. Чотири криві	праворуч	праворуч	праворуч	праворуч
	праворуч	праворуч	праворуч	ліворуч
	праворуч	праворуч	ліворуч	ліворуч
	праворуч	ліворуч	ліворуч	ліворуч
	праворуч	ліворуч	праворуч	праворуч
	праворуч	праворуч	ліворуч	праворуч
	праворуч	ліворуч	праворуч	ліворуч
	праворуч	ліворуч	ліворуч	праворуч

$S_{ij}^n$  — проектна відстань між новими положеннями ВК, вона знаходиться за на ступною формулою

$$S_{ij}^n = T_i + d_p + T_j, \text{ м} \quad (3)$$

де  $T_i, T_j$  — тангенси кривих, знайдені при проектному радіусі, м;

$d_p$  — проектна пряма вставка, м.

Підходи, які можуть бути застосовані для вирішення задачі реконструкції модулів, включають в себе:

- виключення або введення однієї або декількох ВК;
- зміщення однієї або декількох ВК по тангенсу;
- зміщення однієї або декількох ВК по бісектрисі кутів повороту;
- комбінований підхід, що дозволяє застосовувати спільно окремі елементи перерахованих вище пунктів;
- рівноваження величин радіусів суміжних кривих.

Вирішуючи завдання реконструкції модулів, використовуючи ці підходи, можна домогтися збільшення відстані між сусідніми ВК, а також зменшення значень кутів повороту, що в свою чергу дозволяє поліпшити характеристики плану, тобто збільшити значення радіусу і довжини прямої вставки.

Для визначення відстані між новими положеннями ВК, як зазначалося вище, потрібно знати кутові коефіцієнти рівнянь прямих, що з'єднують ВК існуючого і проектного плану —  $K_{ij}$ , які знаходяться за наступною формулою

$$K_{ij} = \frac{(Y_i - Y_j)}{(X_i - X_j)}, \quad (4)$$

де  $(X_i; Y_i), (X_j; Y_j)$  — координати сусідніх ВК.

Нові координати суміщених ВК

$$X_i^n = X_i - d_i \cdot \cos(\arctg K_{ij}), \text{ м} \quad (5)$$

$$Y_i^n = Y_i - d_i \cdot \sin(\arctg K_{ij}), \text{ м} \quad (6)$$

де  $(X_i^n; Y_i^n)$  — координати нового положення  $BK_i$ ;

$(X_i; Y_i)$  — координати існуючої  $BK_i$ ;

$d_i$  — величина суміщення положення  $BK_i$  по тангенсу, м.

При зміні положення ВК також змінюються кути повороту, величини яких знаходяться наступним чином

$$\alpha_n = \arctg\left(\frac{K_{ij}^n - K_{ki}}{1 + K_{ij}^n \cdot K_{ki}}\right), \text{ град.}, \quad (7)$$

де  $\alpha_n$  — значення нового кута повороту, град.;

$K_{ij}^n$  — кутовий коефіцієнт проектної прямої між ВК;

$K_{ki}$  — кутовий коефіцієнт існуючої прямої між ВК.

Зсув осі колії, який при такій реконструкції траси досягає величин кількох десятків метрів, не завжди може слугувати вирішальним критерієм для оцінки варіанта рішення.

Однак, якщо виникає така необхідність, то використання часто застосовуваного методу кутових діаграм для підрахунку величин зміщення після реконструкції не завжди доцільно, так як це призводить до істотних погрешностей, які спотворюють загальну картину. Похибки викликані зміною не тільки значень кутів повороту, а й довжини ділянки траси, що входить в модуль.

Застосування такого підходу, як зміщення ВК може бути обмежене, так як, займаючи нове положення, траса лінії можливо перетне прилеглу будівлю, яка не підлягає знесенню.

Тоді необхідно обмежити величини зміщення ВК модуля. Це обмеження вводиться умовою, що відстань (S) від проектного положення траси до критичної точки (P) має відповідати габариту наближення будови на швидкісних лініях (рисунок 1). Для цього представимо пряму лінію, що сполучає дві зміщені ВУ у вигляді рівняння

$$\begin{vmatrix} X & Y & 1 \\ X_1^n & Y_1^n & 1 \\ X_2 & Y_2 & 1 \end{vmatrix} = 0. \quad (8)$$

Рівняння (8) можна привести до вигляду

$$Ax + By + C = 0, \quad (9)$$

де A, B, C — коефіцієнти, які, відповідно, дорівнюють

$$A = \begin{vmatrix} Y_1^n & 1 \\ Y_2 & 1 \end{vmatrix}; \quad B = - \begin{vmatrix} X_1^n & 1 \\ X_2 & 1 \end{vmatrix}; \quad C = \begin{vmatrix} X_1^n & Y_1^n \\ X_2 & Y_2 \end{vmatrix}, \quad (10)$$

тоді відстань від нової проектної прямої до критичної точки знаходяться як

$$S = \left| \frac{A \cdot x_p + B \cdot y_p + C}{\sqrt{A^2 + B^2}} \right|, \text{ м} \quad (11)$$

Отже, якщо S дорівнює габариту наближення будови, то зміщення ВК (у даному випадку ВК1) слід припинити.

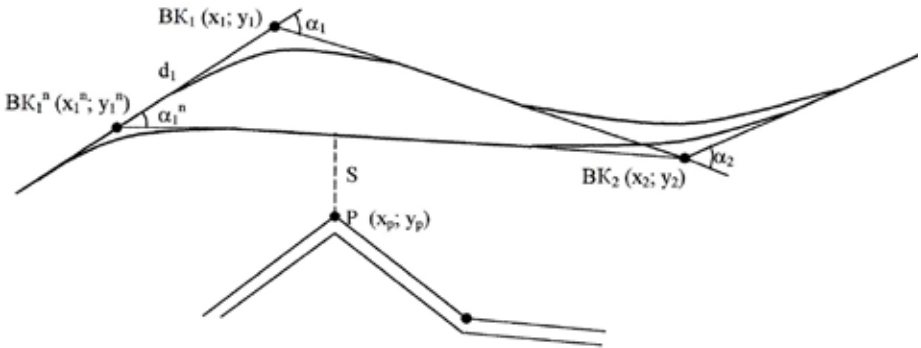


Рисунок 1. – Визначення обмеження суміщення ВК по контуру

В результаті застосування різних підходів до вирішення завдання реконструкції модуля, може бути отриманий ряд варіантів. Оцінка і порівняння цих варіантів в залежності від умов і необхідного рішення, а також вимог, що пред'являються до дільниці реконструкції може здійснюватися за такими критеріями:

- найменша довжина реконструкції;
- зручність реалізації варіанту реконструкції;
- найменше зайняття території;
- приведені витрати, які включають вартість реконструкції і експлуатаційні витрати.

Найбільш загальним рішенням був би багатокритеріальний підхід, для чого слід дати вагові коефіцієнти деяким із зазначених критеріїв.

Загальними для всіх варіантів реконструкції є критерії: мінімальна довжина реконструкції та наведені витрати, так як інші запропоновані критерії носять індивідуальний характер, незважаючи на це вирішальним може виявитися кожен з них.

Після прийняття рішення по реконструкції можна очікувати, що при існуючих зсувах траси в плані можливий вихід за межі смуги відведення, знесення споруд і заняття культивованих земель. Крім цього капітальні витрати, вкладені в реконструкцію складних модулів, можуть бути істотними, які в ряді випадків можливе окупляться за рахунок економії в експлуатаційних витратах. Така економія може виникнути через зняття обмеження швидкості руху поїздів.

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## **DEVELOPMENT OF THE TECHNOLOGY OF ROAD EMBANKMENT CONSTRUCTION WITH INTERLAYERS FROM GEOSYNTHETICS (POLYETHYLENE FILMS) IN EXPERIMENTAL ENGINEERING**

**Abstract:** The measures to solve the effect of groundwater on erected automobile roads in conditions of Uzbekistan are considered in the paper. In connection with this, the sequence of work stages carried out in the construction of experimental sites of the road is given.

**Keywords:** geosynthetic materials, road embankments, geotextile interlayers, settlement marks, soil, compaction, construction, civil engineering.

In recent years the experience of construction in our Republic has shown the need for an inevitable reduction in construction areas for specified volumes, and the need to build various structures on soft soils. All these requirements can be met by using various reinforcing geosynthetic materials<sup>1</sup>.

The worldwide recognition and use of reinforced soil<sup>2</sup> made it one of the most significant directions in engineers' developments in industrial and civil engineering.

To further verify some of the main theoretical assumptions, to develop technology for constructing road embankments with geotextile interlayers and to check their effectiveness in production conditions, the studies have been carried out at special experimental sites in the Syrdarya region on the 1<sup>st</sup> —

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<sup>1</sup> Matveyev S. A., Sirotyuk S. S. Use of Geosynthetic Materials for the Reinforcement of Road Structures. Khanty-Mansiysk. 2010. Pp.13–20; Recommendations on the Use of Geosynthetic Materials in Construction and Repair of Highways. Ministry of Transport of the Russian Federation. State Road Service (Rosavtodor).—Moscow: 2003.— Pp. 2–3.

<sup>2</sup> Johns K. D. Construction from Reinforced Soils. Moscow: Stroyizdat 1989.— Pp. 10–11.

category road Gulistan-Akhangaran (length – 24 km, beginning at 104 km of automobile road to Gulistan ending at 21 km of automobile road 4P-29 with a bypass of new direction with overpass and transport interchange construction)<sup>1</sup>.

Construction has been carried out by SJSC “Uzavtoyul” SDRSO “Avtomagistral”. To carry out works based on the engineering survey materials presented by the GTN at the design stage, a 100 m long section (PK 81 + 50 ... PK 82 + 50) with approximately similar engineering geological conditions has been chosen. The roadbed was filled by loess, sandy loamy soils; the plasticity number – 5.35; the average salinity –3.46 mg/l, PH-8.6; the optimum moisture content – 17.5%, the maximum density – 1780 kg/cm<sup>3</sup>.

Polyethylene films of M-1 brand, manufactured in Uzbekistan, have been used in experimental sites. The length of the roll is 100 m, the width is 3.0 m. The film thickness is 1.0 mm.

### **Construction of road embankments in experimental sites**

Total length of experimental sites is 200 m. A reference site with conventional technology without the use of a film was built near the experimental site. Film layer was unrolled along the road embankment.

To observe the settlement of embankment surface, settlement marks were installed along the diameters — special shields with sizes 0.5x0.75 m. The shields were installed along the marginal strips of the roadway, at the distance of 3 m from the edge of the roadbed (Fig.1.).

At the stage of preparation for construction, geodetic lay-out work was done (Fig. 2).



Fig. 1. Installation of shields



Fig. 2. Geodetic layout work

<sup>1</sup> Khozhmetov G. Kh., Kayumov A., Miralimov M., Komilov S. Geosynthetic Reinforcing of Road Embankments in Experimental Construction. Proceedings of Republican Scientific and Technical Conference, May 15–16. Djizak.2009.– Pp.125–126.

Development of the technology of road embankment construction with geosynthetics.

At the next stage the prepared surface of the compacted layer was leveled. Polyethylene film was rolled out manually by one (or two) worker(s). On all sites of the roadbed the rollout was done with tension (Fig. 3).

A single layer of film was rolled out at 20–25 cm overlapping (Fig. 4) in the longitudinal direction.



Fig. 3. Rollout with tension



Fig.4. Rollout with overlapping

Landfilling of the first layer of road embankment was carried out by the “push away” method using lorries and trucks (Fig. 5). Then the soil was leveled with a motor grader (Fig. 6).



Fig.5. Landfilling by the «push away» method



Fig. 6. Leveling with a motor grader

After soil compaction by a semi-trailer road-roller on a pneumatic run (Fig. 7.) soil density and moisture content were determined by the DorNII striker. Then, the film was backfilled with the second layer of soil (Fig. 8) and again leveled with a autograder.



Fig.7. Soil compaction by a road-roller on a pneumatic run



Fig.8. Backfill with the second layer

### Results of the base surface survey

The following was determined during the road survey:

1. The height of road embankments.
2. Density in depth.
3. Groundwater level.

Table 1. – Roadbed height above the earth's surface of surveyed roads

Name of automobile roads	PK	Height of road embankment, m
Automobile road connecting M-34 «Tashkent-Dushanbe» with 4R-29 «Guliston-Gagarin» new direction (bypass of Gulistan)	81 + 50	1.6
	81 + 70	1.5
	81 + 90	1.4
	82 + 10	1.4
	82 + 30	1.3
	82 + 50	1.3

Table 2. – Groundwater level (m) above the earth's surface

Name of automobile roads	in April and October, 2017	
	April	October
Automobile road connecting M-34 «Tashkent-Dushanbe» with 4R-29 «Guliston-Gagarin» new direction (bypass of Gulistan)	1.95	1.90

As a result of inspection of the pilot site, the optimal design solutions for reinforcing the roadbed with polyethylene film were selected.

Together with the staff of Syrdaryaavtoyul, observations of experimental sites are currently being conducted.

Table 3. – Coefficient of compaction  $K_u$  of loess soil on the surveyed roads

Name of automobile roads	Year	Period	Coefficient of compaction $K_u$ in depth (m) from the bottom of roadbed				
			0.1	0.3	0.5	0.8	1.0
Automobile road connecting M-34 «Tashkent-Dushanbe» with 4R-29 «Guliston-Gagarin» new direction (bypass of Gulistan)	2017	Summer	<u>0.99</u>	<u>0.98</u>	<u>0.99</u>	<u>0.96</u>	<u>0.97</u>
			0.03	0.06	0.03	0.04	0.07
		Autumn	<u>0.99</u>	<u>0.99</u>	<u>1.00</u>	<u>0.96</u>	<u>0.93</u>
			0.02	0.08	0.08	0.05	0.08

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### **VARIOUS METHODS FOR THE SYNTHESIS OF NANOSIZED MANGANITE**

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## **РАЗЛИЧНЫЕ МЕТОДЫ СИНТЕЗА НАНОРАЗМЕРНОГО МАНГАНИТА**

Мультиферроики считаются важным классом материалов, которые проявляют одновременный магнетизм, сегнетоэлектричество и ферроупругость в одной фазе. В мультиферроиках магнитные и электрические порядки сильно связаны и настолько заинтересованы в литературе<sup>1</sup>. Недавние экспериментальные исследования мультиферроиков показали, что сегнетоэлектричество и магнетизм не только сосуществуют в одном и том же материале, но также настолько сильно, что магнитную степень свободы можно манипулировать электрическим. Это свойство обещает потенциальные применения в новых многофункциональных устройствах, таких как датчики, преобразователи, память и спинтроника. Ряд мультиферроидных материалов с композиционной формулой  $\text{RMnO}_3$  (где  $R = \text{Sm, Eu, Gd, Tb}$  и  $\text{Dy}$ ) в последние годы имеют большое значение из-за того, что сильно

<sup>1</sup> Kimura T., Goto T., Shintani H., Ishizaka K., Arima T., and Tokura Y., Magnetic control of ferroelectric polarization. *Nature*. 426, 55–59 (2003); Звездин А. К., Логинов А. С., Мешков Г. А., и Пятаков А. П., Multiferroics: Promising Материалы для микроэлектроники, спинтроники и сенсорной техники. *Bull. Рос.акад., Наука. Физика*. 71(11), 1561–1562 (2007); Lahmar, S. Habouti, C. -H. Solterbeck, M. Dietze, and M. Es-Souni, Multiferroic properties of  $\text{Bi0.9Gd0.1Fe0.9Mn0.1O3}$ . *J. Appl. Phys.* 107, 024104 (2010).

конкурирующие магнитные взаимодействия могут играть очень важную роль индуцируя магнитоэлектрический эффект<sup>1</sup>.

В последнее время значительное внимание уделяется нанокристаллическим материалам, что вызвано, как минимум, двумя причинами. Во-первых, уменьшение размера кристаллитов — традиционный способ улучшения таких свойств материала, как каталитическая активность, активность в твердофазных реакциях, процессах спекания. Вторая причина — проявление веществом в нанокристаллическом состоянии особых свойств (магнитных, оптических и др.), не характерных для объемных материалов и обусловленных проявлением квантовых эффектов. Поэтому получение и исследование нанокристаллических материалов является важным этапом в создании техники нового поколения<sup>2</sup>.

В соответствии с принятой классификацией, к числу «наноразмерных» относят объекты, имеющие «наноразмер», хотя бы в одном направлении — кристаллы, пленки, трубки.

Данная работа посвящена методикам синтеза именно нанопорошков. Проблемы, связанные с эволюцией их топологии и свойств, проявляющиеся при превращении порошка в компактный материал, тем более с изменением функциональных свойств, намеренно опущены, поскольку далеко выходят за рамки данного пособия и требуют отдельного систематического изложения.

Разработанные к настоящему времени методы получения нанопорошков весьма разнообразны. В литературе приводится около десятка классификаций этих методов по разным физическим и химическим принципам.

В настоящей работе мы будем использовать, в качестве основной, классификацию по принципу изменения размера частиц в ходе синтеза.

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<sup>1</sup> Feyerherm R., Dudzik E., Wolter A. U. B., Valencia S., Prokhnenko O., Maljuk A., Landsgesell S., Aliouane N., Bouchenoire L., Brown S., and Argyriou D. N., Magnetic-field induced effects on the electric polarization in RMnO<sub>3</sub>. *Phys. Rev. B*. 79, 134426 (2009).; Chupis E., Some features of the phase diagram of the ferroelectromagnet TbMnO<sub>3</sub>. *Low Temp. Phys.* 37, 126 (2011); Taka-Hisa Arima, Spin-Driven Ferroelectricity and Magneto-Electric Effects in Frustrated Magnetic Systems. *J. Phys. Soc. Jpn.* 80, 052001 (2011); Андреев Н., Абрамов Н., Чичков В., Пестун А., Свиридова Т. и Муковский Я., Изготовление и изучение мультиферроических тонких пленок GdMnO<sub>3</sub>. *Acta. Физика. А*. 117, 218–220 (2010).

<sup>2</sup> Курс лекций. Методы получения наноразмерных материалов. Уральский государственный университет им. А. М. Горького, Екатеринбург, 2007. С. 4.



### 1. Твердофазный метод синтеза.

Наиболее высокой эффективностью и экологической чистотой обладают “сухие” технологии, не требующие вообще (или минимизирующие использование) растворителей для проведения химических реакций.

Наноструктурированный  $Dy_{0,5}Ba_{0,5}MnO_3$  (BDMO) перовскит — образцы различных размеров зерен получают из высокой чистоты оксида диспрозия (99,9%), оксида бария (99,0%) и оксида марганца (III) (99,9%) с помощью обычной твердофазной реакции.

Стехиометрическое отношение исходных материалов измерены и перетирались в агатовой ступке. Порошки были подвергнуты высокоэнергетической планетарной мельнице с промежуточным заземлением. В заключений, образцы спекали от 600 °C до при 1110 °C в течение 40 ч в муфельной печи. Спеченные гранулы были использованы для дальнейшей характеристики<sup>1</sup>.

Показана перспективность применения метода твердофазового синтеза для определения размеров частиц ультрадисперсных порошков перовскит подобных манганитов редкоземельных элементов, измельченных в высокоэнергетической планетарной мельнице.

### 2. Механохимический метод синтеза.

В основе синтеза представленных материалов является многостадийная твердофазная реакция. В качестве исходных материалов были использованы химический стандартные реактивы —  $Dy_2O_3$ ,  $Mn_2O_3$  и  $Bi_2O_3$ . В стехиометрических соотношениях исходные вещества хорошо перемешивали и перетирали в агатовой ступке. Для активации смесь исходных компонентов подвергалась измельчению шаровой планетарной мельнице в течение 10–20 минут. После этого гранулированную смесь помещали в алундовые тигли, подвергали термообработке в высокотемпературную печь и нагревали при температуре 600 °C в течение 13 часов, при температуре 700 °C в течение 5 часов, при температуре 800C в течение 11 часа, при температуре 900 °C в течение 6 часа. После каждой стадии синтеза проводили промежуточные перетирания<sup>2</sup>.

<sup>1</sup> Mataev M. M., Sukhodayev P. O., Tursinova Zh. I., Sarsenbaeva Z. B., Seitbek A. Zh. Synthesis, X-ray study and determination of the particle size of manganites // International scientific-practical conference “Development of education and science by modern directions in the field of chemistry, biology, ecology and geography”. – 2017. P. 68–70.

<sup>2</sup> Mataev M.M.; Saxena S.M.; Tursinova Zh.I.; Nurbekova M.A.; Sarsenbaeva Z.B.; Seitbek A. Zh. Chemical journal of Kazakhstan; 2017, 4, 181–188.

### 3. Золь-гель метод с использованием многоатомного спирта глицерина

В данном методе синтеза использовали также оксиды металлов. Необходимое количество оксидов растворяли в дистиллированной воде. К полученному раствору добавляли лимонную кислоту и глицерин (2:3) в качестве гелеобразующих агентов. Затем полученный раствор нагревали на электрической плите при постоянном перемешивании при 80 °С для удаления избытка воды и получения вязкой гели. Гель высушивали при 250 °С и прокаливали при 500 °С в течение 10 ч для получения желаемого порошка. Порошки измельчались в агатовой ступке, чтобы получить однородную смесь. Затем их помещали в тигли и отжигали при температурах 600–1000 °С в течение 19 часов.

### 4. Цитратно-нитратный метод

Перовскитный тип ВДМО получали цитратно-нитратным методом с использованием в качестве исходных оксидов  $Du_2O_3$  (ос.ч.),  $Bi_2O_3$  (ос.ч.),  $Mn_2O_3$  (ос.ч.). Также как и во втором методе смесь оксидов растворяли в дистиллированной воде. К полученному раствору добавляли 2М азотную кислоту в качестве осадителя. В качестве реакционной среды использовали лимонную кислоту в соотношении с оксидами 1:2. Хелатирующий эффект благоприятствует величине рН. Таким образом, были добавлены адекватные объемы 2М раствора  $HNO_3$ , чтобы увеличить значение рН смесей до 7. Полученную смесь выпаривали на электрической плите при 80 °С при непрерывном перемешивании для удаления избытка растворителя до образования сухого полупродукта и прокаливали при 500 °С в течение 10 ч для получения желаемого порошка.

Присутствие исходных оксидов в смеси сохраняется до температуры 700–800 °С. При этом с ростом температуры марганец активно восстанавливается, находясь в составе образца в виде смеси оксидов с различной степенью его окисления. Оксид висмута окончательно входит в структуру твердого раствора на основе манганита диспрозия при 800–900 °С, оксид диспрозия тоже остается в виде оксида или гидроксида до 900 °С, после этого вступает в реакцию. Окончательную тепловую обработку прекурсоров проводили в муфельной печи при различных температурах (900, 1000 °С) в течение 21 часов в муфельной печи. Образование новой фазы завершается при температуре 1000 °С.

Наночастицы манганитов были синтезированы 4 способами: твердофазный, механохимический, золь-гель, цитратно-нитратный метод,

где использовались два разных поверхностно-активных вещества. Применение мокрых методов синтеза позволило получить кристаллические наночастицы при более низких температурах (до 1000 °С) по сравнению с твердофазным методом.

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## Section 5. Electrical engineering

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### **INVESTIGATION OF HEAT TECHNICAL CHARACTERISTICS OF THE HELI-AIR-HEATING SYSTEM FOR SOLAR- THERMAL REGENERATION OF ADSORBENTS**

**Abstract:** The article presents the results of experimental and computational studies of the thermal performance of a helium-air-heating system for solar-thermal regeneration of solid adsorbents in the climatic conditions of Karshi. The dependence of the efficiency of the helio-air heating installation on the air velocity is determined.

**Keywords:** solar energy, solar air heater, air velocity, solar radiation, thermal energy.

In modern refrigerators and storage facilities, adsorption units with electrothermal regeneration of adsorbents are used to control the gas composition of the chambers. The electrothermal method of regeneration of adsorbents in fruit and vegetable storage facilities is energy-consuming, therefore the use of helium-air heating installations in the regeneration system to provide substantial savings of electrical energy.

This paper presents the results of studies of the thermal performance of a helium-air-heating system for solar-thermal regeneration of solid adsorbents, carried out by the authors in<sup>1</sup>.

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<sup>1</sup> Uzakov G. N., Khuzhakulov S. M. Investigation of temperature regimes of helium-air heating installation for systems of thermal regeneration of adsorbents. //Heliotekhnika,

We have developed a helium-air-heating system for the thermal regeneration of adsorbents (Fig. 1) and determined the main thermal characteristics.

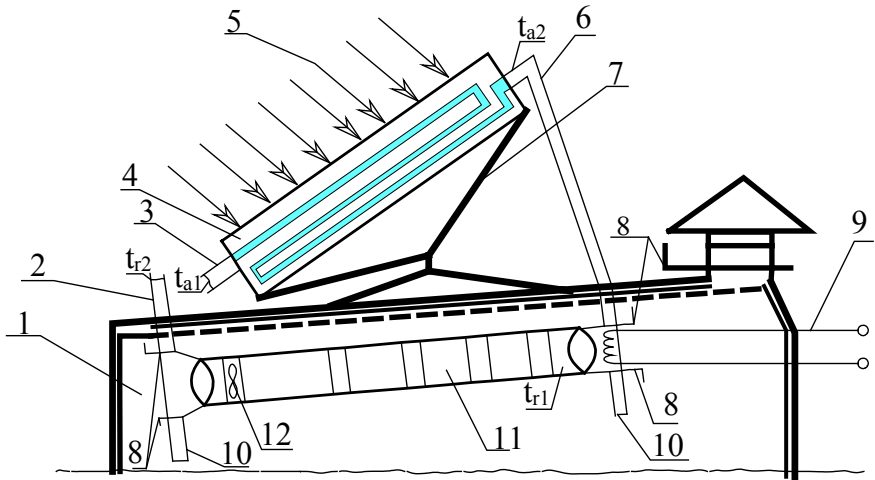


Fig. 1. The scheme of thermal regeneration of adsorbents and active ventilation of the refrigerating chamber with a solar air heater: 1 – refrigerating chamber; 2 – outgoing duct; 3 – inlet duct; 4 – helium air heater; 5 – rays of the sun; 6 – hot air duct; 7 – stand; 8 – switching valves; 9 thermoelectric heater; 10 – internal air ducts of the refrigerating chamber; 11 – adsorber; 12 – the fan;  $t_{a1}$  – ambient temperature;  $t_{a2}$  – heated air from the solar air heater;  $t_{r1}$  – air for regeneration,  $t_{r1} = t_{a2}$ ;  $t_{r2}$  – air with thermal emissions

The main thermal characteristics of a solar thermal installation include heat output and its efficiency. The useful energy withdrawn from the solar-air-heating installation at a given time is the difference between the amount of solar energy absorbed by the plate and the amount of energy lost to the environment. Useful heat energy withdrawn from the solar-air heating installation,  $W$ , is determined by the equation, which is applicable for the calculation of flat collectors<sup>1</sup>.

2017. – № 1. – with. 40–43.; Uzakov G. N., Khuzhakulov S. M., Aliyarova L. A. Determination of the thermal efficiency of the helium-air heating system for the thermal regeneration of adsorbents and active ventilation. //Proceedings of the conference of the NGO “Physics-Sun” of the Academy of Sciences of the Republic of Uzbekistan named after SA Azimova “Renewable Energy: New Research, Technologies and Innovative Approaches” P. 304–308.

<sup>1</sup> Beckman W., Klein S., Duffy J. Calculation of solar heating systems. – M.: Energoizdat, 1982. – 80 p.; Авезов П. Р., Орлов А. Ю. Солнечные системы отопления и горячего водоснабжения. – Ташкент: Фан, 1988. – 288 с.

$$Q_{us} = F_R \cdot F_{col} \left[ q_r^\Sigma \cdot (\tau \cdot \alpha) - u_L \cdot (t_{a1} - t_{at}) \right], \quad (1)$$

where,  $F_R$  is the coefficient of heat removal from the collector;  $F_{col}$  — collector area,  $m^2$ ; — total solar radiation flux density in the collector plane,  $W/m^2$ ;  $\tau$  — is the transmittance of transparent coatings with respect to solar radiation;  $\alpha$  — is the absorption capacity of the collector plate with respect to solar radiation;  $u_L$  — is the total heat loss coefficient of the collector,  $W/(m^2 \cdot ^\circ C)$ ;  $t_{a1}$  — air temperature at the inlet to the collector,  $^\circ C$ ;  $t_{at}$  — ambient temperature,  $^\circ C$ .

In the process of testing the helio-air heating installation, it is necessary to measure the flux density of incident solar radiation, the outdoor air temperature, the flow rate and the air temperature at the inlet and outlet of the collector. In this case, the useful energy of the helio-air heating installation is determined by the expression<sup>1</sup>:

$$Q_{us} = G_w \cdot \rho_a \cdot c_p \cdot (t_{a2} - t_{a1}), \quad W, \quad (2)$$

where,  $G_w$  — volumetric air flow,  $m^3/s$ ;  $\rho_a$  — air density,  $kg/m^3$ ;  $c_p$  — is the specific heat capacity of air,  $J/(kg \cdot ^\circ C)$ ;  $t_{a2}$  — air temperature at the outlet of the collector,  $^\circ C$ .

The volume flow of air through the helio-air heating installation  $G_b$  can be determined by the equation:

$$G_w = \frac{G_m}{\rho}, \quad \frac{m^3}{s}, \quad (3)$$

where,  $G_m$  — mass air flow,  $kg/s$ .

Then the volume air flow is equal to:

$$G_w = w \cdot F_o, \quad \frac{m^3}{s}, \quad (4)$$

where,  $w$  is the air velocity in the channel of the helio-air heating installation,  $m/s$ ;  $F_o$  — is the cross section of a helium-air heating installation,  $m^2$ ,  $F_o = b \cdot h = 1,0 \cdot 0,1 = 0,1 \text{ m}^2$ .

The specific heat output of the solar heater installation is equal to:

$$q_{sp} = \frac{Q_{us}}{F_{col}}, \quad \frac{W}{m^2}, \quad (5)$$

<sup>1</sup> Beckman W., Klein S., Duffy J. Calculation of solar heating systems. — M.: Energoizdat, 1982. — 80 p.

According to the test results, it is possible to determine the effectiveness of a solar air heating installation, i.e. its efficiency by the equation:

$$\eta = \frac{q_{sp}}{q_r^\Sigma}, \quad (6)$$

$$\text{or } \eta = \frac{Q_{us}}{q_r^\Sigma \cdot F_{col}}, \quad (7)$$

where  $F_{col} = b \cdot l = 2,25 \text{ m}^2$ .

The efficiency of the helio-air heating installation with regard to equation (2) will be equal to:

$$\eta = \frac{G_w \cdot \rho_a \cdot c_p \cdot \Delta t}{q_r^\Sigma \cdot F_{col}}, \quad (8)$$

Considering the heat balance equation:

$$G_w \cdot \rho_a \cdot c_p \cdot \Delta t = \alpha \cdot F \cdot \Delta t_{av}, \quad (9)$$

where  $\alpha$  — is the heat transfer coefficient,  $\text{W}/\text{m}^2 \cdot ^\circ\text{C}$ ;  $F$  — heat exchange area,  $\text{m}^2$ ;  $\Delta t_{av}$  — average temperature pressure,  $^\circ\text{C}$ , then substituting equation (9) into (8), we obtain the following expression for the efficiency of a helium-air heating installation:

$$\eta = \frac{\alpha \cdot \Delta t_{av}}{q_r^\Sigma}, \quad (10)$$

Thus, the efficiency of the helio-air heating installation depends on  $\alpha$ ,  $\Delta t_{av}$  and. Increase  $\alpha$ , i.e. Intensification of heat exchange in a solar-air-heating installation is the main way to increase thermal efficiency and create rational designs of solar air-heating installations.

On the basis of the above methodology, computational and experimental studies have been carried out to determine the indicators of the thermal efficiency of a helio-air heating installation — heat output and efficiency. The experiments were conducted under the conditions of the city of Karshi in the period of August 3–5, 2018. The results of the research are given in Table 1 and in Fig. 2, 3, 4, 5.

Table 1. – Temperature regime of solar thermal regeneration of adsorbents (active carbon)

Measurement time, hour, min.	Air consumption, m <sup>3</sup> /s (speed)	Air temperature in helium-air heating installation, °C		Temperature difference, $\Delta t_1$ , °C	Temperature of regeneration air in an adsorber, °C		Temperature difference, $\Delta t_2$ , °C	Efficiency, $\eta$ , %
		$t_{h1}$	$t_{h2}$		$t_{a1}$	$t_{a2}$		
10-00	at 0,1 m/s	32	41	9	41	34	7	6
11-00		34	44	10	44	37	7	6,6
12-00		35	47	12	47	40	7	7,1
13-00		37	51	14	51	44	7	7,6
14-00		38	54	16	54	47	7	8,1
15-00		38	55	17	55	46,5	8,5	8,4
16-00		37	54	17	54	45	9	7,6
17-00		34	49	15	49	40	9	6,6
18-00		33	41	8	41	34	7	5,7
10-00	at 0,2 m/s	30	40	10	40	35	5	12
11-00		34	42	8	43	38	5	13
12-00		37	45	8	46	41	5	14
13-00		38	50	12	50	45	5	15
14-00		40	52	12	52	48	4	16
15-00		38	53	15	53	47,5	5,5	16,2
16-00		36	50	14	50	46	4	16,4
17-00		34	45	11	45	41	4	15,5
18-00		32	40	8	40	35	5	13,5
10-00	at 0,5 m/s	32	40	8	40	37	3	35
11-00		35	42	7	42	39	3	36
12-00		38	45	7	45	42	3	38,5
13-00		41	48	7	48	45	3	40
14-00		39	52	13	52	49	3	40,7
15-00		37	51	14	51	48	3	42,1
16-00		35	48	13	48	45	3	40,2
17-00		33	44	11	44	41	3	36,4
18-00		32	39	7	39	36	3	35,5



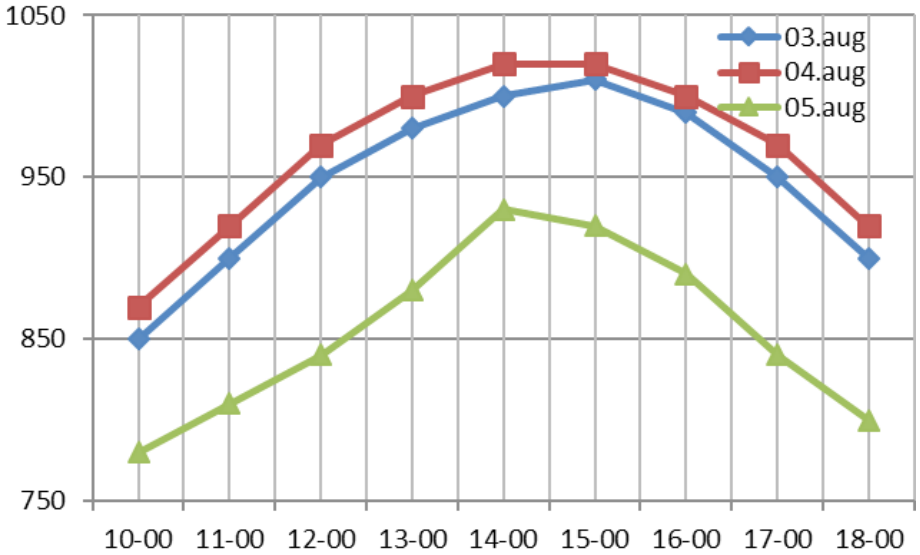


Fig. 2. The intensity of solar radiation during the day (in conditions of Karshi)

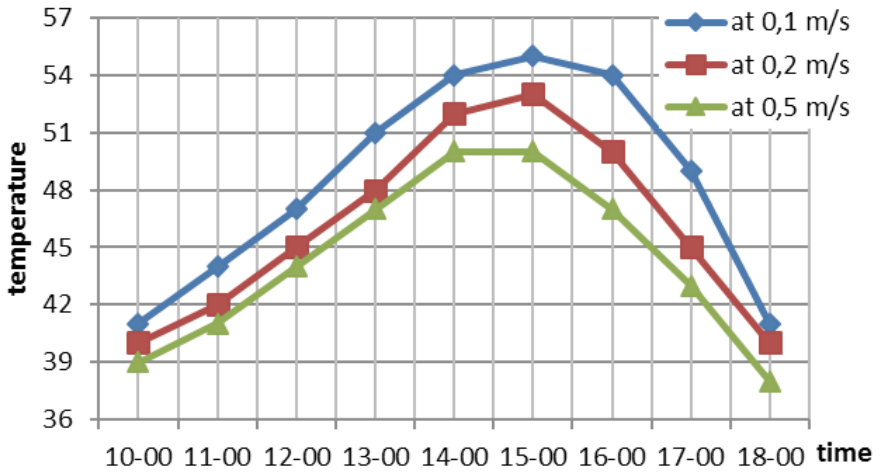


Fig. 3. The change in air temperature at the exit of the solar-air-heating installation at different speeds

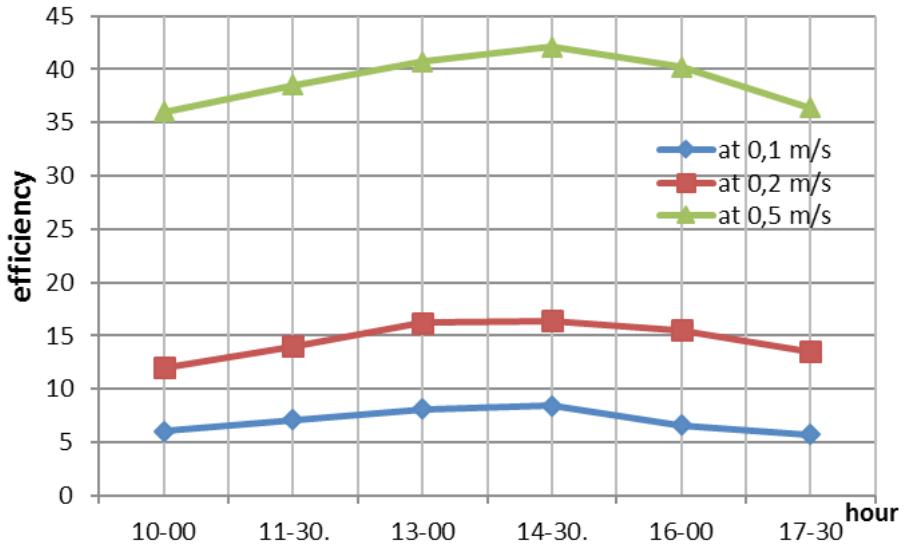


Fig.4. Dependence of the efficiency of a helio-air heating installation on time and air velocity

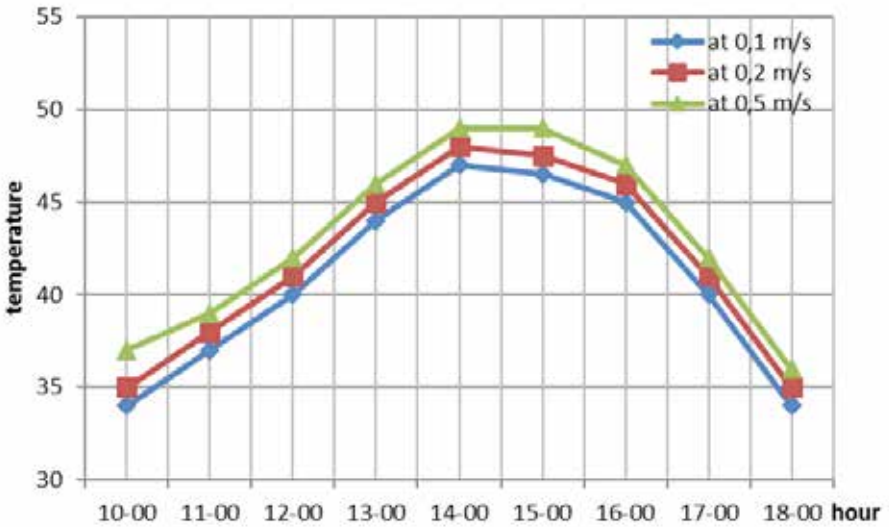


Fig.5. Change of air temperature in the adsorbent regenerator depending on time and air velocity

As can be seen from the table. 1. and from fig. 2–5 the maximum efficiency of the helio-air heating installation is achieved at an inlet velocity of collector  $w = 0,5 \text{ m / s}$  and is 42.2% (from  $14^{30}$  to  $16^{00}$ ). This is explained by the fact that during this period, the optical losses of the collector decrease and an increase in the difference between the air temperatures in the channels of the solar-air-heating plant and the solar-heated absorbing surface is observed. With an increase in air velocity, the heat output and, accordingly, the efficiency of the helio-air heating installation increase.

The results of the experiments show that the temperature at the exit to the helio-air heating installation reaches up to 50–55 °C. This temperature mode is fully consistent with the heat technology thermal regeneration of activated carbon (adsorbent) in the systems of active ventilation and gas control in fruit and vegetable refrigeration chambers.

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## **ON THE IMPROVEMENT OF ADMINISTRATIVE REGULATION AIMED AT IMPROVING ELECTRIC POWER QUALITY**

Administrative regulation aimed at improving the quality of electric power is presented by Article 542 of the Civil Code of the Russian Federation. Paragraph 1 of this article reads as follows: “The energy-supply quality should meet the requirements established in accordance with the legislation of the Russian Federation, including obligatory rules, or the provided agreement of power supply”<sup>1</sup>.

Requirements for electric power quality are presented by a wide range of regulatory and technical documents. Analysis of these documents shows that they are adequately set standards of indicator of quality and technical requirements for devices to measure and improve electric power quality. However, electric power quality in the Russian electric power system can not be considered as exemplary: the damage from the low quality level is about 25 billion dollars a year<sup>2</sup>.

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<sup>1</sup> The civil code of the Russian Federation. Part 2 of January 26, 1996. № 14-FZ // Collected legislation of the Russian Federation. 1996.– No. 5.– Article 542.

<sup>2</sup> Dobrushin L. A. Investments in the power industry of Russia and the program to enhance their effectiveness. Report. // VI all-Russian Energy forum “Russian fuel and energy complex in the XXI century”, Moscow, State Kremlin Palace, April 1–4, 2008 Final materials.

Meeting the requirements presented in the normative and technical documents is not possible without additional economic impact as both on the energy supplying organization and the consumer. The economic impact is currently carried out on the basis of paragraph 2 of Article 542 of the Civil Code of the Russian Federation that states: “In case of violation of the requirements by an energy supplying organization imposed on energy quality the subscriber has the right to refuse payment for such energy. Thus an energy supplying organization has the right to demand the subscriber to compensate the cost of saved money due to the use of this energy (Paragraph 2, Article 1105)<sup>1</sup>”. The Civil Code allows you to pay for the consumer of electricity of poor quality at a reduced cost.

It should be noted that the effectiveness of Article 542 of the Civil Code is very limited. So the management is effective for a limited number of indicators, regulated by GOST 32144–2013. Such indicators include the frequency deviation or voltage deviation. These indicators are determined by the operation mode of the equipment of an energy supplying organization. They don't depend on the operating mode of the electrical equipment owned by a consumer. From the Civil Code standpoint an energy supplying organization should be punished for low quality of the electrical energy. It is fair and reasonable.

As for other indicators (e.g. non-sinusoidal or unbalanced phases), their distortion is due to other reasons not depending on the operation mode of the equipment owned by an energy supplying organization, and depending on the operation mode of the equipment consumer (e.g. non-linear load, unbalanced loading of the phases).

In this case, from the Civil Code standpoint, the energy supplying organization can be punished again, no matter it is innocent of the distortion of quality: management of electric power quality is absent. According to the Civil Code, it would be fair to decrease the payment made by those receiving electric power of the low quality and compensate the costs by the increased charge to the consumer that is guilty for a deterioration of electric power quality. Currently, as shown above, an innocent energy supplying organization is unreasonably punished. This circumstance requires to add new content to the Articles of the Civil code.

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<sup>1</sup> The civil code of the Russian Federation. Part 2 of January 26, 1996. № 14-FZ // Collected legislation of the Russian Federation. 1996.– No. 5.– Article 542.

We suggest the following wording for an additional paragraph of Article 542 of the Civil Code: “In case of violation of requirements imposed on the quality of energy by the consumer (customer), the energy supplying organization has the right to demand compensation from the subscriber for loss of profits due to the supply of reduced quality electricity to related consumers”.

The consumer that doesn't reduce the electric power quality should pay for the poor-quality electric power at lower rates than the consumer who affects the quality in the system. The reduction of the rate for the related consumers by increasing the rate for a consumer being responsible for the deterioration is represented as a formal method of compensation for related consumer for electricity consumption of reduced quality.

An attempt of administrative regulation of electric power quality by economic power took place in our country in 1991–2004. The management mechanism provided for the payment for electricity at higher rate by the consumer, the culprit in the distortion of electric power quality. Consumers who are forced to consume the electricity of low quality made payment at a reduced rate. Increased and reduced rates were formed by applying premiums and discounts to the basic rate<sup>1</sup>. Premiums and discounts were tailored to meet each client's individual needs depending on the variation of indicators quality and the duration of the period of existence of the distortion index during the calculation period<sup>2</sup>.

For example, the guilty party received an allowance in accordance with the degree and duration of the distortion indicator of electric power quality for the pay period. This allowance is a percentage in relation to energy consumption. At the same time related consumers receive a discount relative to their energy consumption. It is obvious that the balance between the premium and the amount of discounts was observed only in case of equal consumption of electricity by the consumer — the culprit of the distortion indicator of the quality and related consumers. The energy consumed by a consumer that is the culprit can not be equal to energy consumed by related customers. Electricity consumption depends on the power of consumers and their demand for the implementation of their activities. In reality, the allowance will never be equal to the amount of

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<sup>1</sup> The instruction on the procedure of payments for electricity and heat (Registered by Ministry of justice of the Russian Federation on 28 December 1993, No. 449) // Economy and life.–1994.– No. 3.– Jan.

<sup>2</sup> Rules for applying discounts and surcharges to tariffs for electric power quality // Promyshlennaya Energetika.– 1990.– No. 11.– P. 52–55.

the discounts. The amount of the discounts may exceed the allowance and vice versa. The idea of a formalized method of damage compensation for electricity consumption of low quality for related consumers is meaningless.

This case as well as a number of other circumstances related to the application of discounts and allowances, generated conflicts between consumers and the energy supply organization. It turned out that the mechanism of control conflicts with existing legislation. In 2000, the Ministry of Justice evaluated the legality of the application of the instruction provisions about procedure of payments for electrical and heat energy<sup>1</sup>. As a result, the instructions and rules for applying discounts and premiums have been cancelled. Hence there is the need to improve legislation and mechanism of discounts and allowances.

As for improvement of legislation, it is necessary to say that the Civil Code of the Russian Federation protects the rights of consumers and does not protect the rights of the energy supplying organization. The previously proposed addition to the Civil Code protects the right of the energy supplying organization in the case when it is forced to supply electricity of poor quality and to pay compensation for consumers in case of innocence. In accordance with the proposed addition the energy supplying organization is able to forward the compensation to the consumer — the person responsible for the distortion of indicator of quality. Taking into account this addition the Civil Code of the Russian Federation will regulate all the parameters of electric power quality regulated by GOST 32144–2013.

Besides, the proposed addition identifies the requirement for improved management mechanism of electric power quality by applying discounts and premiums. In accordance with this requirement, the amount of lost profits for the energy supplying organization must be balanced by the amount of damage of consumers that are forced to consume the electricity of low quality by the fault of another consumer. The mechanism meeting this requirement would not conflict with existing legislation, in contrast to the proposed rules for the application of discounts and premiums to the tariffs for electric power quality.

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<sup>1</sup> Help about the contradiction of normative legal acts of the Russian Federation separate provisions of the Instruction about procedure of payments for electrical and heat energy, approved by goskomsen, and the Russian Ministry of energy 30 November 1993 NN01–17/1443–11, VC-7539 (registered in Ministry of justice of the Russian Federation on 28 December 1993, registration N449).

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