АНГЛИЙСКИЙ ЯЗЫК В СФЕРЕ ПРОФЕССИОНАЛЬНОЙ КОММУНИКАЦИИ

Материалы VIII Всероссийской молодежной научной конференции

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СЕКЦИЯ 1

ПРАВОВЫЕ, ЭКОНОМИЧЕСКИЕ И СОЦИАЛЬНЫЕ
ПРОБЛЕМЫ НА СОВРЕМЕННОМ ЭТАПЕ
РАЗВИТИЯ ОБЩЕСТВА

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ANDROGYNY IN THE WORLDVIEW OF YOUTH OF THE 21ST CENTURY

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The last decade of the 21st century has seen an increased interest in social issues. Many researchers turn to the topic of a person's self-identification, his/her psychological state, their view on modern social realities.

Questions relating to the relationship between men and women, from time immemorial, have had a large share in the human mind. That is why in the 1970s, gender anthropology developed within the framework of socio-cultural anthropology. Gender anthropology studies men and women, their relationships, the place of each of the genders in society.

Our article is devoted to the study of masculinity and femininity in the minds of modern youth. When compiling the survey, on the basis of which the study was conducted, we turned to the works of D. Gilmore, S. Ushakin, E. Ilyin. Gilmore's book describes in great detail the development of masculinity in the various tribes of Africa. We have tried to draw parallels between traditional and industrial societies. For example, Gilmore says that a real man in the tribes of Africa is one who is willing to risk his life. In more advanced societies, we see that one of the fundamental criteria for masculinity is risk-taking [1].

We have similarly looked at a few more "primary aspects" of masculinity.

S. Ushakin's book " Gender field: in the center and along the edges " presents a comparison of men and women at the psychological and physiological level: "It was believed that a man should be strong-willed, active, decisive, rational nistic, aggressive, progressive, variable, independent active, selfish, purposeful, rational; to him the essence of creativity and the desire to compete and achieve goals; he is prone to abstraction and fantasy. A woman, for example, tiv, should have diametrically opposed qualities. She was ordered to be passive, weak, compliant, submissive, inconspicuous, modest, meek, indecisive, receptive, thrifty, selfless, faithful, hardworking; she shouldn't to be independent and creative"[2].

E. Ilyin writes about gender stereotypes, how they developed, what are their benefits and harms. He comes to the conclusion that a typical male image is a set of traits associated with a socially non-restrictive style of behavior, competence and rational abilities, activity and efficiency. A typical female image, on the contrary, includes social and communication skills, warmth and emotional support"[3].

Thus, our survey included questions about gender stereotypes about men and women, about how exactly modern youth acquires knowledge about the opposite sex, and a section on androgyny became a separate part of the survey.

According to the explanatory dictionary, androgyny is a phenomenon in which a person simultaneously shows masculine and feminine qualities. According to the results of research by many scientists, the phenomenon of androgyny has existed since antiquity. At that time, the ancestors of modern people were called "androgynies". These were creatures in which both the masculine and the feminine existed. Today there are several "types" of androgyny: physiological and psychological. In our article we will touch on the latter and try to find out if the youth of the 21st century believe that androgyny become the norm in today's society and if young people face this phenomenon.

The results of the study of this aspect were the following: 90% of the men and 95% of the women surveyed believe that a combination of male and female qualities in one person is possible. To the question: "Is such a combination a plus or minus?" the following answers were received: 34% of men and 54.3% of women consider the combination of male and female qualities a plus,

and 21.3% of men and 15.2% of women – a minus. The rest of the respondents said that this combination can be both a plus and a minus.

We also learned the opinion of young people about when exactly androgyny appeared. 36% of men and 34% of women are of the opinion that the phenomenon of androgyny has always existed.It is worth noting that women are of the opinion that this phenomenon appeared with the "arrival of feminists."

According to the survey, 87% of men have met individuals whose character contains both masculine and feminine qualities. Of these 87%, 34% had a positive opinion of such people. The percentage of women who met individuals with a combination of masculine and feminine qualities is 97%, of which 56% described their feelings after interacting with such people as "beautiful, excellent or normal."

Also in the survey, we tried to find out whether the respondents consider the existence of people with a set of only male or only female qualities possible. The statistics are as follows: 62% of men and 74% of women believe that such a phenomenon does not exist.

Thus, based on the results obtained in the course of a survey of 100 young people aged 18 to 25, it can be concluded that young people in the 21st century understand that androgyny exists and has always existed. In general, the attitude towards people with a set of male and female qualities is positive. Consequently, the respondents are aware that androgyny, as S. Bam said, is a way of adapting to the environment среде [4]. In the modern, changing world, the individual simply needs to adapt to the conditions that society creates. And, in our opinion, today it is practically impossible to have a full life existing as a "stereotypical" woman or a "stereotypical" man. Realizing this, people begin to analyze the character traits of men and women, highlight the pros and cons, and then try to adopt the necessary aspects of behavior, whether they are male or female.

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УДК 502/504

NEGATIVE IMPACT OF AVIATION ON THE ENVIRONMENT

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For a long time, air transport has been one of the main sources of environmental pollution. At the same time, the effect of air transport can be fairly divided into chemical and acoustic effects. Despite the fact that aviation, in comparison with automobiles, emits significantly less harmful substances into the atmosphere, it does not have a positive effect on it every day. So, according to Professor Ulrich Schumann, who is the director of the Institute of Atmospheric Physics of the

German Aerospace Center, aviation currently accounts for about three percent of the anthropogenic greenhouse effect. The exhaust gases of jet and turboprop aircraft contain water vapor, carbon dioxide and nitric oxide; moreover, all of these components have a different, but clearly negative impact on the environment. So, kerosene, in its turn, consists of a mixture of 86 percent carbon and 14 percent hydrogen. During combustion, carbon combines with atmospheric oxygen, which with each kilogram of kerosene burned leads to the release of 3.15 kilograms of carbon dioxide. According to Professor Schumann – "carbon dioxide is a stable substance; it is evenly distributed around the entire globe".

The question of studying the state of air pollution, primarily with the active development of the aviation industry of many aircraft manufacturing enterprises, which include Boeing, Airbus, McDonnell Douglas. Air pollution near airports and major cities by chemical substances is represented by the following emissions: nitric oxide, carbon monoxide, sulfur oxide, hydrocarbons and other substances generated during the operation of engines on take-off mode during the climb and operation of aircraft engines during braking (reverse) [1].

The greatest impact on living conditions is caused by emissions from gas turbine engines at airports and in nearby territories. Comparative data on emissions of harmful substances at airports show that revenues from gas turbine engines to the surface layer of the atmosphere are: Carbon oxides - 56%, nitrogen oxides - 78%, hydrocarbons - 92%, aerosol - 94%.

In order to assess the air quality near airports and major cities, the "Guidance material for aviation emissions charges related to local air quality" was developed, which implies the introduction of certain duties levied by the state and designed to reduce the environmental impact of the liners during their operation [2].

The methodology for estimating emissions of civilian aircraft engines was described in Document 9889 "Guidelines for Air Quality at Airports"; three parameters were formulated in it.

The first parameter is the time in minutes that the aircraft spends to establish the takeoff and landing cycle (HFC) mode: when the engine is at idle, during approach, during climb and takeoff.

The second parameter is the EI emission index (mass of the substance released during the combustion of a unit mass of fuel)

And the third is the consumption [3].

Based on the emission indicators for the PW4074D engines with which the Airbus A330 aircraft are equipped, we can say that when taking off, the smoke number is 4.22, and when the aircraft is idling this number will be 0.33. The fuel consumption in this case (kg / s) will be 10 times less than during take-off.

An important factor in the negative impact on the population living near airports is aircraft noise. Not only people living in areas lying near airports, but also passengers and airport workers fall under its influence. A large amount of airborne noise contributes to hearing loss, headaches, stress, and tension. Since the main source of noise is the engine fan, it is necessary to pay attention to the improvement of this assembly of liners. The International Civil Aviation Organization (ICAO) and its constituent Committee for the Protection of the Environment from Aviation Impacts are called upon to protect the public, especially those who live near airports. By systematically tightening the standards for noise and emissions of harmful substances, they encourage aircraft manufacturing corporations to use more efficient technologies to reduce engine noise on new aircraft models. To develop noise reduction technology, a group of independent experts identified two main technological goals: medium-term (until 2020) and long-term (until 2030). They represent standards that will be mandatory for four categories of aircraft in 2030: regional jet, twin-engine short / medium range, twin-engine long-haul, four-engine long-haul.

In our opinion, the possible solutions to the problem are the following:

1. Reducing the impact of aircraft noise. Locate airports far from settlements or change the direction of runways, upgrade engines to modern standards by resizing the engines themselves and finalizing their fans (increasing engine contour).

2. Reducing the chemical effect can be achieved by creating alternative fuels that will be more environmentally friendly and will allow the use of less fuel during the take-off and landing cycle of the aircraft ; for example, the use of hydrogen as the main type of fuel.

Despite the fact that aviation, in comparison with others, is a relatively “clean” mode of transport, its environmental impact may become more noticeable over time due to constantly increasing air traffic, leading to increased pollution in the lower layers of the troposphere. The usage of new aircraft (Next generation) from Boeing and Airbus NEO will significantly reduce the environmental and chemical effects.

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УДК 338.2

PROBLEMS OF SOCIO-ECONOMIC DEVELOPMENT OF MODERN RUSSIA

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Globalization and increased competition in the world market, the deterioration of the environmental situation, the volatility of world currencies, and the aging of the population have led to the aggravation of socio-economic problems in modern Russia. At present, state policy should include not only efforts to change unfavorable trends, but also measures to adapt to those of them that cannot be changed.

In this article, we shall review the main contradictions of socio-economic development that face modern Russia. It is quite natural that they intersect, exacerbate and in many respects are conditioned by each other. Some of them are the most acute and require an early solution and immediate intervention of the state. Others are a consequence of the first or their influence on the socio-economic situation of the country is not so strong.

The main problems facing modern Russia are considered to be the following:

1. Demographic situation.
2. Nation health.
3. Quality of life of the population.
4. Socio-economic inequality and poverty.
5. Low level of culture of the population, cultural "marginalization" and "primitivization" of a significant part of the population.
6. Territorial disproportions in socio-economic development [1].

The demographic problem is the most complex one and pulls many others along with it. It appears, first of all, in the decline and aging of the indigenous population, its low birth rate and high mortality.

In 2015, the natural increase in the population of Russia amounted to 21.1 thousand people. This is lower than in 2014 by approximately one and a half times. There is an opinion that the entire birth rate is concentrated in the republics of the North Caucasus, while the Russian regions continue to die out, and a significant part of the newborns in Moscow, for example, are guest workers. The

decline in the birth rate is taking place against the background of an increase in the death rate of the population. The natural loss of Russians doubled over the past year, from 0.4 to 0.8 per 1,000 of population.

One of the most acute problems of the current demographic situation remains low life expectancy, especially among men, and their high mortality rate in the working age. At the same time, the proportion of the elderly population in relation to the able-bodied is quite large. The aging of the population leads, if we take into account the costs of paying pensions, social services, medical and drug provision, to an increase in the "dependant" burden on the working population. In the future, due to the low birth rate, this disproportion will only increase. These demographic changes can undoubtedly lead to a slowdown in the socio-economic development of the country. There is only one way out of this situation, namely, an increase in the birth rate of the population.

The low birth rate is evidence of a lack of funds for raising and raising a child. That is why a program was developed, according to which, for the birth of a second child and further children, parents can receive an amount that will compensate for the costs of maintaining the baby. The program started on January 1, 2007 and is still active today. In addition, there are a number of other government programs aimed at supporting young and large families.

The health of the nation is closely intertwined with the demographic problem. High mortality among the able-bodied part of the population is a consequence of the poor quality of public health. The health of a nation is determined by the level and structure of the incidence of various diseases leading to death. The analysis of statistical data makes it clear that Russia is dying from cardiovascular diseases (about 30% of the total number of deaths). Next come cancer, respiratory and digestive diseases. The high mortality rate from these diseases is largely due not only to the poor quality of health care, but also to the lifestyle and diet of the population.

The quality of life of the population is, first of all, a decent level of income and consumption, the accessibility of all segments of the population to public goods. In the context of a protracted financial economic crisis, an increase in unemployment, rising inflation, the incomes of the population are falling. According to Rosstat, last year the population's expenses exceed its income, which makes it impossible for most citizens to get access to quality healthcare, good leisure and recreation, and provide a good education for their children. A number of others flow smoothly from this problem, namely, socio-economic inequality and poverty, low level of culture of the population, cultural "marginalization" and "primitivization" of a significant part of the population [2].

Growing socio-economic polarization of the society remains one of the main socio-economic problems of modern Russia. In the process of Russia's economic development, not only the incomes of the population have grown, but also the gap between the income levels of the rich and the poor. On the one hand, we are seeing the growth of stable groups of the population with a low standard of living - pensioners (despite the ongoing indexation, the average pension today in most regions is comparable to the subsistence level of pensioners), recipients of social benefits, large families, part of public sector employees. On the other hand, most of the income, resources and property continue to be concentrated in the hands of a narrow section of the population - top-level entrepreneurs, major political figures. The middle class, which should become the backbone of the economy of any developed country, is still in a weak position in Russia.

The model of human behavior, especially a teenager, is often the result of the influence of the media. The oversaturation of the media with “negative” heroes, the lack of the necessary promotion of a healthy lifestyle and family values, the wrong prioritization, the blind worship of “false” idols leads to the “marginalization” of a significant part of the population. The low degree of civilization of the Russian society is a serious obstacle to the decent educational and mental development of the population, which, in turn, is reflected in the state and vectors of demographic and socio-economic development [3].

Unfortunately, in modern Russia there is a gap between the capital cities and the periphery. The standard of living, the development of productive forces, social sectors, the infrastructure of large cities and the Russian “outback” differ significantly. As a result, we are witnessing the so-called

"internal" migration, the outflow of a significant part of the able-bodied population to regional centers from small towns, which negatively affects the socio-economic situation of the latter.

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COVID-19 ANALYSIS OF THE WORD FORMATION OF NEOLOGISMS AROSE DURING THE COVID-19 PANDEMIC

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The modern language does not stand still; it evolves, enriches itself with a variety of linguistic means, and also instantly responds to various changes taking place in society. The emergence of new words almost always depends on scientific progress, political situations, natural phenomena, and the emergence of new diseases, the development of social networks, cinema and music. At the beginning of 2020, the world community faced a new danger: a new virus, which was subsequently named COVID-19 (the name is a contaminant formed on the basis of fragments of COronaVIrus and Disease and the year when the first cases of the disease were registered). The unprecedented situation could not but bring with it completely new words, called neologisms, into English.

Neologisms that have arisen in a certain area give rise to changes in the language and in other domains. From March 2020 onward, as the incidence increased, there was a "medicalization" of the language. Medical vocabulary began to be widely used in news reports, official documents and in everyday communication. For example, the use of the words self-isolation/quarantine/lockdown before the pandemic was limited and used only in medicine, but during COVID-19 they have become the most frequently used words, meaning being forced to stay at home due to an unwillingness to put oneself or others at risk of infection. Another example is the abbreviation Personal protective equipment (PPE), can often be found in everyday life. Also, the narrow medical terms anosmia (complete or partial loss of smell), fomite (an object that has been in contact with an infectious agent that can be a source of disease transmission) have become more often used in speech due to the pandemic [1, p. 210].

The COVID-19 pandemic has spawned a significant number of compounds, i.e. lexemes combining two original words without any overlap or truncation. During the pandemic, the roots of "coron" and "covid" became widespread, which led to the creation of new neologisms, for example:

• covidiot – a person who behaves unwisely: either ignoring safety warnings or frantically buying various goods in stores, depriving others of the opportunity to do so;

• coronials – babies conceived during a pandemic;

• coronavirusing – idleness, spending time at home during self-isolation or quarantine;

• coronaphobia – a strong fear of the COVID-19 pandemic;

• coronacoma – indicates that all public places are closed during the quarantine.

Blending is another common way to generate neologisms related to COVID-19. O. A. Khrushcheva believes that a blend is formed as a result of the interaction of two or more original units that go through the process of truncation and are combined into a single lexeme, or have

similar fragments in their structure and are combined by superposition [2, p.233]. However, the main feature that distinguishes blends from compounds is that blends, unlike compounds, combine parts of lexemes, not whole lexemes:

• coronageddon (corona + armageddon) – the end of the world caused by the coronavirus pandemic;

• isobeard (isolation+beard) – a beard grown during the stay in self-isolation;

• boreout (boredom + burnout) – severe fatigue and depression caused by boredom at work for a long period of time.

Some neologisms of covid time are formed in such a way as conversion. According to T. I. Arbekova, conversion is a non-affixal method of word formation, as a result of which a categorically different word is formed, coinciding in some forms with the original word [3, p.41]. In other words, conversion is the transition of a word from one part of speech to another. For example, using the noun" coronavirus" as a verb:

• To be coroned – to be infected with the coronavirus;

• To self-quarantine – avoid contact with other people.

Thus, COVID-19 has not only greatly affected the economic and demographic situation in the world; it has made changes in the lexical composition of the language. The English language quickly reacts to various social phenomena by creating new words to describe them. In addition to neologisms that name various objects and phenomena of reality, or words that were in our language, but gave a modern name to old concepts, a large number of emotional, expressive, author's words also appeared.

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THE IMPACT OF LISTENING TO PODCASTS ON LEARNING ENGLISH

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In the process of globalization, continuous education is an important criterion for the dynamic development of society, which should effectively and quickly respond to all social problems of the XXI century. Cultural and linguistic knowledge form the conditions for the economic and technical well-being of any country. Today, English is the language of international communication, so English is in demand in Russian universities more than ever. To improve the quality of education and increase the motivation of students to learn English, teachers use interactive equipment and innovative educational technologies, such as the Internet, podcasts, electronic whiteboards, online magazines (blogs), social networks, video conferences, special mobile applications. The use of modern educational technologies helps teachers to teach students as effectively as possible all four types of speech activity (reading, listening, writing and speaking). Let's consider the influence of podcasts on the process of learning English [1].

A podcast is a digital audio file. It implies sound information that is freely distributed on the Internet. Initially, this method of transmitting information was of an entertaining and informative nature. However, it was the choice of this format of content processing by Internet users, a variety

of topics and genres that allowed podcasts to be used as an effective tool in educational activities. Compared to other sources that have a similar format for presenting information, podcasts have a number of advantages. A podcast is an audio file, which means it does not depend on the availability of the Internet and represents the minimum requirements for playback devices. In addition, it is not the semantic load of podcasts that plays an important role in learning a foreign language, but the format of information presentation, since the main goal will be the study of grammar and vocabulary. At the same time, the student will be able to choose the topic and genre of the podcast for himself. This condition is the reason for the effectiveness of using podcasts when learning a language. The student motivates himself to listen to any content. At the same time, there is no need to motivate the student to study, since this process takes place when listening to the material of interest to the student [2, 3].

In order to study the popularity of listening to podcasts as a way of effectively learning English, a sociological survey was conducted. The respondents were students of Kazan State Energy University. The survey results are listed below.

76 people took part in the survey – first and third year students. 89.5% of respondents know what a podcast is. 60.5% of respondents do not listen to podcasts in English. 29% listen to podcasts in English.

21% of respondents believe that listening to podcasts has a positive effect on learning English, while respondents noted that listening improves the perception of oral speech, helps to increase vocabulary, and also develops oral speech.

Respondents listening to podcasts in English assessed the effectiveness of using this method when learning a language as follows:

- 4.5% believe that this is not an effective method;
- 40.9% consider it an effective method of fixing the material passed;
- 50% consider it an effective method not only for consolidating existing knowledge, but also for obtaining new ones;
- 4.5% consider this method an integral part of the language learning process.

To the question: "Does listening to podcasts allow you to immerse yourself in the environment of native speakers?" respondents listening to podcasts in English answered as follows:

- 59.1% answered "Partially";
- 40.9% answered "Yes".

To the question "Do you think listening to podcasts is a popular way to learn English?" students listening to podcasts in English answered as follows:

- 54.5% chose the option "Not very";
- 36.4% answered "Yes";
- 9.1% chose the option "No".

Based on the survey results, we can draw the following conclusions. The majority of students are familiar with podcasts. However, less than a third of students listen to podcasts in English. Students listening to podcasts in English note that podcasts help to gain new knowledge, but it is better to use this method to consolidate the material. When listening to podcasts, difficulties encountered by students are usually associated with a high rate of speech, lack of subtitles. Thus, in the process of learning a language, podcasts perform the function of consolidating knowledge, it is also worth noting that in order to use this method, it is necessary to have a certain level of knowledge of this language. At the initial stage of learning English, you will need to listen to podcasts specially created for educational purposes. Listening to other podcasts created not for educational purposes is not effective, due to the very high rate of speech and the presence of dialects in the pronunciation of speakers. It is not necessary to consider listening to podcasts as an independent effective way of learning a language.

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THE USE OF INTERNET TECHNOLOGIES IN TEACHING FOREIGN LANGUAGES

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The relevance of the topic is due to the fact that in modern society the knowledge of a foreign language plays an increasingly important role, which opens up opportunities for many areas of activity: familiarization with world culture, the use of a foreign language in work, it also contributes to the development of international relations, etc. Learning a foreign language using information and communication technologies (ICT) makes its learning more useful and interesting. Modern methods of teaching foreign languages are directly related to ongoing technical progress, as well as technological renewal of the learning process. Recent achievements in the sphere of high technologies and the spread of the global Internet open up the widest opportunities for foreign language teachers, methodologists, as well as the students themselves to further improve the educational process. The purpose of using these technologies is directly related to the needs of modern education in improving the effectiveness of learning. Thus, ICT helps to form the skills of independent learning, the use of a creative and research method.

It is worth noting that the Internet itself has a significant role in the lives of today's students. The process of learning in such an environment is highly motivated and increases student activity to learn. Teenagers spend a lot of time on social networks and various mobile applications, so using them for learning is really a good solution. The current multimedia and Internet technologies allow students to train oral speech effectively, explore grammar, build real communication situations, break through psychological barriers and fall in love with the language being studied. These features are very important in the process of language learning. Therefore, we can say that the use of Internet technologies helps to gain or improve skills well.

According to E.R. Sokolova's opinion the size of the involvement in use of a computer and Internet resources directly depends on the pedagogical task, which is determined based on the goals of a particular lesson and taking into account the training course. The involvement of Internet resources into the educational process varies and starts from the use of individual Internet technologies (blog technologies, wiki technologies, webinars, e-mail, podcasts) to the complete transition of the learning process to the technological environment. So, on the basis of the Internet communication, distance learning is organized [1].

Nowadays, the Internet presents language learning opportunities that are available now more than ever. With the support of the Internet, any student can find a huge number of materials: various educational sources, articles, audio-video materials. Thus, it is possible to achieve that technological language environment that allows you to learn the language as conveniently as possible. In turn, teachers can create more effective language learning process by adapting online resources. So, teachers can use different literature, news of different nature (culture, politics), country studies. The teacher can choose materials on his own or find ready-made disciplines. Depending on the quality of the presentation of the material by the teacher, the students, having received a sufficient level of knowledge, can participate in various activities: Internet conferences, competitions, making

presentations. Thus, a large number of opportunities will provide a closer relationship with a language.

Moreover, the use of Internet resources does not miss the opportunity to improve oral speech skills, regardless of the location of classes. For example, using video conferencing applications such as Skype or Zoom makes it easier to improve your speaking skills. The previously discussed Interest social networks among students will improve writing skills. What is most interesting, in social networks, students can correspond, chat among not only their classmates or peers, but also native speakers of the language itself, thereby making the practice of writing more effective. The use of social networks will allow you to create a real situation of communication on any topic, rather than pre-prepared at school. Thus, students expand their vocabulary and get a unique experience of communicating with foreigners. It should be concluded that social networks, as a means of language teaching, solve many problems, among which territorial and cultural problems can be distinguished.

E.V. Voevoda emphasizes the importance of using Internet resources in preparing for the exams. By solving electronic versions of test items, students increase their chances of passing the state exam by solving typical items that they may encounter on a real exam. For example, the Internet site en-ege.sdamgia.ru offers school students to prepare for the English exam on the basis of 11^{th} grade knowledge. On this site, training options are displayed, and they are changed every month. Each of the options is compiled on the basis of new tasks and those tasks events that turned out to be the most difficult according to the results of the previous month. In addition to ready-made options, the student has the right to make his/her own version on certain topics, thereby fixing weak spots. Thus, students can practice at any time, control their level of knowledge and learn how to work with print and audio format tasks [2].

Let's have a look on the specific positive aspects with the use of ICT in teaching a foreign language:

- increased motivation to learn a foreign language;
- comfortable atmosphere in the classroom;
- increased volume of work performed due to optimization by Internet technologies;
- rational organization of the lesson for the effectiveness of the acquired knowledge;
- providing students with information resources on the Internet.

There are several types of Internet services that can be used for independent work of students:

1. Hotlist is an extensive list of sites with texts on the selected topic.

2. Multimedia scrapbook is a multimedia collection of resources, which, in addition to links to sites with texts, also consists of photographs, audio-video files. As a rule, the resources are easy to download and can be used as a demonstration material in learning.

3. Treasure hunt (treasure hunt). It is a web resource that also contains links to sites, but in this case, the sites will be accompanied by questions about their content. Questions, in turn, help a teacher to control the level of students' knowledge.

4. Sample subject is a site that also contains links to text and multimedia materials from the Internet. As a part of the work with this resource, the user has to express and argue his opinion on the issue under study.

5. Webquest is the most complex type of educational Internet materials. It includes components of the four previously described materials and involves a project with the participation of students [3].

The use of the above online learning materials should extend to both schoolwork and homework. Also, do not forget that when choosing online materials, you need to take into account the age, psychological and individual characteristics of the student. By observing these factors, we can achieve successful learning of educational material and the development of language skills, as well as make the educational process more creative, informative and interesting.

In conclusion, we can say that the use of Internet technologies allow teachers to improve the process of language learning, increase its efficiency, teach how to save time, increase students'

motivation, inspire them to self-improvement and the desire to know more. Such an alignment cannot negatively affect the result of learning.

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УДК 005

FINANCIAL POTENTIAL OF THE REGION

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Abstract: This article discusses the main methodological approaches to the concept of "financial potential of the region", raises the question of the sources of formation of the region's finances, its possible directions of use, as well as the relationship between the volume of financial resources of the region and its development.

Keywords: finance, financial potential, financial resources, finances of the region, factors of financial potential; principles of financial potential of the region.

Let's consider the structure of the financial potential of the region in more detail in Figure 1.

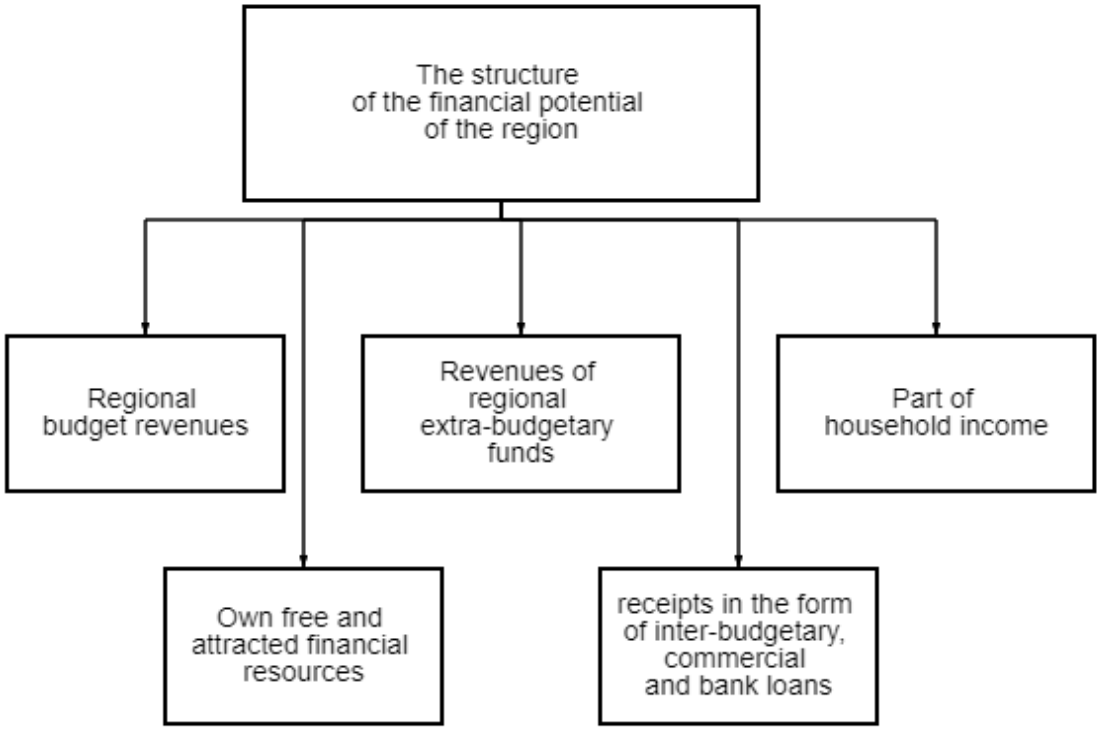

Fig. 1. The structure of the financial potential of the region.

This structure reflects the sources of education of funds with which the region can be financially potential. But, as follows from the generalized definition of financial potential, it is much more important how effectively the attracted financial resources are used.

The financial system of the region and its capabilities as a whole are influenced by many factors. We will consider the main ones in Table 1 [2, p.21].

Table 1. Groups of factors affecting the financial potential of the region.

I. Geographical / industry	II. Economic	III. Innovative
They include the geographical location of the region, natural and climatic conditions, and the sectoral structure of the region. Each subject is characterized by its own area of economy, directly affects the financial potential of the subjects of the Russian Federation.	They include the level of inflation, the level of employment of the population and the dynamics of changes in GRP (gross regional product).	Represent the level of scientific and technical potential of the region. The system of support and implementation of innovations, the presence of new territories and zones due to the creation of high-tech industries using advanced technologies, the turnover and turnover of production are expanding, which leads to an increase in income and an increase in the tax base.

There are other factors, but all of them together make up a single system, a violation of processes in one factor will inevitably entail a change in processes in another. Therefore, in order to achieve the highest financial result, the region needs to be able to predict possible losses, adapt to events that are independent of the region and the person as a whole, and also follow the basic, as we believe, principles of the formation of the financial potential of the region [1, p.36]:

1) the principle of consistency. This principle makes it possible to classify the ways of financial and economic activity in the region, as well as to establish the purpose of functioning, their subordination, comparison of various directions and methods of achieving goals.

2) the principle of permanence ensures timely corrections of the created long-term plans, while starting from the changes taking place both within the financial system of the region and beyond.

3) the principle of coordination of long-term plans for all elements of the financial potential of the region. Forecasts that are created vertically and horizontally. Vertically means by region, the economy as a whole, and horizontally means elements of the resource base of the region.

4) the principle of pooling funds. Guarantees the necessary level of concentration of the region's resources on priority areas.

We believe that this system of principles takes into account the most important determinants of financial potential and is the most effective from the point of view of management.

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FORMING THE SECONDARY SCHOOL CHILDREN MOTIVATION IN THE PROCESS OF TEACHING ENGLISH LANGUAGE BY MEANS OF APPS ON SMARTPHONES

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Abstract. The concepts such as motivation, motives, mobile devices and apps are examined in this work. The article describes the main reasons for the reducing motivation the secondary school students in the study of English language, as well as ways to increase it through apps to improve English skills. Particular attention is paid to the aged characteristics of adolescents.

Key words: motivation, secondary school students, teaching, game, app.

Adolescence begins at 10-11 years old and ends at 14-15 years old. It can be called the transition period from childhood to adulthood. Against the background of puberty and gender identification, the following features appear:

- realization of the desire to "be" and "be considered" an adult;
- self-affirmation both among adults and among peers;
- the desire to take a worthy place in the peer group.

The onset of puberty increases their activity and creates favorable conditions for them to develop a sense of adulthood and independence. A sense of adulthood is a psychological symptom of the onset of adolescence. A teenager begins to feel like an adult and wants others to recognize his independence and significance. He already has his own "I", which he willingly shows. It is during this period that problems with studies may arise: everything will seem uninteresting, boring, ordinary to him, work on homework will be replaced by a walk with friends, etc.

Therefore, it is during this period that it is necessary to form the correct motivation for learning in a teenager.

Motivation for learning is one of the main conditions for the implementation of the educational process. What kind of motivation will be formed in the student depends on a number of factors, among which the following can be distinguished: the competent construction of the educational system, a favorable atmosphere for teachers and students, the subjective characteristics of the student (age, gender, intellectual development, self-esteem, the presence of any diseases) and etc. However, sometimes motivation can fade. The task of the teacher is to find a way to solve this problem. It is necessary to encourage the actions and desire of students for independence, praise their successes and avoid monotony in the classroom.

Mobile devices can come to help teachers and students to achieve this goal. They can be used when students learn English. Now mobile devices have taken a strong place in our daily lives, every student starting from the 1st grade has a mobile phone. The student just needs to have a phone, Internet access. The use of e-learning makes it possible to improve the quality of education through the use of rapidly growing global educational resources [4]. Mobile applications have great potential in increasing the efficiency of the process of learning foreign languages and are designed to significantly improve the process of foreign language training for a wide range of students, open up new aspects of it and turn it from a serious labor-intensive process into an exciting activity [1].

This topic is relevant and was touched upon in the works of such domestic researchers as M.V. Arkhipova [1], E.V. Vulfovich, I.N. Golitsyna, N.L. Polovnikova, N.V. Samokhin, O.V. Smolovik and others. Foreign researchers also dealt with this problem: K. Betty, V.M. Frank, S. Freinik, D. Richardson [1], etc.

Mobile learning is the use of convenient portable mobile devices and wireless, always available technologies to support, optimize and enhance the learning and learning process [4].

The uniqueness of mobile learning lies in the fact that, first of all, students are not tied to a specific time and place, but have access to educational material always, at any convenient time. In addition, mobile applications have a number of other advantages: intensification of independent activity, individualization of learning, increase in cognitive activity and learning motivation [4].

There are several popular mobile apps for learning English, some of them are: Quizlet, Lingualeo, Duolingo, Memrise. In testing with secondary school students we identified two of the most popular apps.

Duolingo is a service for learning foreign languages and group translations. The mobile application is public and helps in improving writing, speaking, reading, listening.

The benefits of the Duolingo app include:

1. Free to use.
2. Extensive forum.
3. Ease of use.
4. Gradual complication of exercises.

Quizlet is a program in which the user creates simple flash cards, while working with which the student effectively memorizes and trains new vocabulary, can also view a word or its translation, listen to the pronunciation.

Benefits of the Quizlet app:

1. Monitoring the progress of student activity.
2. Fast results.
3. Publicity.
5. Save time.
6. Multiple applications.

Thus, special language mobile applications allow you to speed up and improve the process of learning English. They also help develop stable language patterns, communication skills, and English grammar rules. The proposed approach to the organization of teaching a foreign language using mobile devices not only continues the previously established traditions of teaching a foreign language using technical devices, but also expands them through the use of fundamentally new capabilities of mobile platforms, and also forms a sustainable motivation for the subject.

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УДК 371.39

THE CASE STUDY METHOD AS AN EFFECTIVE TOOL OF DEVELOPING ENGLISH-SPEAKING COMMUNICATIVE COMPETENCE IN THE CONDITIONS OF SECONDARY PROFESSIONAL EDUCATION

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The introduction of the Federal State Educational Standard has significantly changed the requirements for the final results of the educational process, and, accordingly, for the process of their formation and measurement. The development and formation of general and professional competencies necessary for the FGOS SPO depends, in particular, on the innovative teaching methods used by the teacher. In addition to purely professional skills and knowledge, competencies include such qualities as the ability to work in a group, initiative, cooperation, communication skills, the ability to learn, to gather and use information, to evaluate, to think logically. It is the formation of students' key competencies that determines the self-realization of the student in the profession and society.

One of the key competencies identified by V. N. Vvedensky is communicative, which is responsible for determining the emotional state of other people and personal characteristics, orientation in social situations, speech culture and establishing psychological contact [1]. Communicative competence implies two types of skills. The first type is everyday communication (at work, in the family, with friends, etc.). The second type is directly related to a specific profession or specialty, it distinguishes status-oriented communication (one for a subordinate, the other for a boss) and communication of a "pedagogical format, professional and personal interaction of a student and a teacher).

In turn, the term foreign language communication means the ability to solve problems of communication relevant to students in everyday, industrial, educational and cultural life by means of a foreign language; the ability of a student to use the facts of language and speech to achieve communication goals.

One of the most effective innovative teaching methods for mastering English-speaking communicative competence is the case study method.

A case is a certain practical situation that tells about events, a sequence of events or a case and describes real people at the moment of decision–making, from whom the situation or event requires an important decision to be taken, the performance of any actions with subsequent responsibility for the consequences. Case solving activity is a process of forming decision–making skills and abilities, which is based on group or individual analysis and modeling of specific situations with their further discussion during open discussions on overcoming and solving the problems contained in the situation. Cases are used in the study and consolidation of new topics, the formation of certain practical skills, quality control of the training of specialists. Case study was first applied during the educational process at Harvard Law School in 1870. At the moment, there are two class schools of case study - Manchester (European) and Harvard (American), within the framework of the first school, the goal of the method is the multivariance of solving the problem, the second involves the search for a single solution.

The main requirement of using the case is the authenticity of the situation proposed for analysis. The source of information for case development can be scientific publications from newspapers and specialized journals, the novelty and relevance of the proposed material are important. It is also worth remembering that the content of the case should correspond to the volume of language and speech competencies that students possess, have contradictions as a stimulant for the development of discussion, be the basis for the formation of debatable skills, provide the necessary knowledge in

accordance with curricula and plans; the problem should not be artificially imposed, but should be formulated in the course of studying the material [2].

Before discussing the case in English, it is necessary to work out the necessary lexical and grammatical material that students need for the correct formulation of thoughts and correct argumentation. It is important to pay attention to professional terminological vocabulary so that the simulated situation is close to the professional situation played out during the solution of the case, all this allows you to work out speech skills, depending on the presentation of the situation (reading, listening, speech communication, written speech). All this contributes to the comprehensive implementation of the language training of students of the vocational school as a whole.

As an example of such an interactive lesson using the case study method, a textbook on business English published by Pearson Longman (authors: D. Cotton, D. Falvey, S. Kent Market Leader) was chosen, which was designed in such a way that each section ends with a case study format assignment.

A sample case study assignment will be given under the Career section. The content of the section itself is very rich, which contains tasks and materials that are aimed at the development of speech practice in general, namely: writing, reading, speaking, listening. The exercises and materials of the entire section are interconnected, some combine several types of speech activity at once. All this is a good preparatory stage before completing the case. The case itself is associated with Fast-Track Incorporated, whose central office is located in Boston, USA. The company sells training courses, corporate management trainings. The problem turned out to be the following: at the branch in Poland, profits fell 30% below planned, and in connection with this, the head of the sales department was dismissed. Several reasons were identified: lack of motivation of employees, lack of a clear strategy from the previous manager, staff turnover. The company has placed a vacancy announcement for the position of head of the regional sales department. Students are invited to familiarize themselves with the questionnaires of three candidates, where key information is indicated, as well as excerpts from the interview, where candidates talk about themselves, about the prospects of the company, etc. After analyzing all the strengths and weaknesses, students should choose a suitable candidate, with the possibility of to clarify information about them from the director of the company. As a result, the following positive effects were noticed – after working with cases, the number of students who are active in the learning process increased [3].

Summing up, we can safely say that even despite the complexity of the preparation of cases, there is a positive dynamics of cognitive abilities for students of SPO. It is important to note that the use of this method improves the skills of reading, speaking, listening and writing in English, since during the independent analysis of English-language information, its discussion, all forms of learning English are activated. The analysis of a professionally oriented case forms the preparation of students for studying the material, searching for the necessary information according to the required conditions. The result of using the case method is a higher indicator of the quality of learning, the level of motivation to learn English increases, and a creative approach develops when solving the necessary tasks.

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DISCUSSING THE PROBLEM OF RATIO OF GENERAL AND TECHNICAL ENGLISH LANGUAGE AT TECHNICAL UNIVERSITY

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In the modern world, learning a foreign language at a university is of great importance. Due to various circumstances, the English language occupies the leading position in education today. The educational path of language learning, as well as its amount within the years of education, forms and methods of study are highly determined by the profile of the university. There is still no mutual consensus on the ratio of general and specialized professional English in non-linguistic universities of different profile areas. In technical universities, the question about the distribution of the number of hours between general and technical English also occupies a special place. There are still discussions about which type should be given more attention. How in conditions of a small number of hours it is enough and complete to study the material that will be most necessary for the student in his future professional activity. [1]

On the one hand, it seems obvious that technical universities should devote more hours to technical English because of a number of factors.

Firstly, English is the language of international interaction today.

Secondly, in the context of globalization, many of the latest technologies that are widely used and operated nowadays are designed, manufactured and maintained in different countries, and both components and equipment produced abroad are widely used at Russian enterprises (manufactures). Thus, a highly qualified engineer should be able to read the documentation, instructions in English, understand it absolutely clearly and be able to follow the regulation set-outs for installation, operation, troubleshooting, storage, and etc. [2]

Thirdly, within the framework of professional development, exchange of experience or establishment of cooperation, an engineer can and should attend international forums, participate in international projects and grants, exchange professional knowledge and experience with foreign colleagues.

All above mentioned is impossible without knowledge of technical English, so this justifies the increase in the number of hours of technical English in the curriculum of technical universities.

On the other hand, a technical university is not a specialized language university and, while preparing for entering it, future students do not pay, as a rule, much attention to the study of general English at school and, therefore, enter the university with a low level of foreign language competence. The existing language knowledge and skill gaps lead to difficulties in improving one's language level, since it is very difficult to master technical English without good base of general English due to limited time allocated to the language learning process at universities. For example, some students have no clear idea of how to translate English verb forms, do not understand the difference between active and passive voices. But the vast majority of sentences in technical English used in various professional fields are given exactly in passive type constructions. That means that before starting technical English, precise attention should be paid to the quality of general English, since it is the base that allows you to move from simple to complex items of language learning.

So, what is the ratio of general and technical English that will be optimal for learning the language at a technical university? Let's consider this issue on the example of the KNRTU named after A.N.Tupolev - KAI (Kazan).

The English language program for most areas of training is designed for 2 years: 1 year (terms 1-2) of general English and 1 year (terms 3-4) of technical English. Within the framework of this research, in order to identify the public opinion of students a survey for students of 1-2 year of

education was created and conducted via the Google Forms Service, As a result of the analysis of the answers, it was determined that more than 80% of respondents are more interested in learning a technical language, although they do not completely deny the need to study general English. The respondents themselves found that the most optimal ratio would be 1:3, where 1 term is devoted to the study of general English (to liquidate the language gaps), and 3 terms are devoted to the study of technical English. Thus, in the 1st semester, emphasis should be placed on those basics of general English that are most important in learning technical English, which must result into a more correct understanding of the information of a professionally-oriented text. An additional term of learning technical English can be aimed at the process of expansion of vocabulary knowledge in the specific engineering sphere according to the exact major of students, at the formation of not only linguistic communicative competence, but at the formation of important general cultural and professional competencies as well. [3] The combination of the latter will allow future graduates to become highly qualified specialists capable to expand their professional career horizons.

Another problem is the distribution of the lessons for learning English within the week days. Language learning should be based on the principles of cyclical learning through even and steady stages of presentation, consolidation, repetition of the material. Therefore, to make the study of technical English with large amount of new vocabulary more effective, it is necessary to distribute reasonably classroom hours and hours for self-study. According to the respondents' answers, 90% of students do homework to consolidate the material on the eve of the classroom lesson or immediately before the lesson itself. Therefore, it seems inappropriate to have double classes of English language once a week. Firstly, double classes result in less concentration of students' attention and, accordingly, decrease the degree of primary perception of educational material. Secondly, self-study and self-revision of the material is carried out once a week with a long time period of students' "inactivity". To create the more appealing external motivation to perform tasks that consolidate and repeat the language material, English language classes should be split up into even intervals.

Thus, to sum it all up, we came to the conclusion that:

- technical English at technical universities should occupy the larger part of the curriculum;
- there is a need for a more even distribution of English language classes of the discipline "Foreign language" during the study week.

Meeting these requirements will contribute to the more effective assimilation of the material, achievement of higher learning outcomes, and will subsequently ensure the career growth opportunity of a future engineer.

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УДК 376

INCLUSIVE EDUCATION AS A SOCIALLY SIGNIFICANT INNOVATION

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In modern society, everyone has the right to receive education at all levels. However, for some categories of persons, special efforts are required to exercise this right. We are talking about people with disabilities and people with disabilities. Therefore, one of the socially significant issues of pedagogy is considered to be the problem of teaching people with special educational needs in higher educational institutions. The development of inclusive education is one of the important conditions for successful socialization, full-fledged interaction with public life, successful self-realization of this category of persons in various sectors of both public and professional activities.

Paragraph 27 of Article 2 of the Federal Law "On Education in the Russian Federation" dated December 29, 2012 states: "Inclusive education – ensuring equal access to education for all students, taking into account the diversity of special educational needs and individual opportunities." Thus, inclusive education is an education that provides every individual, regardless of his intellectual, physical, emotional, social and linguistic characteristics, with the opportunity to be included (inclusion from fr. inclusif as "inclusive") in the general and unified process of learning, socialization, upbringing and development, which enables a person to be an equal member of society, reduces the risks of his isolation from other people [2].

Today, inclusive education is understood as a specially organized educational process that guarantees the inclusion and acceptance of persons with disabilities into the society of ordinary peers in an educational institution, receiving education according to adapted programs taking into account their specific educational needs and health opportunities [1].

The main questions about teaching people with special educational needs together with their peers without impaired bodily functions were presented in the Salamanca Declaration (1994) on Principles, Policies and Practices in the Field of education of People with special needs: "The fundamental principle of an inclusive school is that everyone everywhere should study together, regardless of some learning difficulties or differences. Inclusive educational institutions should recognize these differences and respond in a certain way to the diversity of student needs, adapting both different learning styles and an assessment system, and provide quality education to all students through the application of an appropriate curriculum, organizational measures, teaching strategies, resource use and cooperation with communities. In order for all educational institutions to be able to constructively solve the problem of special needs, a comprehensive combination of support and services provided is necessary..." [4]

Access to quality education for students with special educational needs in the conditions of a higher educational institution in many cases depends on the optimal organization of the process of educational and extracurricular activities. As already noted, the inclusive learning model implies the targeting of educational institutions for the needs of "special" students. Individual curricula and adapted educational programs are considered a necessary criterion for the successful acquisition of education for persons with special educational needs, which, in turn, "provides an opportunity to study for students with different needs by increasing the duration of training and reducing the academic load" [3].

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УДК 376

INCLUSIVE EDUCATION: THE PROBLEM OF TECHNOLOGY INTRODUCTION INTO SOCIETY

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The modern stage of society's development is marked by the humanization of the education system, which implies the creation of conditions aimed at the disclosure and development of human abilities and skills, its effective and successful implementation. All this is inextricably linked with a positive change in the attitude towards people with special educational needs, the search and research of modern methods of obtaining high-quality education, providing and developing a safe barrier-free environment for them. The barrier-free environment, in turn, is interpreted in the educational and methodological manual [3] as "a set of measures to ensure accessibility and create equal opportunities for persons with special psychophysical development in all spheres of society."

One of the main goals of the educational process of persons with special educational needs is their mastery of any kind of activity, profession, full and effective involvement in society in order to implement professional skills and establish interpersonal contacts in teams. This task can be solved in the context of an inclusive approach in the educational process.

The inclusive model of education means inclusion in the educational process, in which each student acquires knowledge, skills and abilities through an individually selected educational program corresponding to his abilities, satisfying the individual educational needs of the individual [1]. Inclusive education is designed to solve such tasks as creating an adaptive educational environment that meets the general and educational requirements of persons with special educational needs, providing an individual educational approach to a person with special educational needs, taking into account the peculiarities of health disorders, taking into account the uniqueness of social experience and personal capabilities; developing and providing specialized software and methodological complexes for education of persons with special educational needs [4].

The development of inclusive education is impossible without the use of specially selected technologies in the educational process. Technology is a framework, methodology is a shell, a form of activity of a teacher. Educational technology implies a system of joint activities of students and teachers to organize and adjust the educational process in order to achieve a specific result while providing comfortable conditions for participants.

Inclusive education technologies mean technologies that lead to the development of conditions for obtaining high-quality and, most importantly, affordable education for all students without any exceptions, i.e. for the acquisition of barrier-free education.

In modern didactics, there are two groups of technologies: organizational and pedagogical.

Organizational technologies of inclusive education are associated with the stages of organizing an inclusive educational process. This group includes design and programming technologies, technologies of team interaction between teachers and specialists, technologies for organizing a structured, adapted and accessible environment.

It is necessary to minimize the difference between the marks of the sidewalk and the vestibule. If there is a height difference, the entrance platforms, in addition to the stairs, must have a ramp. Tactile-contrast pointers are tactile tiles and tactile indicators. They help visually impaired people navigate their way to their destination in an institution/on the street. Informing tactile signs for people with visual impairment using relief signs and symbols. The entrance doors accessible to the disabled can be designed automatically, manually or mechanically.

Methodological recommendations on equipping professional organizations with the necessary equipment for training persons with disabilities and HIA with all types of nosologies:

- support of disabled people with persistent visual impairment, and the ability to move independently on the territory of the facility;
- information board with a "running line" / monitors on the floors where up-to-date information can be presented;
- light indication of the beginning and end of classes in common areas (halls, recreation, dining room, library, etc.), which allows teenagers to navigate in the learning space and independently organize their working hours;
- accessible Internet and a phone with the function of working in SMS mode, designed for contacts with parents, peers, teachers;
- local computer network;
- headphones with microphone;
- to prevent the phenomenon of reverberation, the audience where the hearing-prosthetic student is trained must have sound-absorbing equipment (panels, curtains, etc.);
- a mobile radio class or a mobile radio class based on an FM system;
- acoustic system (Free sound field system);
- special keyboard: a keyboard with large buttons and a pad separating the keys and/or a specialized keyboard with minimal effort for positioning and typing and/or a touch keyboard;
- virtual on-screen keyboard [2].

Among pedagogical technologies, it is possible to single out those that can be effectively applied by a teacher in the inclusive practice of the educational process. This classification is made in accordance with the tasks and role in the organization of "inclusive" education of persons with special educational needs.

1. Technologies aimed at acquiring academic competencies in the joint education of persons with special educational needs: technologies of differentiated learning, technologies of individualization of the educational process.

2. Technologies for correcting educational and behavioral difficulties encountered by students in the learning process. This group includes special speech therapy technologies and technologies of special pedagogy aimed at correcting disorders, technologies of the neuropsychological approach in correcting educational difficulties, etc.

3. Technologies for assessing achievements in an inclusive approach. The subject of evaluation is the acquired learning outcomes and the process of achieving them, as well as the measure of awareness by each student of the peculiarities of his own learning process.

4. Technologies aimed at the development of social (life) competencies of students. In direct teaching of social skills, the teacher teaches students the correct behavior through rules and examples. For example, "talk in turn", "listen to each other", "ask questions if something is not clear".

Thus, it can be concluded that the role of inclusive education is increasing, and in modern society the goal of educational institutions is to create and develop a "barrier-free" educational environment.

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УДК 778.5

RE-EXAMINATION OF SOVIET HERITAGE IN THE MODERN DOMESTIC CINEMATOGRAPHY: CRYSTAL-GAZING BY DARIA ZHUK

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Meticulous consideration of the Soviet past and its cultural heritage, its infinite re- and deconstruction, assessment and reassessment is a mainstream narrative in the Russian-speaking cinematography of the past decades. Both celebrated connoisseurs of filmmaking (Pavel Chukhrai, “A Driver for Vera”, 2004) and pert debutants (Kantemir Balagov, “Closeness”, 2017) address these triggering plots in their pictures, strenuously trying to offer a new take on the fateful events of the XXth century, to explain the contradictions, habitually seeming inexplicable, to heal the collective ‘after-Soviet-empire’ trauma, and, more importantly, to find the long-awaited hopeful itineraries towards a better future.

Daria Zhuk (born 1980) directed a strikingly, disarmingly earnest story of a generational rather than single feminine destiny, where the stars have aligned notoriously enough – the post-Soviet environment with all what implies, the so-called “turbulent nineties” in their Belorussian version, outrageously assertive character of the main heroine, multiplied by a viral “American dream”, urban myths and violence of rural patriarchal morale. “Crystal Swan” (2018) is the first Belorussian Oscar-nominated film ever.

The greatest, perhaps, attainment of the picture, apart from “portraying the nineties far too honestly” [1] – is an evidentiary debunking of beloved ‘We versus They’ dichotomy, traditionally exploited in the Post-Soviet environment: “We”, the righteous sufferers, oppressed by ominous “Them”: commusists/apparatchiks/bureaucrates/officials/racketeers/gangsters’ (underline whatever applicable). D. Zhuk analyses the epoch without nostalgic sugarcoating, refraining from delegating accountability – either collective or personal – to anyone but people themselves, because the alleged ‘They’ are nothing short of *our* true selves, though masterfully concealed.

The protagonist, Evelina Soroka (Eveline Magpie if translated into English; the choice of a speaking name is deliberate and eloquent) is a charismatic twentysomething lady, living in Minsk in 1996 and wholeheartedly aspiring to press ‘an escape button’ by moving to America. Certified lawyer, she lives a wonderfully marginal lifestyle, DJ’ying at a nightclub and earning almost nothing, having a dope fiend boyfriend, telling packs of lies, stealing money from her mother, crossly putting up with the toxic realities, dreaming naively, desperately, hopelessly.

Eveline, who is apparently not featured in an angelic manner, first becomes a captive of her own illusions, which led her to an ugly backwater village, and then – a random victim of what is commonly referred to as ‘banality of evil’, normalized, routine violence, being heartlessly raped by her new acquaintance, an ordinary guy with no obvious criminal proclivities (too mediocre, perhaps, for providing any grounds to suspect anything unsavory). The rape, on top of that, was indifferently eye witnessed by the rapist’s father.

One might have hurriedly interpreted this episode as an example of barbaric masculinity, raised by a 'bloodthirsty regime'. We believe, however, that the message is deeper: this horrific scene is a poignant illustration of one of the most painful discoveries of the nineties (applicable to all CIS states, we reckon): the abolishment of 'red monsters', armed with the 'hammer-and-cycle rhetoric' did not make the other monsters vanish into thin air. It is not the regime alone, that made our living standards go from bad to worse, the matters happen to be way more complicated: these are deeply-rooted hatred, blatant ignorance and boastful impunity, that are at play when it comes to interpersonal relations in the societies, which have undergone the cataclysmic changes of the merciless nineties.

The picture in question belongs to a multilayer genre of dramedy, conscientiously diagnosing Eveline with Peter Pan syndrome, invisibly hugging her tight, when she was leaving the ominous place by bus, holding a surreal senseless Crystal Swan. Additionally, the picture simultaneously infers, though, that Eveline is not the only kidult in this story – the entire community is a troublesome adolescent itself; and new crises the lack of collective maturity gives way to, are, regrettably, yet to come.

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УДК 37.01

TEACHING ORAL SPEECH ON THE MATERIAL OF THE ENGLISH-LANGUAGE MASS MEDIA IN HIGH SCHOOL

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The main goal of learning a language is the ability to speak it. In reality, using a language, expressing your thoughts orally is what causes the main problems among learners. Learners may know grammar profoundly, read fast and understand almost every word, write long essays on deeply touching subjects, but when they come across native speaker, all their knowledge may become absolutely useful. As Doctor of Pedagogical Scientists E.N. Solovova fairly mentions "we are not interested in the level of knowledge, but the level of applying this knowledge in real communication. These two levels do not always overlap" [4]. Why is this happening? People fear to talk thinking they may say something wrong and sound foolish to whom they speak. This is why, the vital role of a teacher is to find the way to inspire student and make them comfortable. How to put a student into the English-speaking environment? Introduce them to the world of mass media.

According to Oxford Advanced Learner's Dictionary mass media "is the sources of information and news such as newspapers, television, radio and the internet, that reach and influence large numbers of people" [3]. Mass media links everything, brings people together all over the globe, gives the opportunity to see, read and listen everything about anything. This paper aims to encourage resourcefulness in teaching English language by highlighting the importance of using all means of English-language mass media such as newspapers, tv and radio programs, podcasts to develop the speaking skills of learners. The paper aims to review language learning activities regarding English-language mass media to teach learners at high schools, where knowledge level is intermediate-to-advanced.

Teachers can use a much wider range of media – particularly popular media (media not designed primarily for education) – to enrich their teaching. Popular print mass media – mainly newspapers and magazines – can be used to support teaching in many different learning areas. You may ask to make student they own newspaper in order them to research structure itself, find needed

information on the topics, talk about what drew them during the whole process. The use of print mass media is endless and versatile. Many variants of exploitation may be seen in journals about science or pedagogy itself. For example, in Journal of Educational Research and Reviews Doctors from Federal University of Technology of Minna came with idea of combining newspapers and quizzes [5]. In this case, teacher divides students into groups and gives a plain sheet paper and a section of newspaper. A ten- or fifteen-minute quiz based on a section of the newspaper can be include simple questions like "Where the picture is taken?" or "Who are the subjects of the report?". The teacher monitors the activity and checks grammar and spelling used in the questions and answers. Then gives feedback and discusses mistakes. Students at this level may be asked to look for examples of similes, metaphors, irony, hyperbole, satire and other literacy principles found in newspaper. This is not only to develop their English language but also enriches vocabulary and show specific features of this genre of mass media. Another suggested activity involving the use of newspaper is to cut out several photographs of people found in the newspaper and mandate students to write descriptions of them. Those photographs or pictures should be familiar, relevant and of interest to the learners. Students should also match the photographs with the descriptions and speculate about what the news story could be. They may tell the group about which details led them to believe their story is true, debate about other stories, choose the most believable and read the real one's from actual newspapers.

The educational potential of popular electronic media, such as television, radio and internet can be used widely at speaking tasks. Traditionally, the schools tend to spent most of the time developing written expression: knowledge of spelling and punctuation, along with reading and writing exercises. It is an easy way to form the learning schedule. However, as noted in the works by candidate of pedagogical sciences Dulmukhametova G.F., that oral comprehension and expression cannot be neglected; this is the reason why, through dynamic exercises, where the dialogue teacher-student is the main strategy, we must develop oral skills through television" [1]. Through this form of mass media, we can achieve the understanding of the context, the purpose of the message, and recipients; phonetic and lexical correctness, so that the message can be decrypted appropriately in the formal oral speech. Moreover, via television it is possible to study non-verbal aspects, such as articulation, specific pronunciation, intonation, facial expression etc., so that the listener could have clearer understanding of situation. Television may become the closest form of preparation for real conversation. Another electronic means of mass media are radio and podcasts. According to A.G. Mazharova and A.T. Goltseva, PhD's in Philology from Voronezh Institute of the Ministry of Internal Affairs of Russia, "in contrast to writing and speaking practice, the type of mass media such as radio provides the development of a passive skill of listening. This is a great way to expand your vocabulary and improve your intonation and phonetic skills" [2]. They also mention that more effective way of mastering foreign language material is by a multimodal format, using audio and visual materials. Using materials offered by TV channels in the classroom, the teacher can quite easily provide the environment, that is necessary for learning a foreign language. For instance, you may ask student to make their own "report from the scene". They listen and explore recorded reports from any news and make personal report impromptu or prepared. Those measures not only contribute immersing in the culture, but also make student think in English. It pushes them to speak to deliver thoughts. In addition, news may become the question for discussion and if this task is conducted in a group, students may have debates regarding the topic.

In conclusion, using this vast sphere as the mass media would not only help to improve learning of English in general, but at the same time integrate student into English culture, help them think in English and to conquer the fear of speaking in it.

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MASS CULTURE AS A MODERN SOCIAL PHENOMENON

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In social terms, mass culture forms a new social stratum, called the "middle class". The processes of its formation and functioning in the field of culture are most concretized in the book of the French philosopher and sociologist E. Morin "The Spirit of the Times" [1]. The concept of "middle class" has become fundamental in Western culture and philosophy. This "middle class" has also become the core of the life of industrial society. He made popular popular culture. Mass culture mythologizes human consciousness, mystifies the real processes taking place in nature and in human society. There is a rejection of the rational principle in consciousness.

The purpose of mass culture is not so much to fill leisure and relieve tension and stress in a person of industrial and post-industrial society, as to stimulate consumer consciousness in the recipient (i.e., the viewer, listener, reader), which in turn forms a special type of passive, uncritical perception of this culture in a person. All this creates a personality that is easy enough to manipulate. In other words, there is manipulation of the human psyche and exploitation of emotions and instincts of the subconscious sphere of human feelings, and above all feelings of loneliness, guilt, hostility, fear, self-preservation [2]. The mass consciousness formed by mass culture is diverse in its manifestation. However, it is characterized by conservatism, inertia, and limitations. It cannot cover all the processes in development, in all the complexity of their interaction. In the practice of mass culture, mass consciousness has specific means of expression. Mass culture is more focused not on realistic images, but on artificially created images (image) and stereotypes. In popular culture, the formula is the main thing. Based on the analysis of scientific literature, among the main directions and manifestations of modern mass culture, we have identified:

- the "subculture of childhood" industry (children's literature and art, industrially produced toys and games, children's clubs and camps, paramilitary, etc. organizations, etc.), pursuing the goals of explicitly or disguised universalization of the upbringing of children, the introduction into their consciousness of standardized norms and patterns of personal culture, ideologically oriented world representations;

- a mass comprehensive school, closely correlating with the target settings of the "subculture of childhood", introducing students to the basics of scientific knowledge, philosophical and religious ideas about the world around them, to the historical socio-cultural experience of the collective life of people, standardizing all this knowledge and ideas based on standard programs and reducing them to simplified forms of children's consciousness and understanding;

- a system of national (state) ideology and propaganda, "patriotic" education of citizens, controlling and shaping the political and ideological orientations of the population, manipulating its consciousness in the interests of the ruling elites, ensuring political reliability and desirable electoral

behavior of people [3]. Teachers and psychologists note that under the influence of mass culture, the following negative personal qualities are formed in a modern teenager:

-undemanding artistic taste;

-ease of perception of life problems or vice versa "withdrawal into oneself";

-thirst for entertainment and empty pastime;

-predisposition to doping;

- unmotivated aggression.

Psychologists working with teenagers also notice how quickly they change. How neurotic they have become, how difficult it is for them to focus on something even for a short time. They do not engage in communication, they do not paint sublime landscapes, but deserted rooms full of computers, sing worthless and empty hits, etc. And many adults already think that the artistic development of teenagers is a thankless Sisyphean work. As a result of this research, we can talk about two poles of culture in modern society: mass – commercial, cheap, "low" and elite – pure, intellectual, personal, "high". But high culture today functions only in the sphere of the intellectual elite, professional spiritual intelligentsia. Its main characteristics: depth of subject matter, philosophical meaning, appeal to the human soul, complexity, variety of artistic forms, unfortunately, are not inherent in modern mass culture [4]. The culture of the turn of the 20th and 21st centuries is really two-faced. On the one hand, the history passed by mankind has left huge spiritual values. On the other hand, modernity gives bad examples of the degradation of culture, ignoring by teenagers its high standards and true riches.

Mass culture today consciously orients the disseminated spiritual and material values to the average level of development of mass consumers and the task of the teacher as a conductor of spirituality and morality is to help the younger generation to make a choice in favor of a high, meaningful, spiritually filled culture.

There are wonderful game and animation films: educational, films about nature, about animals. There are even films created by children themselves. There are also wonderful concerts and festivals with the participation of children and teenagers. There are wonderful film adaptations that "push" the child to the book. It was the book that always defined Russian culture. But all of the above has an influential competitor in the face of mass culture.

Thus, a teacher can and should talk in detail about mass culture, about the problem of "high" and "low" in art. But in adolescence, the worldview has already been formed, it is necessary to raise these issues much earlier. Starting to introduce students to art, it is necessary to draw parallels with today, it is necessary to consider which art serves for what and to whom.

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SUCCESSFUL EMPLOYEE TRAINING PROGRAM

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Nowadays, there is a big shortage of specialists in production in various fields who perform their work efficiently. It depends on different factors, but we will look at just one. Not everyone learns useful skills and knowledge from learning. A person may not understand the whole process at all. It is not enough for all of us to open a manual, a reference book and other literature and get involved in the the production process a couple of times ourselves. Each of us has a brain working in its own rhythm, which means that for one person it is easy, and for the other it is difficult. It is worth noting that our brain is by nature quite lazy and when a person starts something and it does not work out, he or she will either give up, or will try to figure it out until he or she will succeed. Imagine that a person needs to perform some task. To illustrate, make a model of a device, process a part or pass a level. To do this work, a person has to know how a program, a machine works and know their mechanics, and the brain has to build a projection in the head. The better this projection is, the faster and more accurately a person will do his or her job. But not all people immediately understand the rules of a particular device and try to come up with something of their own. This can lead to the fact that a person won't understand anything or will have to complete the work several times. For example, let's have a look at compass. It is called a point-by-point spline. With its help, the user can easily mark the place of the cut of the part in the drawing. But a person may not know about this function and try to show this section in all other ways. It will take a very long time. Nowadays there are quite a lot of simulators of op machines, all kinds of programs, but not all of them easily meet the requirements of the user. Now we have two methods of staff training: outside and during work.

Employee training methods	Advantages of the methods	Disadvantages of methods
Off-the-job training	- the opportunity to share experience with colleagues from other organizations; - the possibility of using specialized and expensive educational equipment; - the possibility of training with the participation of qualified teachers; - employees are more willing to share problematic situations from their work practice with colleagues from other companies; - learning outside the usual environment contributes to the formation of fundamentally new knowledge and skills	- the difficulty of achieving full compliance of curricula the needs of the organization; - the schedule of classes is set by an external organization conducting training; - the difficulty of recalling an employee from a training event due to production necessity; - when a participant withdraws from the program, its cost may be withheld;
On-the-job training	compliance of the program and time of training events with the needs of the organization; - the possibility of withdrawing	- the possibility of interaction and exchange of experience exclusively with colleagues from your organization;

	employees from the training program through a simple notification of the occurrence of a production need; - the possibility of learning skills to work on the equipment of the organization and taking into account the technological processes adopted in it; - ease of transition from training to work, associated with the coincidence of most parameters of activity; - ample opportunities for repetition and consolidation of acquired knowledge and skills; - the possibility of an individual approach to employee training; - for the company it turns out it is economically advantageous to simultaneously train a group of workers with similar needs	- the probability of a high frequency of employee feedback due to production necessity; - participants of training events may be reluctant to discuss the real problem situations of their working life in the presence of a supervisor and colleagues; - increasing the load on managers of trained employees and appointed teachers; - limited educational programs by the conditions and capabilities of the organization, which prevents the expansion of students' horizons and creative approach;

Tab.1 personnel training methods [1]

We can combine them into one. We can create a training program that will work as a sandbox, mentor and library in one place. For example, production needs milling machine specialists, installers and metrologists. The manual includes these items in the program library and each student works with his or her own plan. It will include two main modes: learning and sandbox. In other words, the first mode works with the built-in AI. The internal training system will analyze the work of mechanisms and programs from step to step, as well as give tasks and give advice on how to do this work better. For instance, a person needs to figure out how a compass works and what properties it has. First, the AI will introduce the student to the program interface and begin to explain the functions. In the first lesson, the student will figure out how to work with the geometry tab. It will show animated examples and how other people use it. After that, you may put in your request to draw squares, rectangles, arcs, circles, etc. Without completing one task, the system will not allow you to start the next lessons. Conditionally, the system will be divided into levels. The second mode will be based on an already projected machine, program, or something else. The user can perform any actions and the AI will show what will happen with such actions. In addition, achievement systems will be built into the system. People can be motivated to perform all sorts of actions by small rewards. Imagine, a person finishes a lesson and the system shows the achievement level with notes and the words of counterargument, that help motivate the person to continue further. The program with its capabilities will push a person to perform better and create the right perception of the work, creating the right projection in his head.

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УДК 629.7

PROSPECTS FOR THE USE OF ALTERNATIVE FUELS IN THE INTERESTS OF AIR TRANSPORT

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Currently, energy production is mainly based on the use of fossil energy sources. They provide more than 90% of the world's fuel and energy balance. The relevance of research on alternative fuels and energy sources is determined by the finiteness of fossil resources, as well as environmental, economic and political factors.

The largest consumer of the most valuable grades of petroleum fuel is transport. Civil aviation accounts for about 12% of the oil fuel consumed by world transport. Air transport is characterized by a high level of energy consumption associated with a high speed of transportation. Fuel costs account for about 30% of the direct operating costs of aircraft.

The volume of fuel consumption and greenhouse gas emissions by the world civil aviation is increasing annually, while the efficiency of traditional aircraft is approaching the limit. It is impossible to radically improve the situation without the use of new aircraft schemes, engines, alternative fuels and energy sources.

Russian civil aviation is also characterized by an increase in fuel consumption due to an increase in demand for air transportation, outstripping the increase in the fuel efficiency of aircraft. Although in 2001-2013 the specific fuel consumption for air transport work decreased by 2.1 times, nevertheless, in 2000, 5 million tons of fuel were consumed by air transport, and in 2013 – already 8 million. In 2030. as part of the implementation of the Transport Strategy of the Russian Federation, the fuel demand will amount to about 13 million tons (fuel consumption growth is about 3% per year) with a corresponding increase in greenhouse gas emissions and a negative impact on the global climate.

In general, it is considered preferable to offer an alternative fuel for civil aviation, which, in terms of physical and chemical properties, will be similar to traditional aviation fuel from oil and will not require constructive modification of aircraft for its use. So far, among alternative fuels, only synthetic jet fuel, obtained from coal or natural gas, has been brought to a fairly wide practical application in civil aviation. But in addition to the higher (by about 30%) cost of synthetic jet fuel compared to traditional, it does not reduce greenhouse gas emissions and is also produced from fossil raw materials. Nevertheless, it is an alternative to traditional jet fuel in regions where there is a shortage of petroleum products, but enough raw materials for the production of synthetic kerosene.

The introduction of jet biofuels will help dramatically reduce greenhouse gas emissions by civil aviation. Some companies have used biofuel mixtures with kerosene on commercial flights, thereby confirming that they can be used regularly without adversely affecting engines and fuel system units. Three types of biofuels mixed with traditional jet fuel have already received a certificate for use in civil aviation by the existing fleet of aircraft without restrictions, two more types are being prepared for certification.

The introduction of biofuels is constrained by its high cost, which is several times higher than the cost of traditional jet fuel, as well as unresolved problems of sustainable provision of biofuel production with raw materials.

A more promising direction in the search for alternative energy sources for civil aviation is the use of fuel cells (energy sources that create an alternative to burning fuel in engines). The interest in hydrogen fuel cells is due to their ecological purity and renewable fuel – when hydrogen fuel cells work, only water is obtained, and hydrogen used as fuel can be obtained from water through

renewable energy sources (sun, tides, etc.). Fuel cell technologies have already been sufficiently mastered in the field of energy and automotive.

In the near future, it is possible to use fuel cells as energy sources for individual units and systems of aircraft, in the long term – as the main power plant of a fully "electric" aircraft. Laboratory aircraft (A-320 "D-ATRA", B-737-800 "ecoDemonstrator") use hydrogen fuel cells as an auxiliary energy source (in particular, the electric drive of the chassis wheels). Nevertheless, fuel cells still remain a distant prospect for eliminating the need for liquid fuel for civil aviation, although their application in aviation has begun to acquire practical aspects.

Thus, the introduction of alternative fuels and energy sources in civil aviation in the foreseeable future will not yet be on a global scale, although it is possible to use them to solve particular problems, including:

1) due to the shortage of oil due to special foreign policy conditions in South Africa, synthetic jet fuel obtained from coal is used in significant volumes. Qatar produces synthetic jet fuel from natural gas due to the presence of large gas reserves in the country. At the same time, synthetic kerosene is more expensive than traditional and leads to large greenhouse gas emissions.;

2) solar panels can potentially provide a very long duration of flight of light unmanned aerial vehicles;

3) aviation condensed fuel can be used in certain regions, where its price advantage relative to traditional aviation kerosene can be realized due to minimizing investments in the infrastructure for the production of ASCT, its transportation, storage and refueling in aircraft, as well as due to the presence in the region of sufficient demand for the use of aircraft capable of using ASCT;

4)the use of cryogenic gases (hydrogen, natural gas) as fuel for gas turbine engines of commercial aircraft is unlikely due to the combination of technical and economic problems of their implementation in civil aviation. Moreover, fuel cell technologies can significantly increase the efficiency of using gases such as fuels. Nevertheless, the use of hydrogen as fuel for piston engines of unmanned aerial vehicles of long flight duration is being considered.

In general, despite a significant range of studies of alternative fuels, so far, no cost-effective replacement for traditional aviation kerosene derived from oil has been found on a global scale in terms of the totality of all aspects. Comparison of different types of fuel by economic indicators is the basis for evaluating the efficiency of using alternative fuels. Analysis of the impact on the economy of aircraft operation makes it possible to assess in a concentrated form the effectiveness of all aspects of the introduction of alternative fuels in civil aviation.

The potential impact on airline costs of using hydrogen fuel cells on aircraft requires additional study. To date, the level of technology in this area, most likely, does not ensure the achievement of a comprehensive positive effect, but the development of technologies in accordance with the goals set abroad can make them accessible to civil aviation.

Thus, the problem of finding an efficient alternative fuel remains relevant for the civil aviation of the world, and over time the scale of research in this area increases. In recent years, they have mainly focused on the creation of renewable biofuels and technologies for generating energy using fuel cells. However, as practice shows, other types of alternative fuels can find practical application due to their effectiveness in specific conditions.

The transport strategy of the Russian Federation provides for research in the field of alternative fuels, which, however, have not yet acquired a systemic character. Given the international nature of air transport, the desire of a number of foreign countries to use biofuels in civil aviation and the intention to develop a global mechanism for market-based measures to reduce greenhouse gas emissions by international civil aviation, it can be assumed that in the future jet biofuels will become an element of the fuel and energy balance and air transport in Russia. But the share of alternative fuels is unlikely to exceed 5% of the total fuel consumption of Russian air transport by 2030.

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TECHNOLOGIES IN VARIOUS FORMS OF DISTANCE LEARNING: THEORY AND PRACTICE

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Distance learning is a definition that combines many forms of transferring knowledge to students without full-time attendance at classes, when the teacher and student are at a great distance and interaction takes place using various means of communication and achievements of the 21st century. Today, distance learning is very widespread, it is used both in government structures and in private organizations, from online schools to virtual universities that promote remote learning to the masses.

Although distance learning has become so widespread relatively recently, it has more than 100 years of history. Distance learning in the 21st century is certainly associated with the introduction of computer, information, and communication technologies that have improved the quality of distance learning, and the advent of the Internet and electronic means of communication have allowed the creation of a new type of distance learning - virtual universities.

The methodological feature of distance learning is that the acquisition of knowledge, skills and abilities provided for in the curricula is carried out not by attending lectures, lessons and seminars, but by self-study using various technical means. The central aspect of distance learning is not teaching, but teaching self-development, while the student must not only have knowledge about the computer, but also be able to apply them, in addition, it is necessary to be able to work with educational information that will occur in the process of cognition.

A striking example of the use of distance learning in universities is the unique KAI platform for teachers and students - Blackboard. It greatly facilitates the learning process, makes it simpler and more mobile due to its functionality. With the help of blackboard, you can watch lectures, send homework to teachers for verification, perform tests and track homework at home, and all this without visiting the university. This platform is very helpful for those who are often ill, because there is all the necessary information for self-study.

Blackboard makes life easier not only for students, but also for teachers. With its help, teachers spend less time checking intermediate academic performances. In addition, the platform allows to distribute students into groups and check the completion of their homework, which greatly reduces the time of verification, while maintaining the quality of training.

To some extent, we can say that distance learning unites people, because it doesn't matter where you get knowledge, it can be done from anywhere in the world. It is easy to trace this on the example of federal and international distant Olympiads. Most recently, we all had to face the Covid-19 pandemic, when many organizations were deprived of the opportunity to continue their full-time activities, especially in places where there is usually a large crowd of people every day. And the only true and safe solution was the transition to distance learning. This is where many are faced with the problems of information illiteracy, insufficient training and technological support. It was after this event that many universities began to work on creating their own learning platforms, and private companies thought about the advantages of remote activities, because after this event many continued to work remotely, because it is true in some cases it is much easier and more convenient.

The disadvantage of distance learning is definitely its focus on most of the independent preparation and independent study of the material. It is also worth mentioning that at present the amount of information that needs to be studied and understood during the educational process is increasing every day. At the same time, the amount of information on the Internet is also growing, which negatively affects self-study, because many do not know how to handle the flow of information properly and choose what is necessary and necessary from there, whereas in full-time training teachers give only the necessary knowledge. But a large flow of information for inquisitive students is of great benefit, with its help they can delve into the topic, find additional courses, take them and become truly knowledgeable in this area.

At the university, students are forced to independently analyze most of the subjects studied without personal contact with the teacher. At the same time, modern equipment of schools and universities with material and technical means makes it possible to increase the student's time in the educational process without much expense or speed up this learning process, partly due to virtualization. Information technologies allow to achieve this, for example: the exchange of information between participants of the educational process via the Internet. Distance learning systems are used for centralized management of the "virtual educational process". These systems do not cancel the traditional education system, but only complement it. They appeared on the market of educational software products in 1995, as the market for distance learning software developed, these tools became more convenient to use and expanded the range of functions offered to users.

Summing up, we can assume that distance learning will replace the traditional form of knowledge acquisition sometime, but it is unlikely that this will happen very soon, because there are a lot of organizational and conceptual problems with distance learning. So far, we can only talk about a partial transfer to remote education, we can say, to help the main form of obtaining knowledge. Until the moment of full transition to distance education, it is necessary to invest a lot of time, effort and finances so that it becomes accessible and comfortable for all people seeking to gain knowledge, regardless of their age, financial situation and ability to manage technology.

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УДК 331

THE PROBLEM OF RISING UNEMPLOYMENT IN THE WORLD AND POSSIBLE WAYS TO SOLVE IT

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In today's world, the problem of rising unemployment is becoming increasingly acute. Every economic system seeks to increase the social product in order to better meet the growing needs of the population. The most important factor contributing to this goal is a high level of employment. If labor resources are underused or inefficient, on the one hand, the system may not reach the limits of its productive capacity, on the other hand, unemployment causes serious damage to people who cannot use their abilities and skills in the areas closest to their own, depriving them of a source of

income to maintain their livelihood. Unemployment is the phenomenon in which a part of a country's economically active population is willing and ready to work, but cannot find a use for its labor force.

Unemployment can have many sources, such as the following [1]:

- New technologies and inventions
- the state of the economy, which can be affected by a recession
- competition caused by globalization and international trade
- government policies
- regulation and the market

What effects can unemployment have? A country is experiencing a downturn in economic growth, lagging behind in GDP growth. In addition to the purely economic costs, we must consider the significant social and moral consequences of unemployment. It negatively affects the social values and vital interests of citizens, for most of whom wages are the main source of income. Therefore, the forced inactivity of a large part of the able-bodied population and of each person individually leads people into a state of depression. There is a loss of qualifications and practical skills, plans collapse, hopes turn into illusions. Moral standards decline, crime increases, and social tensions in society escalate. Ultimately, the moral and physical health of society is undermined.

Unemployment can be voluntary and exist when there are vacancies, when a worker is not satisfied with the level of wages or the nature of work, and involuntary. It is associated with the establishment of wages above the point of market equilibrium, when there is a gap between the demand for labor and its supply." [2]

Covid-19 had a major impact on job cuts in Europe. Scientists have also proven that high unemployment rates increase crime rates in a country. Therefore, states are taking a number of measures to combat unemployment:

1) reducing business tax rates;
2) improving the system of information on available jobs;
3) creation and improvement of labor exchanges;
4) development of a system of retraining of personnel;
5) creation of conditions for the development of small and medium businesses;
6) development of special targeted employment programs for youth, women and other workers.

However, it should be noted that the labor market is a specific sector of the economy. It differs from all markets by the fact that it is not goods (inanimate things) but living people that move on it. That is why its regulation is of great socio-economic and political importance and is a special concern of the state. And yet the task of the state is not to provide everyone with work, as this increases inflation, but to keep unemployment at the natural level, which means achieving full employment.

Each country seeks to develop its own employment policy: social programs are implemented to provide for the unemployed, income is indexed, public works are organized, etc.

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УДК 311

THE EFFECT OF COFFEE ON THE HUMAN BODY

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Coffee has a different effect on human health, namely, what kind of influence it has depends on what kind of coffee is consumed and in what quantity. Is coffee bad or good for you? It is very difficult to answer this question unequivocally. Coffee affects each organism differently. There are many arguments for and against it. The aim of our research is to study the effects of coffee on the human body. The object of the study is instant and ground coffee. Everyone knows that caffeine stimulates the central nervous system, which means it improves brain function. But it also makes the heart beat faster and raises blood pressure. Some people find it very helpful, while others find it harmful. Coffee is considered to be the best remedy for fighting sleep [2]. It keeps the mind and motor functions clear.Caffeine also increases stamina. The same drink also actively flushes calcium out of the body. Caffeine helps to clear the gallbladder and prevents the formation of cholesterol clots. The same effect can be produced by exercising and eating a healthy diet. Moderate coffee consumption may protect the liver from cirrhosis [1]. Coffee drinking often turns into caffeine addiction. And its frequent use adversely affects the nervous system. Reduced duration of sleep leads to failure of all body functions.Coffee can and should be drunk, but in moderate doses and in the morning [6].

Most people drink instant coffee, so for the study we took “Black Card coffee”; “JARDIN (natural)”. Blood pressure was determined using an automatic tonometer, which records the systolic, diastolic pressure and the person's pulse at a glance.Based on our study, the following results were obtained after drinking "Black Card" coffee. Most participants had 75% of their blood pressure unchanged, as the instant coffee contains less caffeine. In 15% of participants their blood pressure decreased after 30 minutes. In the remaining 10% of participants their blood pressure did not increase much during the hour. After drinking "JARDIN" coffee - 80% of participants had higher blood pressure after only 20 minutes. The other 20% had no change in their blood pressure.

Therefore, coffee can both raise and lower blood pressure. Whether your blood pressure rises after ONE cup of coffee does not depend on what your blood pressure was before you drank it, nor on your gender or age. It is an individual reaction of each organism. It is worth noting that after drinking natural coffee one's blood pressure was higher compared to that of instant coffee. It can be assumed that this is due to the higher caffeine content in natural coffee than in instant coffee [5].

Therefore, coffee can both raise and lower blood pressure. Whether your blood pressure rises after ONE cup of coffee does not depend on what your blood pressure was before you drank it, nor on your gender or age. It is an individual reaction of each organism [4]. It is worth noting that after drinking natural coffee one's blood pressure was higher compared to that of instant coffee. It can be assumed that this is due to the higher caffeine content in natural coffee than in instant coffee [3]. Coffee has an effect on the human body, and how it affects the body depends, in most cases, on ourselves.Based on our research, we have developed the following recommendations.

Coffee is a healthy drink for the body, but it should not be abused.

1.You should drink no more than 1-3 cups of coffee a day, more than this will cause caffeine addiction.

2.It is not recommended to drink coffee before going to bed.

3. People with persistent high blood pressure should not drink coffee.

4.It is better to choose 100 % natural coffee, and drink it with milk or cream to soften the mucous membrane of the stomach.

5.Producers should inform the population about the caffeine content on coffee packaging in order to choose the most suitable coffee, taking into account individual body characteristics.

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ONLINE RESOURSES IN LEARNING ENGLISH FOR THE FIRST YEAR STUDENTS

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In the modern world we need to learn English. Mastering a language opens up new possibilities. But how to learn English? The majority of people put off studying a language due to the lack of time [1]. In the age of information technology new methods of learning languages become popular. It is convenient to use different online applications that allow a person to learn a new language on the way to work, at lunch time or before going to bed.

What kind of applications are effective in learning and teaching and which ones are easier to handle this is a question we need to answer. We have used 3 online resources which help to learn English and to increase the proficiency. Each application has personally been used and we would like to analyze the pros and cons.

Quizlet

Quizlet is one of the most popular apps. It has over 10 million downloads. Cards made in Quizlet are the main way to learn languages. The main advantage of this application is that it doesn't require paid subscriptions. Each user is provided with almost all the basic functions that allow a person to use the application. For an additional fee, if necessary, one can get new ways to memorize English words or to test oneself. Users can create their own modules with the words they are interested in. They can study cards created by other students and teachers. After studying and memorizing words a person has an access to various types of self-examination tests such as spelling or writing tests. All tests are available. The application also contains a large number of textbooks in various areas of professional interests. The textbooks are for foreigners. A bonus is that all textbooks have answers and keys. As a user I can highlight a nice design of the application Quizlet, its intuitive controls. Quizlet provides the possibility to share your own cards with other users. Your cards may be used by your friends or classmates. It is worth noting that using cards as a method of memorizing is the most effective way to learn English.

The disadvantage is that it is impossible to find tests and materials on specific topics of interest, since there are not so many of them. Due to the lack of highly specialized resources, it is necessary to choose, for example, for energy specialties, all material which is available on the topic "Engineering".

Context Reverse

A more advanced version of the well-known translator is Context Reverse. This translator is able to show the use of any word in the real context. It helps to know more about the word's usage. This application does not translate a sentence literally because literal translation is not always possible and can be incorrect in some cases. On the bases of given examples we can make a sentence that corresponds to the norms of the English language. Contexto Reverse is free. We can have an access if we pass verification through any social network to use it properly. The mobile

version is likely to need a number of improvements, as it is not completely adapted to most mobile devices. The ability to download dictionaries and to use them without an Internet connection is an advantage. This translator gives students the opportunity to avoid incorrect sentences and translation and to get closer to native speakers.

The disadvantage is the limited format of the offline application, since it is impossible to find all the necessary words and phrases. As a result, it is best to work always online so that you have access to all resources.

Ablo

This application is one of the most widely used applications in language learning. It has over 10 million downloads. The main reason for such popularity is the ability to communicate with real foreigners by using text chats or video conferences. All people studying a foreign language dream of using it in their lives. Ablo seriously protects personal data of its users. The users of this application are not teachers and they do not aim to show their skills or to make a student to learn something new [2]. The users want to acquire new acquaintances and to have the possibility of communication. In such comfortable conditions a person can relax and concentrate on communication itself. Such video calls increase considerably the level of language proficiency, since, when a person communicates with a native speaker, he or she copies the native speakers' pronunciation. It also contributes greatly to improving language oral skills. A student is able to master the slang and all kinds of abbreviations that native speakers use. You are able to understand which rules are used best and which topics not be worth studying. Finally, the user begins to perceive and recognize the foreigners' fluent speech. This application itself meets all modern requirements, it has a colorful design and simple operation system. This application gives the opportunity to improve the language skills, to meet new people and to learn a lot of interesting things about other countries.

In conclusion, we demonstrated three resources that can help to learn English. Each of them has distinctive features, but they have their own unique approach to learning. The purpose of all these applications is to improve the level of speaking, make it closer to a native speaker's one and to give the opportunity to use the language in everyday life.

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PROSPECTS FOR DOMESTIC PACKAGED SUBSTATIONS

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Annotation. Ensuring energy security is a priority area of development today. It is impossible to imagine the effective operation of the country's industrial complex without stable transmission of electricity that meets high quality standards in accordance with GOST (State All-Union Standard) 32144-2013. The problem of ensuring the efficiency and quality of transmitted electricity today is proposed by the development and implementation of digital substations in the country's energy networks.

Keywords: transformer, efficiency, Economy, energy equipment, opportunities.

Packaged transformer substation (PTS hereinafter) - an electrical substation consisting of cabinets or units with a transformer and other equipment of switchgears and relay protection built

into them. PTS shall be supplied in assembled or prepared for assembly form. These substations are universal, which makes it possible to install them not only at industrial enterprises, but also at agricultural facilities, oil and gas production, in settlements, etc. [1]

Another advantage of PTS is a reduction in cable costs by an average of 20%, a reduction in installation costs of about 30%, a reduction in commissioning costs of about 20%, which in practice saves millions of rubles and makes this type of substations more affordable than classical ones. [2]

The stable interest of the state in import substitution clearly demonstrates a number of legal acts in support of the "Concept of Long-Term Socio-Economic Development of the Russian Federation for the Period until 2020" approved by the Government of the Russian Federation (Order of the Government of the Russian Federation dated 17.11.2008 N 1662-r) and the "Energy Strategy of Russia for the Period until 2030" (Order of the Government of the Russian Federation dated 13.11.2009 N 1715-r). According to these documents, by 2030, the share of domestic equipment in procurement should account for 95% of the main and secondary electrical equipment, including 110-750 kV power transformers, 110-750 kV disconnectors and switches, relay protection and automation equipment, emergency automation, automated process control system and communication systems. [3]

Domestic manufacturers of PTS are currently presented in Table 1.

Table 1. Domestic manufacturers of PTS and the cost of their PTS.

Manufacturer	Price, rub
"RED-Electro" Kursk	153.100 – 792.200
SVEL, Yekaterinburg	150.500 – 950.000
GC New Technologies Odintsovo	200.000 – 850.000

Components for Russian-made transformer substations (Table 2) are also manufactured by our manufacturers. According to market analysis, domestic components are not inferior in quality to imported analogues, while winning in value. Many components, in case of failure, can be bought and replaced without difficulties. Maintenance personnel do not need special skills to handle our equipment, which makes repair and adjustment inexpensive.

Table 2. Components of modern PTS and their manufacturers.

Machinery name	Type, brand	Manufacturer
Power transformers	DPT DPTD TPT TPTOACHD TPTNCP	LLC «SVEL-Rosenergotrans» JSC "MATZ named after V.I. Kozlov"
Load-breaking isolators	AGLS-SESH	JSC “PA Eltekhnik” Joint Stock Company "Plant Integral"
Stress limiters	PT/TEL	CJSC Tavrida Electric Group of Companies
Automatic switches	AS	JSC "Contactor"
Current transformers	TTI CT TOP-O,66 CT TSHP-O,66	IEC GROUP OF COMPANIES OJSC "SZTT"
Microprocessor protection and automation devices	MRPT MESAU MRPU	LLC "NTC Mechanotronics "

Analysis of modern PTS and their components shows the ability to produce this equipment without any problems based on the production facilities of the Russian Federation. At the same

time, the country's energy industry gains independence from external economic influences, including sanctions and the isolation of imports from other countries. Leading developments in the field of PTS implementation reduce the cost of electricity, while increasing its quality, increasing the reliability and safety of its transmission.

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УДК 33

CONCEPT OF ERP SYSTEM

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Abstract: The article presents the concept of ERP system, identifies its main purposes. It analyzes advantages and disadvantages and describes how to integrate the ERP system to a business company.

These days the competitiveness of a business without the use of a resource planning system is impossible. One of the most popular resource planning systems is an ERP system and many micrologistic systems work on the basis of this concept. This system helps to plan all types of resources – labor, financial, information, assets, and also accelerates the processes that are conducted in business. The main purpose of ERP system is automation of interrelated planning, accounting and management processes in key areas of the company. This system is so important and it makes everything simpler: the data reflects the actual state of the company. In this case the head of the company does not need to delve into the essence of each problem - the system indicates the current development of the organization itself. Here are advantages of using the ERP system:

- reduction of workload, as it eliminates duplication of information at different levels of management;
- increases control;
- provides an opportunity for qualitative data analysis, which is especially significant for decision-making in a rapidly changing environment.
- automation of basic operations, such as sales, order fulfillment, payment procedure;
- improved customer service, as a single source is organized for invoicing, tracking the relationship between customers and the organization;
- improving logistics management.
- reduction of operating expenses due to simplified business processes using best practices;
- simplified reporting and planning;
- data security.

On the other hand – disadvantages:

- the complexity of the program and, as a result, the need for additional user training;
- increased requirements for equipment

Creation of ERP system occurs in 5 steps:

1. forming of a working group;
2. identification of information sources of the company;

3. building conceptual, logical and physical models of activity;
4. planning of optimization of business processes;
5. the launch of the pilot project.

Last step is a stage of preliminary implementation and there are modeling of the work of the entire company starts. In some departments, actual data is entered into the system and the ERP system functionality is consistently tested by working out real situations. They also check the integration of the work of different departments on the basis of test examples. In the process of adaptation, the software is debugged in accordance with the project of implementation and testing of individual modules.

Organizations use enterprise resource planning for the following reasons:

- replacing outdated software;
- replacement of home systems;
- software change to more efficient;
- during the initial installation of automation.

ERP software usually consists of several components (modules) corporate software. They can be implemented separately, based on what best suits the specific needs and technical capabilities of the organization. But you can also purchase modules as a single package.

Let us consider the integration process in detail. Above all work on the ERP implementation project at the enterprise begins with the definition of goals and objectives. The customer should clearly know what business effects he wants to achieve. Next step is the survey of business processes of the enterprise. This stage is important because of defending deadlines and cost of implementation works. Then ERP implementation methodologies are selecting.

Integration of ERP system can be realized in 3 ways:

1. Module type: every module of program integrates gradually, one by one. This concept fits for large project with a long development period.

2. One-time type. The developed system integrates in one time. This type is optimal for small systems.

3. Combined type. In that way combines the first two types and it helps to minimize risks, and make adaptation for new system softly.

As a result, the functional requirements for the key modules of the system, the need to download initial data and configure the exchange with the software already in use are determined. Subsequently, the software is installing on the workplaces of employees. Access rights and reports are configuring. Work data and reference information are loading from the old system, Excel files, etc. And, finally, putting the system into commercial operation: upon completion of the automation process, a key group of users is training, instructions for working in the system are developing.

To sum up, creating your own ERP system is a convenient way to optimize the business processes of an enterprise or project. The main advantages of ERP include automation of basic operations, increasing the efficiency of the enterprise and the ability to scale by optimizing processes. Creating your own ERP system may be optimal for a growing company that wants to increase its productivity.

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УДК 303.68

USING SOCIAL MEDIA AS AN ANALYSIS TOOL FOR EMPLOYERS

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This article presents an analysis of the use of social networks as an effective method of recruitment. The positive and negative sides of this method of personnel search have been studied. The developed method is based on the concept of the influence of the visual component of the candidate's profile, his professionalism and further hiring.

The choice of the topic is partly based on the personal interest of the authors, because everyone at some point is faced with the need to get a job. Using social networks to find employees or employers has long ceased to be a trend, it is now necessary.

Nowadays progressive, innovative companies are always faced with the issue of reputation and corporate security, as well as HR issues in recruitment. Social networks help in solving these issues, but the more actively this method is used, the more information garbage becomes on the platforms used. At this point, social networks present employers as a set of cards with user data, the transfer of information between which is carried out by analyzing the account. The process of analyzing various Internet resources, especially user networks, allows you to calculate the risks, check the validity of the information and have a general idea about the candidate.

Analyzing the account of a potential employee, the attention should be paid to several points, each of which we will consider in detail below:

1. Photos. A thorough assessment of the photos can tell us a lot about the candidate. Research in the field of psychotherapy, and in particular the research of Max Lusher, has proved the involvement of color preferences in relation to personality character.

In many ways, the right choice depends on the vacancy, because everyone is applicable in their business. It is necessary to ask the question: "How do you see an employee for this position?" An innovative account implies a creative, advanced personality, therefore this employee will better cope with more ambiguous tasks. In our subjective opinion, an open account that demonstrates friendly meetings, hobbies and travel characterizes a candidate who is likely to become an excellent specialist in working with clients.

2. Profiles to which the user is subscribed. Analyzing and viewing the candidate's groups will allow you to analyze hobbies and interests. But it should be understood that the absence of organizations of a certain subject is not a reason for rejecting the applicant. For the most part, corporate security rules play a role in this paragraph. Participation in banned organizations and reading dangerous literature are grounds for undermining the reputation of the company and abstaining from this candidate.

3. Environment and personal data. This item includes such as the applicant's age, city of residence, marital status and contacts that can be contacted if possible.

4. Posts. Publications of the blog page can tell a lot about the user of the page. First, you should pay attention to the content of the text, the mood of the publication and the competence of the future employee.

5. Risks for the company. Often company policy implies that an employee is not entitled to third-party income. Such an applicant can undermine the reputation of the company by luring the client to another organization. As a result, the company may lose both the financial component and the issues of the internal environment of the organization, its changes, as well as the impact of the integration impact on the company's personnel.

It should be noted that when using conditionally open sources, the personnel officer or the employer does not violate moral and ethical norms in relation to the applicant. After all, the

candidate independently posted the information on the Internet, knowing that this information would become public domain. Also, in addition to social networks, HR specialists are increasingly using databases such as Integrum or SPARK. These are Russian companies offering a wide range of online business information support services for checking counterparties and risk assessment. Such associations provide access to electronic archives in which data is presented through the service "What? Where? When?" or Person – Position – Organization. Such structures, forums and social networks themselves are an inexhaustible source of information for personality analysis.

It is worth recognizing that these methods have advantages over traditional recruitment, but at the same time it is worth emphasizing the limited functionality of such a tool. The advantage of social networks when searching for personnel is the portability of Internet access, information content, diversity and extensive audience coverage, among which you can find many specialists. Still, considering social networks as an important component of recruiting, we should not forget about the mistakes that HR specialists make when selecting personnel. Investigating this problem, we can distinguish 4 groups of mistakes:

1. Insufficient emphasis on the development of relationships and trust between the HR officer and the applicant. Social networks rarely provide an opportunity to build a trusting relationship between a recruit and a candidate. For the most part, an HR specialist risks undermining trust or scaring off a HR specialist by persistently offering his services or work. In this case, the employer loses both the potential candidate and the time spent on building a trusting relationship.

2. The lack of a social recruiting strategy or the choice of extremely limited broadcast channels. Most often, the HR officer's activity is limited to such social networks as XING, Executive.ru or TenChat. Certainly, these information channels are a valuable source in the hands of a knowledgeable person, but do not forget about the existence of other Internet resources. Thus, the activities of many HR managers are reduced to such restrictive aspects as numerous mailing of messages among subscribers or unattended publication of ads. It is worth realizing that such a tool for attracting an audience is obviously doomed to failure.

3. Based on the above, the following problem can be identified – mailing "for everyone" or "for no one". It is necessary to understand that by sending a systematic mailing list, which for the most part resembles spam messages, the HR officer draws the reputation of the company. It follows from this that such messages, on the contrary, repel potential candidates and it is not worth waiting for retaliatory actions.

4. Lack of proper support and professional development for HR managers. There is no "general instruction" for the personality profile. The recruit's task is to find out or "probe" the candidate's account, consider the potential and calculate all the risks. It should not be assumed that the HR manager will intuitively carry out a critical analysis of the prospective employee. For the best result and proper quality of work, demonstration training, a list of recommended actions in case of difficult situations and an alternative sample of messages are necessary.

5. Based on all of the above, we can conclude that the analysis of social networks as a tool for recruitment is currently developing rapidly.

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УДК 81`373

FEATURES OF THE FORMATION AND USAGE OF ABBRIVIATIONS IN ONLINE COMMUNITIES COMMUNICATION

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The modern world is characterized by a high pace of life. A person is forced to quickly respond to changes in society, draw conclusions, and make decisions. Thanks to gadgets, communication has become a written form. But due to lack of time, more and more space in the letters and sms began to be occupied by symbols, shortenings, and abbreviations. The relevance of this work is due to the need to study, create and apply modern abbreviations used in the Internet language.

So, abbreviations are an artificial way of forming words by connecting parts of a word (usually sentences). E. A. Zemskaya in her written works emphasizes that abbreviations are more typical for written speech, explaining that any abbreviation requires decoding when it appears, which, of course, prevents its spontaneous appearance [1]. Nevertheless, in the modern Russian language, there is a trend of gradual penetration of abbreviations into oral speech and urban linguistic creativity. In close connection with the youth slang, the Internet language takes an important place in everyday communication of young people and is a kind of indicator of their development level, interests, tastes and needs, a characteristic of youth as a social group.

Abbreviations in the Internet language perform the following functions:

1) the function of speech economy;

2) thesaurus ("a reservoir for the knowledge accumulation and storage") [Ivanov 2000: 5];

3) actual (contact setting)

4) expressive, conveying the attitude of the speaker to what he/she is talking about[2].

In the Internet language, abbreviations formed from English words or phrases are especially popular.

Such abbreviations are built according to The following word-formation models :

1. Alphabetic abbreviations – these are abbreviations for the first letters of the words of the phrase; however, such an abbreviation is not spelled, but read as one word. For example, LOL (Laughing Out Loud).

2. Numeric abbreviations – abbreviations in numbers (alphanumeric). In such an abbreviation, one digit replaces the whole word or part of the word according to the similarity of pronunciation. For example, the number 2 (two) replaces the preposition or particle to, the adverb too, or can be part of the word as one of the syllables: 2day = today.

3. Abbreviations in which some letters of the word are omitted (mostly vowels). For example, pls (please), txt (text).

In order to analyze which abbreviations are the most popular in the Internet language among young people, a survey was conducted among Russian speaking first-year students on the topic: "What abbreviations do you most often use to express emotions in correspondence." The following questions were asked:

1) "What abbreviations do you use to express joy?"

2) "What abbreviations do you use to express doubt?"

3) "What abbreviations do you use to express confidence?"

4) "What abbreviations do you use to express discourse (logical argument, mental premise)?"

5) "What abbreviations do you use in computer jargon? (For example: while playing computer games)."

The survey involved 50 people. Most of them (80% of those asked) express their joy with abbreviations such as "lol" and "omg". These abbreviations are foreign; they were taken from the English language. The abbreviation "lol" corresponds to the English abbreviation, which means

“laughing out loud”; and the abbreviation “omg” is an English exclamation “Oh My God!” This phrase can often be heard from people who are overly happy, so much so that joy turns into delight or surprise.

When asked which abbreviations they use to express doubt, all the people interviewed answered that such an expression as “MB” is used. This abbreviation stands for the phrase “maybe”, including the doubt or uncertainty in a matter.

60% of the students surveyed express their confidence using the abbreviation “infa sotka”, which is an abbreviated wording of “information is 100% reliable”. This expression means the absolute confidence of a person in what he says. The rest of the respondents expressed confidence with the help of the abbreviation “knshn” (“кншн”), which is a squeeze from the word “of course” (“конечно”), (vowels are omitted).

When asked “what abbreviations the discourse is expressed with”, most of the respondents mentioned such expressions as “ksta”(“кста”)and “norm” (‘норм”). The abbreviation “кста” is a squeeze of the word “кстати” (“by the way”), and “norm” is a shortening for “normal”.

In answering the last question, a wide range of different abbreviations were mentioned. The most popular were the following:

“ty” – this abbreviation is taken from the English language and means the phrase “thank you”;

“brb” – this abbreviation is also taken from the English language and means the phrase “be right back”, which means “I will be back soon”;

“мыло” (“soap”) – the word is taken from the Russian language, but in computer jargon, this word means “email”.

We can see that Russian speaking students quite often use abbreviations that are taken from the English language, but there are also quite interesting expressions that are purely Russian. So, having studied the issue of the abbreviations emergence and formation, and analyzing the results of the survey, we have come to the conclusion that the use of abbreviations contributes to the transfer of more information in the minimum time. Information can be transmitted even if the addressee is far away, while thoughts are formulated more accurately and concisely; in addition, the use of symbols helps to convey the emotions of the speaker.

On the other hand, the use of abbreviations in correspondence makes it difficult for people who are not familiar with youth slang to understand them. In addition, the frequent use of all kinds of abbreviations ultimately leads to a decrease in literacy.

Thus, we can conclude that the usage of abbreviations and various word shortenings must be dosed and very careful, otherwise society may be in danger of the appearance of newspeak (a new language), which can be understood only by using the appropriate dictionary, which J. Orwell warned about in his novel "1984".

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УДК 629

IMPROVING FLIGHT SAFETY IN CONDITIONS OF JET STREAMS

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This topic is relevant because now the Russian civil aviation industry is under severe sanctions. Due to the lack of components and various inspections, flight safety is falling. Safety can be improved by understanding the nature of various meteorological phenomena that cause plane crashes. The object of the study is tropospheric JS, the subject of the study is aspects of the influence of jet streams on FS.

When solving the research tasks, it was revealed that clear air turbulence (CAT) has the greatest impact on flight safety in the jet stream. At the same time, at present, the detection and prediction of CAT zones in the atmosphere is a big problem, the solution of which is necessary to ensure the FS of aircraft.

The definition of CAT and JS in the atmosphere is given in the textbook [1]. In accordance with the concept of fusion, the development of high-altitude frontal zones (HAFZ) and JS occurs, for the most part, due to advective convergence of different thermal properties of air masses (AM). The horizontal temperature gradient leads to the formation of a pressure gradient, under the influence of which the air space acquires an additional (thermal) component of velocity. [2]

The JS forecast has big significance in terms of both cost-effectiveness and FS. In the study of jet streams, it was found that the characteristic features of JS are high wind speeds and strong turbulence associated with zones of significant horizontal and vertical wind shifts, mostly on the cyclonic periphery of the jet stream and less often near its axis. [2]

It is necessary to emphasize the fact that areas of severe turbulence pose the maximum threat to the FS of aircraft flying at altitudes close to the ceiling of aircraft. At such altitudes, due to the insignificant range of speeds and angles of attack, during turbulence there are all chances to cross the threshold of their critical values, which is why factors such as loss of speed, altitude and unwanted vibrations are possible. At the same time, in order to increase the flight distance, reduce fuel consumption, and reduce flight time, jet streams can also be used as tailwinds. [3]

CAT zones are observed in the JS with large lateral wind shifts. Over the high-mountain regions, the CAT regions are observed more often than over the plains. This is explained by the fact that the maximum deformation of the air flow can be traced over the leeward side of the mountain systems. [4]

The study of the meteorological conditions of the appearance of the CAT zones showed that these zones are traced mainly in the area of jet streams. Favorable conditions for the formation of CAT zones are: large vertical wind gradients; sharp breaks in the vertical temperature profile in the atmosphere; unsteadiness of the flow, especially an increase in vertical wind gradients over time; large horizontal wind shifts (along and across the flow), the curvature of the JS; large horizontal temperature gradients; reduced static stability. [4]

The system for relaying meteorological data from aircraft was developed and operated by the World Meteorological Organization as an operational system for automated observations of weather from aircraft, as well as for zones of CAT in the atmosphere. Aircraft Meteorological Data Relay (AMDAR) data can provide regular global observations of the atmosphere in the range from the surface to the upper atmosphere. These data are widely used for monitoring and forecasting weather systems and improving numerical weather forecasting models. [5]

Together with the existing United States eddy dissipation rate (USEDR) data in the northern hemisphere, the EDR turbulence indices obtained using derived equivalent vertical gust (DEVG) in the southern hemisphere and tropical regions can be combined into a homogenized global dataset of atmospheric turbulence causing aircraft turbulence. These data are aimed at improving the global

prediction of atmospheric turbulence affecting aircraft FS. In addition, these data contribute to the construction of a global climatology of high-altitude turbulence. [5]

So, JS can pose a danger to flight operations due to the significant turbulence of air currents in them, mostly in the so-called turbulent zones – layers of moderate and severe turbulence.

Currently, several trends in weather forecasting are considered the most important and significant. First of all, the importance of numerical prediction is increasing due to its increasing accuracy and reliability and due to the improvement and improvement of postprocessing methods. This makes it possible to successfully predict weather events for which numerical monitoring was previously not feasible.

In addition, the improvement of ultra-short-term forecasts and sciencasting is based, on the one hand, on numerical forecasting, and on the other hand, on remote observations using radars and satellites. This uses data from dense networks of ground stations, as well as meteorological data transmitted from the aircraft.

Based on the study of a large number of different sources, the following conclusions are made in the work: JS and CAT zones have a significant impact on the safety of aircraft flights. The constantly changing flight profile under their influence can significantly harm the aircraft; it is necessary to continue studying the JS and CAT zones in order to increase the accuracy, reliability and timeliness of determining speeds, directions and levels of their location in order to prevent possible aviation accidents and incidents with the aircraft, reduce the possible flight time and fuel consumed.

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THE USE OF AUTHENTIC MATERIALS IN ENGLISH CLASSES TO DEVELOP LINGUIST STUDENTS' SPEAKING SKILLS

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Communicative competence is a set of knowledge within a particular topic, as well as skills that, in their unity, help students to solve communicative problems. Learners can acquire communicative competence through frequent speaking practice not only in English classes but also in everyday life and in the process of self-education. Speaking is a complex multifaceted process that enables verbal communication along with listening.

The purpose of teaching speaking is to develop students' ability to carry out oral speech communication in a variety of socially determined situations in accordance with their real needs and interests.

The student should be able to:

a) conduct a dialogue in situations of official and informal communication in the domestic, socio-cultural, educational and labor areas, using argumentation, emotional and evaluative means;

b) reason within a given area; understand the problems of read or listened texts; describe events and state facts;

c) create a verbal socio-cultural portrait of your country and the countries of the language being studied.

Interactivity helps to significantly improve the quality of learning and make the process of acquiring knowledge meaningful. That is when authentic materials can be used. Authentic material means not only oral, but also written texts, as well as various cultural objects that are a real product of native speakers. This product is usually not intended for educational purposes and is not adapted to the needs of students in accordance with their immediate level of foreign language proficiency. Authentic material should be understood as all materials created by native speakers that could be used in the learning process focused on the communicative option [4].

The use of authentic materials contributes to the solution of certain learning goals and objectives. We think they can:

a) Develop memory, attention, as well as creative and intellectual abilities of students;

b) Provide an opportunity to combine all types of communicative activities in one lesson: reading, speaking, listening and writing;

c) Help to master the skills of intercultural communication;

d) Promote easier and faster assimilation of new material, due to the high level of students' motivation;

e) Give an incentive for independent work, due to the preliminary joint cognitive work [1].

It should be emphasized that the effective formation of socio-cultural competence becomes impossible without the use of new learning technologies. At the moment, critical thinking technology, collaborative learning, game technologies, students' project activities, developmental learning technology, etc. are being widely implemented [2]. All of them are designed to increase interest in communication in English, expand the subject content of learning process [5].

Working with an authentic text involves a lot of exercises and tasks aimed at developing speaking skills. Let us consider some of them:

a) Characteristics and description of the character

After reading the text, the student's task is to tell how s/he sees this or that character, describe appearance, character, personal qualities, etc. Tasks of this kind develop speech and the ability to generalize what has been read and isolate the necessary information, conveying it in your own words.

b) Formulation of the main idea of the text

After reading the text, the student should briefly convey the main idea of the text and the main points. This exercise trains memory, logical thinking and the ability to express a thought in your own words.

c) Dialogue

The task of students in pairs is to compose a dialogue as the acting characters of the story, based on the facts and events described in the text. Such a task develops the skills of dialogical speech and trains the ability to work in pairs / groups.

e) Retelling

The student's task is to verbally retell the read text. A task of this type develops the ability to tell a story from a third person, trains the skill of selecting necessary, important information and paraphrasing.

The authenticity of the text is revealed in its structure, content, and external design. The authentic materials clearly show lexical compatibility, the inclusion of words in various speech patterns, examples of statements of a dialogical and monological nature [3].

As a conclusion, it can be stated that authentic materials in teaching a foreign language, namely English, have a number of advantages and are one of the most effective and efficient means of

developing the socio-cultural competence of linguist students. Due to the use of authentic materials in the educational process, one gets acquainted with the peculiarities of the mentality of native speakers of a foreign language, their specific features and characteristics, as well as many other important components related to the society and cultural realities of the country, the language of which they study, contributing to the development and improvement of students' speaking skills.

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RELIABILITY PROBLEMS OF POWER SUPPLY TO CONSUMERS

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Annotation: This article discusses the problem of untimely establishment of security zones of electric grid facilities and ways to solve them.

Key words: power supply reliability, security zone.

During the operation of power supply systems, special attention must be pay attention to the reliability of power supply. Reliability of power supply is the ability electrical system to provide connected consumers with uninterrupted power supply of the established quality.

Required level maintenance reliability of power supply has of paramount importance. Power interruptions lead to process disturbances, leading to significant losses and other negative consequences possessions.

The object of research in this article is the problem of reliability electricity supply consumers. Among the main problems power supply to consumers it is possible to select the problem of untimely establishing security zones for power grid facilities. As practice has shown, due to the lack of information in the Federal Service for State Registration, Cadastre and Cartography of information on the security zones of power lines (hereinafter referred to as power lines) and markings containing an indication of the size of the security zone (the security zone is considered established from the date of entry into the state cadastral registration documents information about its boundaries), information about the respective owner organization, the prescribed restrictions are not observed, leading to emergency situations that affect the required level of reliability of power supply to consumers. Until December 19, 2006, the establishment of security zones was not a mandatory requirement, since Article 89 of the Land Code of the Russian Federation provided that "protective zones may be established to ensure the activities of organizations and the operation of energy facilities." Amendments providing for the mandatory establishment of security zones were introduced into this article by the Federal Law of 04.12.2006 No. 204-FZ "On Amendments to

Articles 87 and 89 of the Land Code of the Russian Federation" [1]. It was worded as follows: "to ensure safe and trouble-free operation, safe operation of electric grid facilities and other electric power facilities determined by the legislation of the Russian Federation on electric power industry, security zones are established with special conditions for the use of land plots, regardless of the category of land that includes these land".

In accordance with this article, the procedure for establishing security zones and using the corresponding land plots was to be determined by the Government of the Russian Federation. This procedure was approved by Decree of the Government of the Russian Federation of February 24, 2009 No [2]. 160 "On the procedure for establishing security zones for electric grid facilities and special conditions for the use of land plots located within the boundaries of such zones", which entered into force on March 17, 2009. But, today, not a single by-law of the Russian Federation has established a clear algorithm for entering information about the location of protected zones into the USRN. When establishing the boundaries of the security zone of a power transmission line, there are cases when Rostekhnadzor refuses to issue a Decision on approving the boundaries of the security zone, referring to the fact that the owner of the power transmission line as part of the package of documents must attach an act of commissioning the facility and / or permission to allow the operation of the power plant. However, how can these documents be provided if a description of the location of the protected area is attached to the application for a building permit. That is, according to the Town Planning Code of the Russian Federation, a security zone is established before construction and installation works are carried out, and Rostekhnadozor's departments can issue a decision on approving the location of the security zone only after the facility is put into operation. And also, not all state authorities and local governments are empowered to approve the location of the boundaries of protected zones. For example, the Charter for administration of Kazan does not enshrine the authority of the Administration to approve the location of the boundaries of protected zones. The same situation is observed in many regions of the Russian Federation.

To solve this problem, it is necessary to change the system of relations between the Owners of power lines and public authorities, by amending the Legislative acts that do not contradict each other and regulate a clear procedure for entering information about the location of the security zones of power lines into the USRN.

To solve this problem, it is necessary to change the system of relationships between Owners of power lines and public authorities, by amending the Legislative acts that do not contradict each other and regulate a clear procedure for entering information on the location of power transmission lines protection zones into the USRN.

An analysis of the situation, approaches to solving this problem of power supply reliability confirms the need to consider the relationship between the owners of power grid facilities of consumers and public authorities.

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УДК 811.112.22

DEVELOPING LEXICAL COMPETENCE THROUGH INFORMATION AND COMMUNICATION TECHNOLOGIES AT THE JUNIOR STAGE OF SCHOOLCHILDREN'S LEARNING

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With the rapid development of science, with the emergence of multimedia technologies and their application in teaching, information communication technology is being fully introduced into teaching foreign languages and creates a favorable platform for reform and research in this area. Most schools today are equipped with a computer, projector and loudspeaker system, interactive whiteboards. Compared to equipment that was available a few years ago, this greatly improves the classroom experience by enabling specially designed technologies to be used in the classroom. The article is aimed at a comprehensive study of the effectiveness of information and communication technologies in improving English lexical skills in primary school.

D.N. Luferov identifies two types of information and communication technologies (ICT): technical teaching aids, i.e. equipment, and audiovisual teaching aids, i.e. electronic media. According to this classification, audiovisual teaching aids are divided into:

1) auditory teaching aids - phonograms;
2) visual learning aids - videograms;
3) combined audiovisual teaching aids - video phonograms [3].

The main goals of using ICT in the classroom include: increasing motivation for learning, activation of the cognitive sphere of students, improving the methodology of conducting lessons, planning and systematization of the teacher's work, use of ICT as a means of self-education [2].

The expediency of using ICT in teaching younger schoolchildren is evidenced by such age characteristics as better development of visual-figurative thinking compared to verbal-logical, as well as uneven and insufficient development of analyzers, with the help of which children perceive information for its further processing; if the information is not perceived, then it cannot be understood, assimilated, cannot become the property of the individual, an element of his culture, therefore it is very important to build their training, using as much high-quality illustrative material as possible, involving not only vision, but also use all the natural abilities of information processing, for example, hearing, emotions, imagination.

According to the Federal State Educational Standard, the main goal of teaching a foreign language in primary school is to form the communicative competence of students in the main types of speech activity (speaking, listening, reading, writing) at a level accessible to students [4]. Therefore, the teaching of vocabulary is one of the most important elements in the formation of communicative competence, allowing younger students to learn to express their thoughts, reflect the existing reality.

In the dictionary of methodological terms and concepts, vocabulary is defined as the entire vocabulary of a language or “a set of words of a language” [1]. In turn, the goal of teaching vocabulary is the formation of lexical skills of speech activity (i.e., lexical competence).

Information and communication technologies are undeniably effective in the formation of active and passive vocabulary. The use of video recordings in the presentation of vocabulary allows to combine the visual image of lexical material with its sound form; showing presentations promotes to present the graphic form of the material, as well as visualize its meaning. A high level of visibility contributes to an increase in the level of interest and activity of students.

The computer is an effective tool that organizes and manages the independent work of students, especially in the process of training with language and speech material. In order to form productive

lexical competence in the lesson, computer can be used to train students in actions on a combination of lexical units. For example, an exercise to practice:

What can be the listed items: house, room, sofa, carpet. The other column contains adjectives: big, old, white, beautiful. The student must correctly compose phrases from the given adjectives and nouns, moving them from the corresponding columns to the lines below. At the same time, the number of empty lines tells the student that there are other possible phrases that he has not yet compiled. The student who made up the phrases more than others gets more points. Correct answer: big house, old room, white sofa, beautiful carpet

Furthermore, with the assistance of ICT following activities can be used:

- exercises in the form of crossword puzzles;
- exercises in the form of a sentence-making game, during which the student points the cursor at the required word, which then moves into the sentence being composed and becomes after the last moved word;
- the student is asked to match two lists of foreign words and establish pairs of synonyms or antonyms;
- exercises with a list of foreign words and a list of definitions of these words. The student is required to connect each word with its corresponding definition (picture);
- exercises "Find the mistake", in which it is proposed to correct a particular word in accordance with a given situation.

Our analysis of scientific studies on this topic showed that tests and games programs play an important role in teaching English vocabulary, which allows students to achieve the required level of lexical skills. It should also be noted that in the formation of lexical skills, work should be directed to all components of their structure: form, meaning and use.

It can be concluded that methods of theoretical analysis and capturing learned best practices helped to ascertain that information and communication technologies in teaching can improve the process of teaching English, in particular, in the formation of English-language lexical competence at a younger stage of school.

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WORLD EXPERIENCE IN THE USE OF HYDROGEN FUEL CELLS IN MOTOR TRANSPORT

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Annotation: This paper describes the world experience in the use of hydrogen fuel cells in motor vehicles. Examples of the use of hydrogen fuel cells as power plants for both passenger cars and trucks and buses are given. The advantages of fuel cells are presented.

Keywords: hydrogen, fuel cell, motor transport

Hydrogen is a chemical element that is part of many natural compounds, including water. Hydrogen (H_2) used in vehicles is an odorless gas and is usually formed by extracting hydrogen from water or natural gas. While there may be a lot of hype today, hydrogen technology is nothing new. In fact, hydrogen has been used for a long time to power spacecraft. But we are seeing a renewed interest thanks to a push to decarbonise the transportation industry, lower renewable energy costs and more detailed strategies from governments around the world to further develop the technology.

A hydrogen fuel cell (HFC) is a device designed to convert chemical energy into electricity. It is supposed to be a safe and clean alternative to burning fossil fuels. Hydrogen fuel cell technology is an area of the automotive industry that is becoming increasingly important as more and more manufacturers strive for environmental friendliness. Like electric vehicles, hydrogen fuel cell vehicles are classified as low-emission vehicles because the only type of emissions from a fuel cell is water vapor.

Hydrogen fuel cell technology has a number of advantages over other energy sources, including:

1)Hydrogen is the most abundant element in the universe and, despite the challenges associated with extracting it from water, is a uniquely abundant and renewable energy source, ideally suited to our future zero-carbon needs for combined heat and power supplies [1].

2)Hydrogen fuel cells are more efficient than many other energy sources, including many green energy solutions. This fuel efficiency allows you to produce more energy per pound of fuel. For example, a conventional combustion-based power plant generates electricity with an efficiency of 33-35% compared to 65% for hydrogen fuel cells. The same applies to vehicles where hydrogen fuel cells consume 40-60% of fuel energy, and also offer a 50% reduction in fuel consumption.

3)Hydrogen fuel cells do not generate greenhouse gas emissions as for fossil fuel sources, thereby reducing pollution and improving air quality as a result.

4)The charge time for hydrogen fuel cell power units is extremely rapid, similar to that for conventional internal combustion engine (ICE) vehicles and markedly quicker in comparison to battery-powered electric vehicles. Where electric vehicles require between 30 minutes and several hours to charge, hydrogen fuel cells can be recharged in under five minutes. This fast charging time means that hydrogen powered vehicles provide the same flexibility as conventional cars.

5)Hydrogen fuel cells do not produce noise pollution like other renewable energy sources such as wind energy. This also means that, like electric cars, hydrogen vehicles are much quieter than those using conventional internal combustion engines.

6) Hydrogen fuel cells offer greater efficiencies with regard to usage times. A hydrogen vehicle has the same range as those that use fossil fuels (around 300 miles). This is superior to that currently offered by electric vehicles (EVs), which are increasingly being developed with fuel cell power units as ‘range-extenders’. Hydrogen fuel cells are also not significantly impacted by the outside temperature and do not deteriorate in cold weather, unlike EVs. This advantage is increased further when coupled with the short charging times.

7) Where local conditions allow, the availability of hydrogen through local generation and storage could prove to be an alternative to diesel-based power and heating in remote areas. Not only will this reduce the need to transport fuels but will also improve the lives of those living in distant regions by offering a non-polluting fuel obtain from a readily-available natural resource.

The basic principle of operation of a fuel cell is that hydrogen decomposes under the action of a catalyst into electrons and positively charged hydrogen ions. Then a special membrane comes into action, acting here as an electrolyte in a conventional battery. Due to its chemical composition, it passes protons through itself, but delays electrons. Thus, electrons accumulated at the anode create an excessive negative charge, and hydrogen ions create a positive charge at the cathode. Currently, the development of technologies for the use of fuel cells goes in several directions: the creation of stationary power plants; the use of hydrogen for automobile engines, the use of hydrogen fuel cells in air transport and in water transport.

The first fuel cell, called the Grove Gas Battery, was built by Sir William Robert Grove in Wales in 1843. In 1959, Francis Bacon developed a fuel cell with an output power of 5 kW. But that was in the 1960s, when General Electric took a big step forward in the development of proton-exchange membrane (PEM) fuel cells. NASA was the first to use them, they used fuel cells with Project Gemini and the Apollo Program. After that, auto manufacturers started working with fuel cells in cars. The Chevrolet Electrovan was the first fuel cell road vehicle, it was developed in 1966 by General Motors.

Global manufacturers of diesel power units are actively acquiring companies specializing in the development and manufacture of fuel cells. In the fall of 2019, Cummins acquired a controlling stake in the Canadian Hydrogenics Corporation, a leading developer and manufacturer of hydrogen production technologies based on water electrolysis, as well as the creation of fuel cells based on proton exchange membranes on the North American continent. In addition, Hydrogenics Corporation is a manufacturer of equipment for hydrogen filling stations.

Another example was the coalition of concerns of manufacturers of trucks and special equipment Daimler Truck AG and Volvo Group (Mercedec-Benz, Freightliner, Western Star, Mitsubishi Fuso, Volvo Trucks, Renault Trucks, UD) to concentrate efforts in the field of hydrogen technologies. With a competent approach to the development of this topic, publications about the successes in the development periodically appear and vehicle concepts are presented. For example, one of the latest innovations is a presentation from the Mercedec-Benz brand. At the premiere held on September 16, 2020, Daimler presented another novelty to the world community: the concept of the Mercedec-Benz GenH2 tractor truck [2].

According to the data on the fleet of hydrogen cars in the member countries of IPHE (International Partnership for Hydrogen and Fuel Cells in the Economy), the top three are the USA, Japan and South Korea, at the same time, the largest share of the transport segment is accounted for by passenger cars.

The market of hydrogen fuel cells is steadily developing. There is no rapid demand yet, but it is only a matter of time, due to the high cost of fuel cells due to low production volumes and the cautious attitude of consumers to the safety of hydrogen. Experience shows that economically attractive conditions for operating persons and organizations are leasing programs for deferred purchase, as well as conditions for leasing with the possibility of subsequent redemption. According to the most modest estimates of the portal Resarch-AndMarkets.com, global fuel cell market in March 2020 was estimated at $476 million and promises to soar to $55 billion by 2026.

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IS IT NECESSARY TO COPE THE DRAMATIZATION?

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First, let's understand what dramatization is. Dramatization, in the context of this article, is an exaggeration in the expression of feelings, in the perception of an event. This event may not even have a strong impact on a person’s life, but he still worries about it, winds himself up. People who

over-dramatize even minor annoyances like a rude comment under a photo or an unsuccessful joke in a company can seriously knock them out of a state of peace of mind [1].

Let's analyze the possible causes of dramatization:

1. Low self-esteem. People with low self-esteem are constantly puzzled by what other people think of them, they do not believe in their own strength. Because of this, any event can cause them negative emotions and make them get confused for a long time.

2. An attempt to draw attention to yourself. People who over-dramatize want to get the attention and sympathy of others. They hope that there will always be a person who will pity them and support them. In some cases, such a reaction eventually leads to a manipulative habit. Ultimately, people understand this and do not want to get involved with such manipulators.

3. Character trait. Dramatization is characteristic of hypersensitive people who are such from birth or as a result of life experience [2].

Do we need to deal with drama? In my personal opinion, it's worth it. Such behavior poisons not only the life of the person who overdramatizes, but also the people around him. For our brain, it doesn't matter if a fictional event happened or a real one. In stressful situations, we produce adrenaline - a stress hormone that is produced in our source in response to an acute stressful situation, and as a result of exposure to adverse factors. Constant "chewing" and "outlining" gloomy pictures just applies to such situations. As a result of regular intake of adrenaline in the blood, health problems can occur. No wonder they say: "All problems are from nerves" [3].

However, there are likely to be people who disagree with this point of view. Therefore, for a more detailed disclosure of the topic, we conducted a sociological study in the form of a survey. It consisted of the following questions:

1. Do you tend to over-dramatize? Yes/no.

2. Do you consider dramatization a disadvantage? Yes/no.

133 people took part in the survey.

Slightly less than half of the respondents (49%) tend to dramatization. We admit that some people, due to age and life experience, may not be aware of the tendency to dramatization. 51% of respondents are not prone to dramatization.

We also found that 53% of respondents do not consider dramatization a disadvantage, and 47% believe that it should be combated. Excessive dramatization can indeed negatively affect a person and his environment. To stop over-dramatizing, you need to accept yourself for who you are. You have to allow yourself to be wrong. It is impossible to control everything and everyone in our lives. But it's also not worth shifting responsibility for your failures to others. You need to set yourself up for the positive moments in life and every potential event. You need to be able to see not only the negative sides, but also the positive ones.

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THE ESSENCE, PRINCIPLES AND PROBLEMS OF ENTREPRENEURIAL ACTIVITY

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The formation of entrepreneurial activity is the beginning of the growth of the country's competitiveness at the universal level. Business efficiency is determined by the number and quality of existing organizations and mainly by the approving moments around the environment that provide the most suitable circumstances and resources for conducting any business.

A rather large increase in the number of various laws and decrees that stabilize and control entrepreneurial activity in the Russian Federation indicates that there is a high attention of the state to the dilemmas of entrepreneurship and awareness of the need to change business agreements in order to take advantage of positive changes [1].

Types of entrepreneurial activity (to reveal the concept and essence of entrepreneurial activity, the principles of organization and conduct of entrepreneurial activity, to describe the main types of entrepreneurial activity, factors affecting entrepreneurial activity).

Entrepreneurship is an active and independent economic and business activity, fully focused on making a profit.

Type of activity: production and brokerage activities.

Entrepreneurial activity is aimed at the production and promotion of goods on the market. The main purpose of mediation is the integration of economic interests, producers and consumers.

The current approach to the development of entrepreneurship determines the proper order in the world as a whole. In addition to all this, entrepreneurial activity primarily ensures not only the economic formation of the country, but also plays the role of an intermediary between the state and, directly, society. This point of view has not yet been fully approved by all kinds of business communities, but the history of the development of major global economies testifies to its stable viability. In connection with these data, not only entrepreneurial activity is usually considered, but also various difficulties and certain principles are revealed that are emerging as a result of today's global transformations.

Entrepreneurship is an innovative process, the ultimate goal of which is, first of all, to ensure the continuity of production, coupled with an increase in demand and satisfaction of the constantly changing needs of specific people, that is, social groups and society as a whole. The simplest provisions of the progressive consideration of entrepreneurship were considered by J. Schumpeter. In his opinion, it was believed that the highly functional essence of the merchant is the discovery and application of the newest and freshest composition of production moments – the acquisition and use of innovations.

In the agreements of the established schedule, it is not possible to insist on effective functioning without any fundamental changes, meaning the exclusion of outliving its age of layouts and techniques in order to further introduce new ones. The course of destruction is natural due to the fact that a freshly baked idea embodied in technological processes, that is, equipment, about the agreement of its relevance expels existing analogues. Thus, a course of "creative destruction" occurs, which appears to be the result of commercial efficiency at the meso- and macro-levels [2].

Commercial activity perceives all kinds of articles regardless of the type of activity, the level of law-abiding, the uniqueness of the products performed, that is, services, the number and number of employees, the manufacturability of production, location and prevalence.

The main feature of an entrepreneur is the presence of strong motivation, which is not supported by visible incentives.

High profitability indicators are not the only purpose of creating a business, an important indicator indicating the correctness of the chosen direction is the satisfaction of people's needs. There is a direct correlation between satisfaction of needs and an increase in profits. Continuous improvement of a product capable of satisfying the consumer is a necessity in modern conditions of a market economy.

Thus, the basic principles of entrepreneurship include:

- independent search and analysis of information in order to identify potential development opportunities.
- attraction of tangible and intangible resources of both own and other individuals and legal entities for doing business;
- independent choice of the field of activity, as well as an individual approach to the formulation of the development program and the preparation of strategic plans;
- involvement of employees, partners, suppliers and consumers at their discretion;
- free pricing within the limits established by law;
- distribution of net profit in accordance with their own material and moral and ethical needs;
- conducting foreign economic activity, attracting foreign partners within the framework established by law.

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FAKE NEWS: PROBLEMS AND POSSIBLE SOLUTIONS USING AI

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The Internet has become an integral part of our lives. The World Wide Web is the largest source of data from which any information of interest in any field can be found. The Internet is not without drawbacks, despite the obvious advantages. When we search for the information we need, we may accidentally face disinformation. The subject of fake news has become more relevant recently. Despite government restrictions and prohibitions on the distribution of fakes, traditional methods of identifying the accuracy of information lag far behind modern technology.

Fake news is false or misleading information. It can be both credible facts, including some inaccuracies, and data that are completely wrong. According to The Guardian, Collins' dictionary called the fake news the 2017 word, that usage of the term had increased by 365% since 2016 [1]. With the development of Internet technology anyone can become the author of fake news. Fake news fills the vacuum for people or communities offering instant solutions to various problems. In their discourse, knowledge, science, facts, evidence, and rationality are swept aside as the sophistry of the elite. [2]

The speed of fake news propagation requires automated processes of detecting misleading sources and content. Machine learning algorithms have been developed for this purpose, which are able to determine the validity of information in several stages in a short time. The fake news machine learning algorithm developed by researchers at MIT allows content to be analyzed for false information. First, the algorithm checks the so-called baseline: site domain, the anonymity of the author and the presence of an official source. Source verification requires special attention: there is a certain category of sites and news portals that publish exclusively provocative news. If the website has already published fake news, it is paid more attention. But blacklisting certain publications may

affect the criteria for the truth of content. Credible sources such as The New York Times and The Guardian may publish fake news, and provocative news portals may post truthful / real information. [3]

The MIT researchers determined that the most reliable way to detect fake news was to consider the general linguistic features of the article itself, including mood, complexity and structure. During the testing, machine learning processed about 24 articles - 12 fake, and about 9,000 and 2,000 from The New York Times and The Guardian. The analysis identified language patterns specific to different types of news. The machine learning algorithm also found certain words such as "Follow us on", "Read more", or "TRENDING", which are mostly fake news. There is also a tendency in fake news to hyperbolize words and use emotional communication language. Researchers state that the accuracy of the detector measurement in the randomly selected 4,000 articles is 93.5. This development allows you to analyze the content of the article and draw conclusions based on the analysis of the language.

At the moment, the machine learning algorithm from MIT can be seen as one of the main developments in finding fake news. This can be useful both for owners of sites (including social networks) and news portals, for which the main value is the trust of users, and individual companies that have been subjected to libel and disinformation.

For ordinary users who deliberately want to limit their Internet space from false information, the best solution is to use additional programs, plugins. The Factual is one such extension for a browser that evaluates news articles daily for their informativeness. Items on which the informativeness of the site is assessed:

- The quality of the site. How often the site releases articles with unreliable or unimportant information for a person.
- The author's experience: whether the author has experience in writing well-developed, informative articles on the topic.
- Quality and diversity of sources
- Tone of the article and linguistic features of the article [4].

Based on these site features the plugin displays a percentage of content and reliability of the information given on the site. Despite the fact that the working principle coincides with the idea of researchers from MIT, this program has a number of problems. For example, sites that can be accessed by subscription, articles with less than 250 characters, multimedia links within articles, and the lack of a common base of articles and authors are not currently evaluated.

In addition to plugins, the user can also use special sites that specialize in verifying facts and refuting inaccurate stories and allegations. These include such sites as PolitiFact.com, FactCheck.org, and Snopes.com. Most such sites use a similar fake detection algorithm. But they work only on English-language websites and mainly analyze news that operate only on the territory of the United States.

In recent times, fake news has become a socio-cultural phenomenon affecting all segments of the population and playing an important role in the level of trust and authority of individuals or corporations. Using additional services and sites to check news increases media literacy, but one should not blindly trust everything that is online. While the use of critical thinking and traditional methods is a key and proven way to verify the validity of information, traditional users do not always have access to original sources. However, by perfecting the machine learning algorithm proposed by MIT team, the need to recheck certain data for informativeness and reliability will be eliminated. This in turn reduces the time spent on searching for information and increases the reliability of information consumed on the Internet**.**

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PROJECT ACTIVITIES AT ENGLISH LESSONS

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Today, in educational and psychological shpere the common concept of «technology» has come to us with the development of computer technology; because of it Pedagogy has been looking for ways to achieve excellent results working with a grouping or class, and constantly improving their tools, methods and forms. In teaching, there are always new approaches and attitudes to the organization of training and education [1]. Today, the tendency of teachers to improve the quality of education sounds more and more insistently, the call for the transition to teacch using educational technology allows the implementation of different methods in practice. Therefore, one of modern school design techniques that we use is called project activity. This technique is associated with project actions of teachers and students. The design methodology is highly communicative and based on the cyclical organization of educational process, that is, the learning process is planned in cycles, which are divided into beginning, middle and final parts. It gives us the opportunity to design the result of personal training activities and students at the end of each stage of education. In classes it can occur in a variety of forms summarizing all the work [2]. Experience on the technology project methodology for several years makes it possible to analyze and answer the question: «How does the technology affect learning a foreign language». Naturally, as a teacher of foreign language it’s more interesting how technology affects the results and the quality of students' knowledge. The project method first attracts students with its novelty, different ways of presenting the material, the opportunity to express themselves in different activities, that is, external motivation prevails. But gradually the child gains experience, gets acquainted with the algorithm of project acctivity and is included in his/her own research experience, which is already based on inner motivation.

What is the project? Experts identify the following skills that contribute to a successful mastery of project activities: — intelligence (the ability to work with information from text (highlight the main idea, to search according to in the foreign language texts), to analyze information, make generalizations, conclusions, etc., the ability to work with a variety of reference materials); — Creativity (ability to generate ideas, which require information in different areas, the ability to discover not one, but several ways to solve problems, the ability to predict the consequences of a decision); — Communication (the ability to debate, to listen and hear your interlocutor, to defend his point of view, supported by arguments, the ability to find a compromise with the interlocutor, the ability to concisely express their thoughts) [4]. What is the project? The project — an opportunity for the students to express their own ideas in a convenient form they creatively crafted: making collages, posters, noticcs, research with the subsequent registration, etc. In the process of project work the responsibility for training rests with the leaner himself. The most necessary thing is that the child, not the teacher determines that the project will include, in what form and how it will take place, the presentation [6].

Why do we need a method of projects? To teach students independent, critical thinking. To learn to navigate the information space. Meditate on the basis of information of the facts, the laws

of science, to make informed conclusions. Make their own reasoned decisions. To learn to work in teams performing various social roles [5]. When the project work, which can be presented in oral and written form, should be followed, in our opinion, by the following recommendations:

1. The project work allows students to express their ideas, it is important not too obviously to control and regulate the school, it is desirable to encourage their independence.

2. The design works are mostly open, so there can be a clear plan for their implementation. Some additional materials can be entered in carrying out project tasks.

3. Most of the projects can be carried out by individual students, but the project will be the most creative, if it is done in groups. This is especially important, for example, the selection of images for the collages and other works of this kind. Some projects are carried out on their own at home, some of the design specifications of the lesson are spent on the other lesson in the classroom so it is advisable to keep the elderly magazines, scissors, glue. The third recommendation underlines the importance and effectiveness of educational cooperation [3].

Thus the project method allows the integration of different types of activities, making the learning process more exciting, more interesting, and therefore more effective. Children with different abilities become successful and in demand in project activities. Without compulsion, students repeatedly repeat lexical and grammatical material. Many academic, special and communicative skills are developed during the project period. Already in elementary school children memorise to work with dictionaries, reference booĸs, maĸe reports, thinĸ over the way of presentation, and of course learn to design their worĸ.

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DEVELOPMENT OF FOREIGN LANGUAGE COMMUNICATIVE COMPETENCE OF STUDENTS OF PHILOLOGICAL SPECIALTIES USING ICT

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The formation of foreign language communicative competence of students is due to the rapidly changing political picture of the world. “Geopolitical attitudes and principles that seemed strong a decade ago are now destroyed. The spheres of interest of different countries are becoming global, new blocs and alliances are being created, military conflicts and revolutions are breaking out. Moreover, in conditions when computer networks are becoming the main means of social communication, the latest trends in the development of the Internet require a revision of how a modern person acquires knowledge

in new socio-economic conditions [1]. And in these conditions, training in the technique of intellectual labor becomes important. There is an understanding that creativity should permeate the entire life of a person and, of course, the entire education system [3].

Every year there are more and more studies devoted to the study of the effectiveness of the use of modern information and communication technologies (ICT) in teaching foreign languages in various forms of organization of the educational process. It becomes more and more obvious that the use of modern ICT in the educational activities of students also contributes to a more effective formation of foreign language communicative competence of students. The Network also meets the basic requirements of didactics for technical teaching aids, which is substantiated by many modern studies. Therefore, there is a need to unlock its potential in education.

Communicative competence is an integrative concept [2], which includes both skills and abilities to perform actions with language material, as well as regional and linguo-cultural knowledge, skills and abilities that indicate learning to communicate, i.e. receiving and transmitting information using different types of speech activity.

One of the new technologies for the formation and development of foreign language communicative competence through the use of materials from the World Wide Web is a web quest. "A web quest (webquest) is a certain form of presenting material by setting tasks, and students receive solutions to the tasks or answers to questions from different Internet sites. Referring to the problem of typology of web quests and their characteristics, notes that web quests can cover a separate problem, academic subject, topic, and can be interdisciplinary. The same methods are applied to the web-quest as in the development of any project, i.e. setting deadlines, choosing a task, analyzing work done, evaluating, etc. The key points here are the following: the list of links to resources needed to complete the task, the teacher selects in advance. These resources should contain links to websites, thematic forums, electronic libraries, etc. Thanks to this, students will not waste time surfing the Internet. Some (but not all) resources may be copied onto a pre-made webquest (a specially organized web page) to make it easier for students to download materials.

The results of the web quest, depending on the material being studied, can be presented in the form of an oral presentation, essay, etc. The result of this work can be your own multimedia web pages and websites on a given topic, compiled from materials obtained during the work (texts, photos, graphics, video clips, sound materials).

Consider a web quest developed for bachelor students studying in the direction of "Translation and Translation Studies", profile "Foreign Language" (English) on the topic "Youth VS Older Generation".

Introduction. Adults in America are skeptical of youth. At the same time, most find them cute, but criticize for their lifestyle. They believe that young people drink too much alcohol, are lazy, spend a lot of time on social networks and are disrespectful to other people. Other negative traits include violence, illegal drugs, and vandalism. It is suggested to watch a video on this topic.

Problem task. Hikikomori, viola, e-boy, f-boy and so on - youth culture is always brash, flamboyant and full of myths. For decades, the idea of youth has been created. Youth culture is not only at the center of public attention, but is also a favorite topic for criticism. But is today's youth really as bad as they think?

Youth YouTube channel Ok Boomer would like to host a talk show called The Lost Generation? about the life of young people in the United States, to demonstrate to adults the phenomenon of youth culture. The editorial chief instructed you to prepare an interesting report about the life of young people. At the same time, the following issues should be covered: fashion, music, sports, youth language and youth organizations.

The report must be unexpected, fascinating, bewitching and convincing in order to be chosen by the channel.

Instructions for completing each step:

Stage I. Read each of the tasks carefully and discuss which of you will do which task. Follow the instructions for each task:

Role 1: researcher. The first researcher is looking for general information on the topic, and also determines the advantages and disadvantages of the scene that the plot shown in the video demonstrates.

Role 2: researcher. The second researcher must first of all find examples that could interest the audience: he researches Internet forums, selects illustrative material, videos for reporting.

Role 3: journalist. The journalist develops the general idea of the report, formulates the title, collects relevant ideas, opinions, facts, and advice for the audience. The time to complete the first stage is 45 minutes.

Stage II. Together, discuss the results of your work and make a report. Check whether the report meets all the requirements, based on the evaluation criteria. The execution time of the second stage is 45 minutes.

To complete the web quest, students are offered the following Internet links:

1. General information about youth cultures: https://www.unicef.org/cuba/en/publications/who-are-the-youth-today-generation-unlimited https://www.bbc.com/future/article /20220124-why-teens-arent-what-they-used-to-be https://www.vervemagazine.co.nz/the-subcultures-of-today/

2. Scenes from the life of youth:

http://www.bpb.de/gesellschaft/kultur/jugendkulturen-in-deutschland/ http://www.passion1.de/

3. Youth language: https://www.urbandictionary.com/

https://www.oprahdaily.com/entertainment/g23603568/slang-words-meaning/

4. More information: http://www.focus.de/

The criteria for evaluating the Web Quest are: the content and structure of the report, graphic design, lexical and grammatical correctness, emotional impact on the viewer.

In conclusion, the scheme of work with a web quest can be represented as follows: acquaintance with the topic, problem formulation, tasks, task completion (search activity), presentation of the results of activities (selection of significant information and its presentation), discussion of the results of work on web quests, summing up, reflection. This form of work is aimed at developing not only types of speech activity (reading, writing, listening, speaking), but also at developing communicative and speech skills (search for information, a summary of what has been read, the ability to draw conclusions, express and argue one's point of view).

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УДК 378

METHODS OF DEVELOPING STUDENTS' CRITICAL THINKING

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İn the era of the latest information technologies, values, meanings and education purposes are changing. Nowadays one of the most important pedagogical problem is activation of different types of thinking in the learning process. This will help students to manage changes, to become successful, competitive and complete personality. Effective pedagogical methods can help to develop students' critical thinking. Using the saved-up intellectual potential, a student is able to realize himself in the professional sphere more successfully. That is why it is necessary to realize possibilities of the teaching methods which are actively influencing on development of critical thinking in the modern society.

Critical thinking is characterized by abilities to give assessment to the offered information, facts or events, to identify true and false, analyze arguments, reason the choice and take responsibility for it. These abilities are especially important in the era of modern globalization when reflection of any information is necessary not only for successful career but destiny. Development of students' critical thinking allows to increase the level of their success in their professional sphere and self-development of the personality.

It is possible to train an individual to use the skills of system and critical thinking. The algorithm of thinking skills development is universal: it includes problem statement, collecting necessary information with its subsequent thorough analysis followed by choosing the right solution. Development of university students thinking goes through several stages: 1. Actualization - challenge (formation of motivation to obtain new skills and information); 2. Comprehension (understanding and realization of the information obtained); 3. Reflection (analysis and introspection). Teaching methods that develop students' thinking skills are most effectively used in accordance with individual stages of development. Many techniques and methods should be alternated, when applying them at any stage of training.

To study of the declared problem, theoretical and empirical methods of the research were used. In general, research methods in pedagogics differ from other sciences, because "material" of research is a personality in the process of teaching. In the meantime, it is difficult to compare and assess thinking features of the personality. Validity, value, representativeness and objectivity of techniques should be taken into account. In order to understand efficiency of pedagogical interaction with students such methods as poll, conversations, questioning and fulfilling creative tasks were used. Questioning, interview and analysis of professional situations are used to reveal the features of critical thinking development. A series of test tasks was developed. The level of thinking style development was estimated on a 10-point scale. The results were processed by methods of mathematical statistics and break-even chart. Authors applied system approach to the solution of the stated problem (system and target, system and functional), realizing the axiological, synergetic, humanistic principles. The leading method of the research was the method of questioning, poll, expert estimation.

The high information intelligence of students is not always followed by the high level of critical thinking development. In order to evaluate formation of students' critical thinking, the following characteristics were taken as a basis: level of generalizations, reflexivity degree, automation measure and so forth. The authors took into consideration motivation on thinking development, level of knowledge about thinking methodology. To reveal the abilities of system analysis same students were offered to answer 21 questions. Answers demanded special knowledge and skills in their professional area. The questionnaire began with solving everyday situation, demanding system thinking skills. Solving the situation was the most successful: (63%) found the correct way out, but only one student (0, 8%) proved his answer. Having not enough skills of system analysis, students solved the tasks spontaneously. 39% of respondents did not cope with the task. While analyzing professional situations, students used incomplete, inconsistent knowledge and skills.

In order to explore the level of system analysis usage, a special questionnaire was developed, it includes the claims approving the system approach and it's reducing role. The essential difference in motivation of students' system analysis usage was not revealed; the highest motivation is shown in comprehension and usage in practice the relationships of cause and effect. All students are highly motivated to the development of new techniques, methods, thinking styles

Nowadays the society has changed the goals and objectives of education. It is not only the knowledge accumulation but also creation of the personal development and realization of intellectual potential.

The main pedagogical principles that help to develop the heuristic, critical and reflective function of students' thinking are the principles of consistency, competitiveness. A lecturer developing thinking skills needs to work at his own development constantly. He must be ready to change, to develop his ideas and concepts.

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УДК 31

QUALITY OF LIFE AT THE PRESENT STAGE OF SOCIETY DEVELOPMENT

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The problems of the level and quality of life are among the most urgent. The reason is the economic crisis of 2008-2010. Against this background, the society experienced a deep drop in the quality of life of the main population of Russia.

The welfare of our state directly depends on social policy, which depends on whether there is enough information and how accurately it points to the problems of modern Russia.

- The main problems of modern Russia are:
- Demographics
- Citizens' health
- Quality of life of the population
- Poverty and unemployment
- Education system

The demographic problem is one of the most difficult and entails many others. It affects the population, health, a decrease in fertility and an increase in mortality. [1]

The population as of January 1, 2022 was 145,478,097 people. For comparison, in 2021, the number of residents decreased by almost 693,000 people. But the natural decrease in the population in 2021 was 1,042,675 people. [2]

One of the urgent problems of modern demography remains low life expectancy, especially for men. The aging of the population leads to an increase in the burden on the working population. In the future, due to the low birth rate, this will only increase. All these changes lead to a slowdown in the socio-economic development of Russia. The way out of this situation is to increase the birth rate.

Consequently, a program was developed that provided the child with the money (maternity capital) required for further development. The program dates back to January 1, 2007 and is valid to this day. In addition, there are several other programs to support young and large families.

Demography is also closely related to the health of the nation. Increased mortality among the able-bodied population is the reason for a decrease in the quality of life. The health of a nation is determined by the level and structure of morbidity. Statistics show that most people die from

diseases of the cardiovascular system, cancer, respiratory and digestive diseases. All this is connected with the quality of nutrition and the development of medicine.

Also an important factor is the level of income and unemployment. In the current conditions of high inflation, unemployment and economic crisis, the incomes of the population are falling. Last year, household spending exceeded income, which had a very detrimental effect on the economy. Many of them want to get a high-quality education, good medical care, and a full rest. Hence unemployment and impoverishment of the population, everything is directly related to demography. This may also include raising the retirement age and small pensions. [2]

Today, the current education system is going through difficult times. The education system created in Soviet times has almost been destroyed, it has been replaced by the European one. In this regard, there are problems facing the current education system:

- Crisis of the old education system
- Excessive theoretical orientation in education
- Insufficient funding
- Corruption

The modern education system is one of the leading indicators of the socio-economic development of the state, which is why it is necessary to pay attention to solving the problems facing it. [3]

The quality of life of the population is influenced by the state policy of economic processes. At the present stage, the state is taking various measures to improve the level and quality of life of the population, which already gives certain results in the form of improving the welfare of the population and reducing poverty.

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УДК 304

SOCIAL LONELINESS ON THE EXAMPLE OF SOUTH KOREA

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Abstract. In the article we have tried to give consideration to phenomenon of social loneliness with the example from South Korea, forthcoming in comparison new form of family. Based on statistical data from Korean analysts. According to the data, we conclude that this phenomenon is widespread among the young and old generation. This problem is becoming socially significant both in individual countries and in the world.

Keywords: Social lonliness, living alone, social problem, society of South Korea.

Nowadays, we can see the tendency of living alone for futher individualization. "Loneliness" in modern life is almost as common term as "globalization" and "the Internet" or "politicalcorrectness". It is paradoxical in itself that, despite on the rapid pace of development of all communication networks without exception (telephony, mobile communications, media, Internet, etc.), as well as the constant increase in the density of urban population, more people feel lonely because of need for contact with other people.

On the other hand, transition from old type of family to new one being ministerial to separation and solitude of family members. Aptitude to this trajectory is manifested by

globalization, worldwide informatization and so on. Social loneliness is one of the most relevant problems in the social, spiritual and cultural life of society. Social loneliness has always been perceived differently .In any case, loneliness is always an opposition community. These are two diametrically opposed ways of human existence: either he is in society, or alone.

With all the variety of concepts describing loneliness, two trends can be clearly traced in them. There are two points of view on the causes of loneliness. One of them says that loneliness is a subjective experience person, which does not always coincide with the real situation, his position in society. The other, on the contrary, argues that a person is not to blame for his loneliness (this is not his subjective sensation), but the environment, society makes him lonely; loneliness for them is the fruit of special social conditions that force the individual to withdraw into himself, suppress his sincerity and be isolated from others. For example I choose South Korea.

South Korea is bright representative of traditions from Northern-South Asia may help us to see this tendency of people living alone.

It is nonsense for this country because of Korea taking place as canons of Confucianism. According to the Confucian morality in society, there are five main types of relationships: boss - subordinate, sovereign - subjects, father - son, husband - wife, elder brother -little brother is finally just friends. In accordance with these types of relationships, a hierarchy of relationships between members of society was built. Current roles have been established to everyone, from a king to a single man. The father was supposed to take care of the moral and ethical raising sons and daughters, and they, in turn, had to observe principle of filial piety. It is reflected in folk literature. Legend of virtuous daughter Sichuan who sacrificed her life to save my father. All this is reflected in a person's life and preserves the principles of Confucian morality.

Despite the influence of Confucianism on the life of the modern Korean, the trend towards secession or seclusion increases every year. Description of loneliness or a lonely living person, several terms have been risen, such as singleripes, honripes, hansom, single jock and consumer goods also appeared, designed for one person, mini-refrigerators, mini-ovens, etc.

Three characteristic features of the modern one-person family have been noted, the first is that the number of people has increased, living alone for over 10 years. If in 2018 the number of such people accounted for 34.5% of the total number of such families, then in 2019 it has already reached 38%. On plans for family life among respondents aged 20 there was a relatively small percentage of those wishing to get married or get married (for men 8.2%, for women 4.2%). With age, the reluctance of single people (30–50 years old) to start a family life only intensifies, for example, among about 52.7% of women prefer to continue living alone.

The second characteristic feature is about anxiety factor. Among women and men this factor is different. Women were concerned about economical accuracy life. Men were concerned about feeling lonely. The research had been made among people from 20 to 50 years old. Advantages of living lonely life depend on different aspects of the decision making : use of free time for oneself (73.4%), full immersion in work or study (14.7%), no burden of family obligations (13.8%), economic freedom (8.2%), less housework (6.6%).

The third characteristic is about impossibility of saving money after firing from work. The Kookmin Bank Research Center notes that the average retirement age for single-person households for men is this age.

It is necessary to note the peculiarity of the pension system in Korea, each citizen of retirement age has the right to receive a certain amount from the state within the range of $ 200–300 per month, the rest he must receive means of subsistence from his savings, done during work or rely on the help of adult children. Lonely people can rely on their selves. What is negative because of minimal financial assistance from the state.

All in all, solitary lifestyle in South Korea is largely associated with the desire to have freedom, time for oneself, nevertheless, such a lifestyle has some shortcomings such as an unstable economic situation, lack of care in case of illness and others.

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УДК 046

MODERN PROBLEMS OF DISTANCE EDUCATION IN A TECHNICAL UNIVERSITY

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Today, due to the situation at the global level, the relevance of the development of distance education is one of the most important. Every day the situation in our country is changing due to external factors, and our Government must solve this problem immediately, which happened after the pandemic appeared.

However, the problem how well can we study "offline" arises and how would it be better for students to study the material by comparing the two formats of education?

If we compare the work of the field of education in the distance format at the initial stage and nowadays, we can draw attention to a number of significant changes in many areas. Giving an example, many universities were forced to create special websites through which a student could receive information without difficulties, as well as complete assignments on time. This causes many difficulties, because most of the time the work is done by the computer. However, there are big disadvantages: a person spends all day in front of a computer or laptop screen, studying complex material that is difficult to perceive without reading. We should not only read, but also take into account the fact that a large amount of homework is issued, which also need to be sent on time.

One can note the fact that sometimes the system of educational programs is too crowded and students cannot send prepared material due to the workload of the platform. Touching upon the scope of the teacher's work, it can be noted that the distance learning format causes a lot of inconvenience, taking into account the human factor. By submitting the material, one must get a response from the student and evaluate the work, again spending a lot of time on it.

Nowadays the problem of workload with the above examples is almost solved, because the improved model of "offline" work has reached a new level. Many teachers have created certain "Block Lectures" that are easy to take notes, and have also updated the student assessment system in the "questionnaire-test" format. Are these methods practical? The answer is very simple. The computer displays the assessment system on the screen and the student immediately receives his score at the time of delivery, and teachers are engaged in entering the received assessment into the score-rating system. This facilitates the work of both parties, as well as brings into constant operation the training websites and special online platforms.

In conclusion, based on the above arguments, we can say that through work and the development of distance education, a person can continue his education, regardless of external factors that affect the change of the training format. In addition to receiving full-time education, we can use additional information by using sites designed for self-study.

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УДК 168

THE IMPACT OF HOSTEL LIFE ON THE PERSONALITY OF THE STUDENTS

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When students enter universities, they have to live in hostels or dormitories. A term “dormitory” is originated from Latin, but in many countries this word has been shortened to “dorm”. Now many educational institutions no longer use the old word "dormitory" and prefer using the term “residence hall”. But In some countries the word “hostel” is specifically used for the accommodation of students.

Our university offers two types of dormitories such as corridor-type and block-type ones. Some university’s dormitories are historical buildings. They were built in the Soviet Union and students had to share a kitchen, a laundry room and a toilet on the floor.

Dormitories for students become a new living environment, quite unlike a comfortable apartment in their hometown. How does the change of environment affect the student?

My researches have been conducted to highlight the impact of hostel life on the personality of the students.

The aims of the research are:

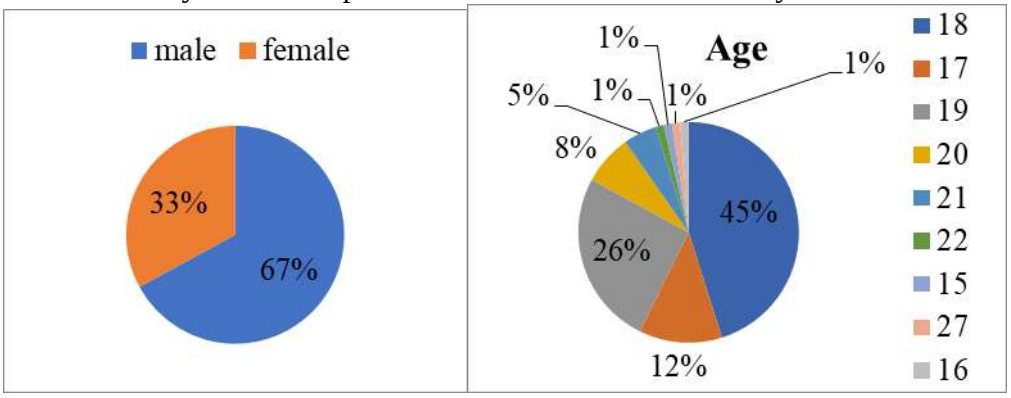
1. To explore the perception of students about hostel life.
2. To study the psychological and behavioral impacts of hostel life.
3. To study the influence of the hostel life on academic performance of student.
4. To make suitable recommendation for the improvement of hostile facilities in Kazan National Research technical University.

Methodology:

To study the impact of hostel life on the personality of the students I carried out a small online interview in the format of a survey with answer options. Then I have analyzed and found patterns in groups that answered the same option to a particular question.

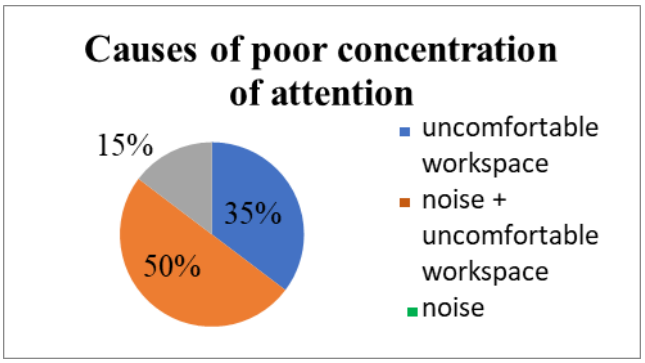
Participants:

I conducted a survey of the subjective assessment of the impact of changes in the living environment on students among the residents of dormitories N1, 3, 5.of Kazan National Research technical University. 82 responses were received. One third of them are girls, the rest are boys. Most of the 17-19 year olds respondents were the first or second year students.

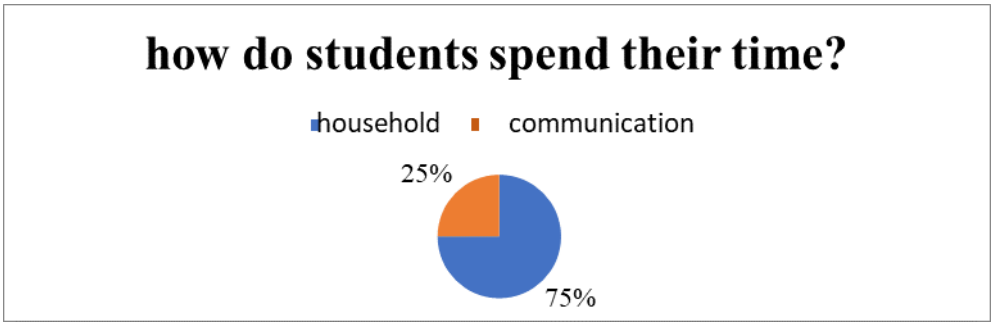


Discussion:

Now let's look at the main issues. The main reason for coming to another city of university's student is education, so it was important to assess the impact of the dormitory on academic performance. So, it became more difficult for half of the students to concentrate while doing homework. Of these, 50% note the impact of noise and workplace inconveniences.



Among the students who noted the absence of a problem with concentration, half of the respondents (44%) began to pay attention to homework less, while the other ones changed nothing. Of course, almost all students with deterioration in attention have also reduced the spending of hours on performing the homework due to everyday increased issues. A few ones complained about the small amount of homework, public work (cleaning days, shifts). It is interesting to note that 15% of students have increased their hours for doing homework, most of them haven't had a problem with concentration or have noticed an improvement in the academic performance.

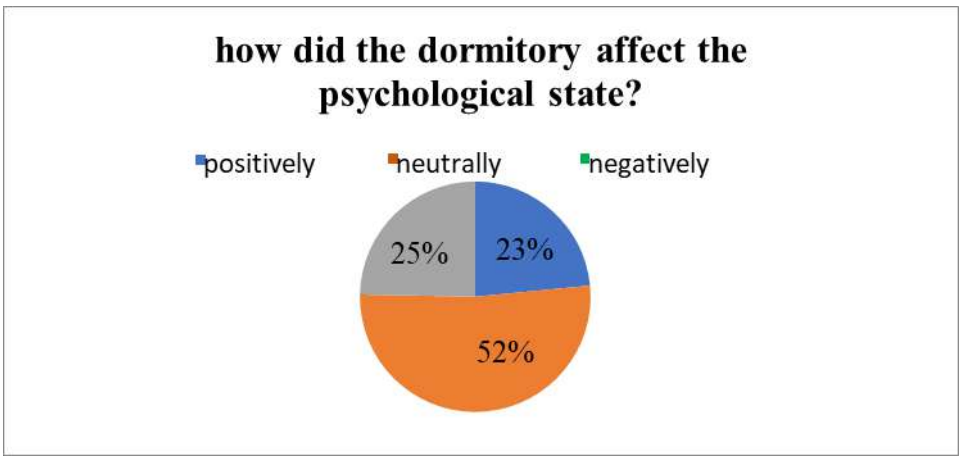


In our university, each institute has its own dormitory and therefore students living there often study the same subjects. Students have the opportunity asking for help a neighbor. According to the survey 77% students doing homework are helped by their neighbors. So the majority of students (73%) believe that their academic performance has not changed after moving, and some of them have noticed an increase in concentration of attention. Almost half of the respondents had problems with concentration or began to spend less time for homework. Among them 13% who noted a drop in academic performance and reducing the number of hours when doing homework.

Sleeping is one of the main components of student life and it greatly affects their performance. So I asked to evaluate the change in sleep after removal. 60% of students have decreased sleep time and 7% of students have increased.

The next question was about changing the student's diet, because the student's menu is not controlled by the parent in the dorm. The results of the survey were mixed. In the dorm some students began to eat worse, some better.

Sanitary conditions, cleanliness of common areas also affect the students' mood. Thus, I asked to evaluate the conditions on a five - point scale and the average assessment was 3.21. Of those who rated higher or equal to 4, only 5% indicated a negative impact of the hostel on their psychological state. Half of the students who indicated a score below 4 have deterioration in their psychological state.



Conclusion:

1. Despite wasting time on everyday issues, as well as problems with attention, many students were able to save their academic performance. Now the student puts more effort, and also devotes less time to sleep.

2. Many people complain about noise and inconvenient workplaces while doing homework – this means the need to notify students about special classrooms in dormitories, as well as to improve them.

3. In general, the hostel did not exert much pressure on most students. It indicates a student good ability to adapt.

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УДК 372.881

THE USAGE OF DIGITAL TECHNOLOGIES IN LEARNING ENGLISH

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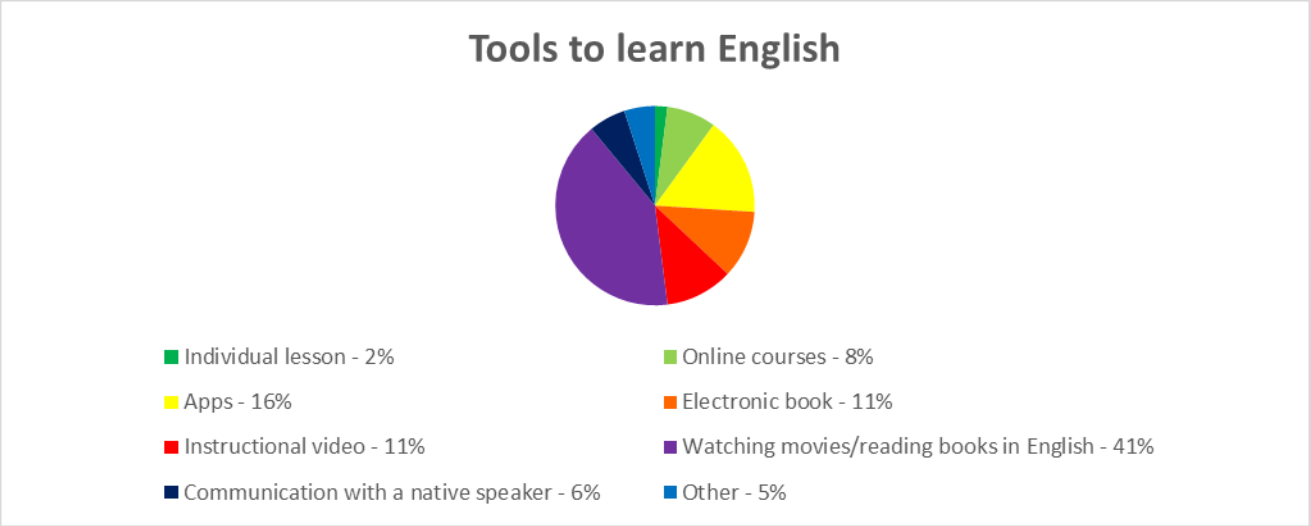
The purpose of this work is to analyze the use of Internet spaces, educational platforms and Internet resources by students of the technical university when learning English.

Digital technologies are electronic tools, systems, devices and resources that generate, store or process data. Digital technologies include: multimedia lessons, electronic textbooks, digital applications, educational videos, simulation models and computer simulators, consultations and tests using telecommunications, etc [1].

On the basis of the Department of Foreign Languages, Russian and Russian as a Foreign KNRTU-KAI named after. A. N. Tupolev, we conducted a sociological survey of 2nd year students. 74 people took part in the survey. Students were asked to talk about the ways of learning English that they use. The survey results can be seen in Chart 1.

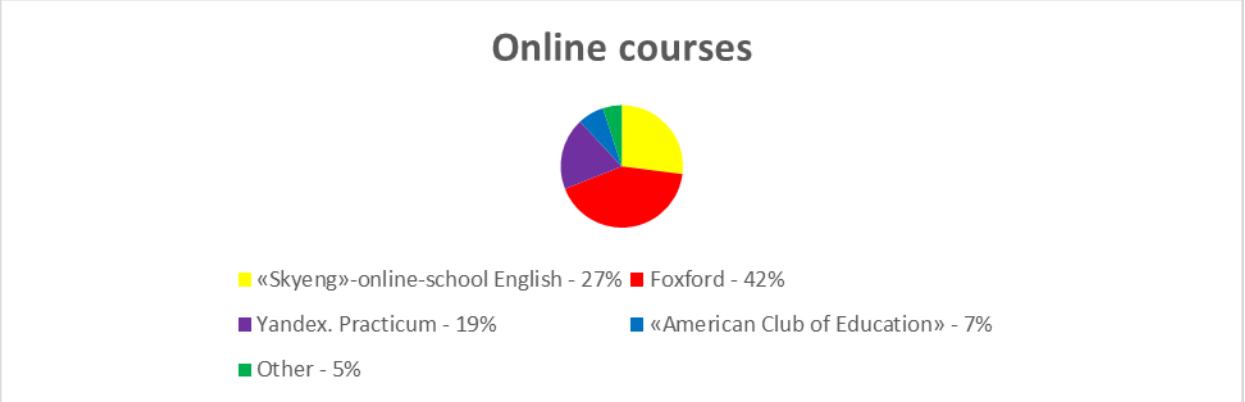
Chart 1



It shows that the majority of respondents use digital technologies for learning English, such as applications (16%), instructional videos (11%), electronic textbooks (11%), and so on. The most popular language learning options are watching movies or reading books in English (41%), as well as apps (16%), as it is easy and convenient to use.

Diagrams 2-6 show which digital technologies are used by the students surveyed to learn English.

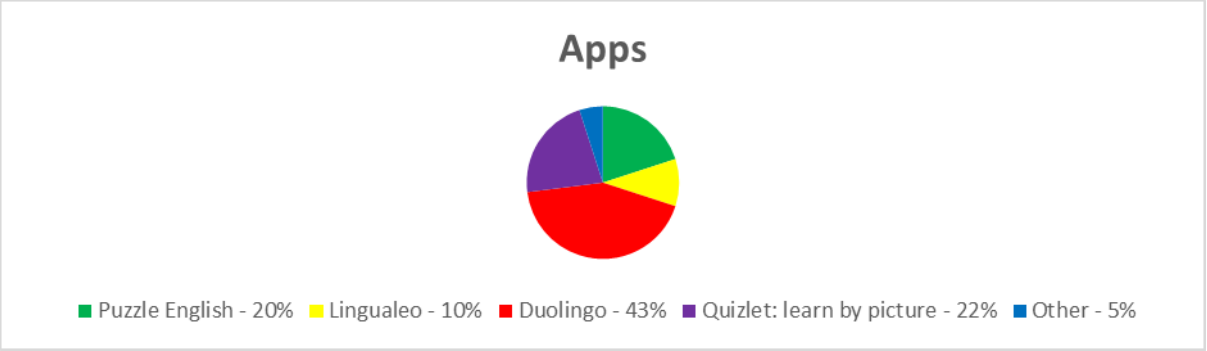
Chart 2



Based on the data in Chart 2, we can conclude that the majority of respondents use online courses – Foxford (42%). Second most popular application is “Skyeng” (27%), and the third place is “Yandex. Practicum” (“Яндекс Практикум”) (19%).

Concerning applications, Chart 3 shows that students mostly use Duolingo (43%), which helps them learn new words as well as improve their pronunciation. “Quizlet” and “Puzzle English” are also very popular (22% and 20% correspondently).

Chart 3

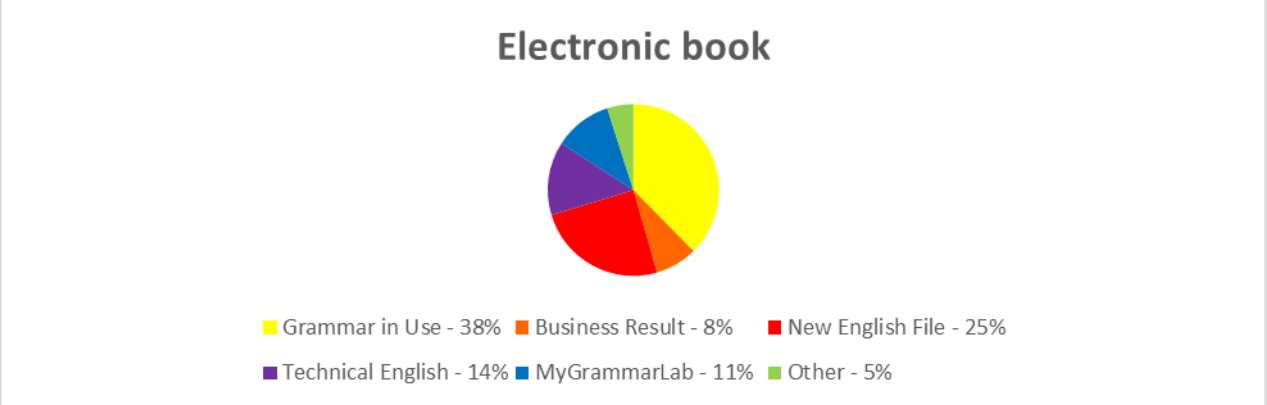


According to the information from the 4th chart, it is clear that a large number of respondents (28%) use the training channel on Youtube, namely “English language by playlists”, in order to improve their knowledge in a particular topic [2].

Chart 4

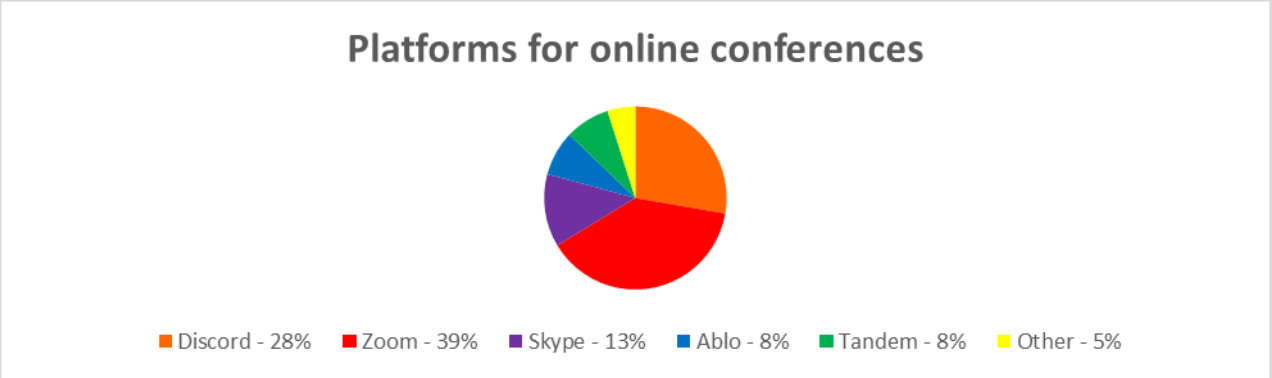
Based on the data in Chart 5, we can conclude that the most popular textbook among students is Grammar in Use.

Chart 5



From the information in Chart 6, we can conclude that Zoom is the most exploited online conferencing platform because it is easy to use for remote communication.

Chart 6



Thus, we can conclude that digital technologies have a huge potential, which is currently not fully realized. They make learning English easier, thanks to which the popularity of this language is growing every day. Now they use various resources: electronic textbooks, applications on a smartphone, watch different training videos on different platforms, and also watch films in English, and the like.

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СЕКЦИЯ 2

ИННОВАЦИИ В НАУКЕ
И СОВРЕМЕННОЕ ОБЩЕСТВО

УДК: 533.65.013.622

PRINCIPLE OF CREATION AND CONSTRUCTION OF A MODEL OF AN UNMANNED AERIAL VEHICLE

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An unmanned aerial vehicle (UAV) is an aircraft without a crew on board. They may differ in the degree of autonomy (from remotely controlled to fully automatic) and other parameters.

Over the past ten years, UAVs have had an extensive field of application, both in the military and civil spheres. But the first drones began to be developed for the military in the 30s of the last century, as target aircraft.

After the study of the theoretical material [1] we can state that UAVs have a great number of advantages in comparison with manned aircraft:

- light weight;
- lower fuel and maintenance costs;
- no need for life support systems for the pilot, since he controls from the ground;
- no need for a runway.

This research work presents a homemade UAV design and construction with the use of composite materials. The problem was solved in a methodical way which was carefully and logically planned.

During the study of the problem and preparation activity before the start of the design of the UAV itself, the following requirements were taken into account and put forward:

- The designed UAV must have remote control.
- The designed UAV must have less weight and sufficient strength.
- The designed UAV must have a camera on board.

Before we started designing the UAV, the desired dimensions of the aircraft and its layout were thoroughly calculated. The aircraft was designed according to a normal aerodynamic scheme, with a high wing arrangement and with an electric power plant:

- aircraft length: 740mm
- wingspan: 1800mm
- the wings and fuselage made of composite materials.

The design began with a general sketch of the project, then with the help of computer modeling with a special program (namely, Compass 3D), separated elements of the airframe were designed.

Next, all individual parts were assembled as one unit – a ready-made 3D model of the object.

Next, according to the plan, the selection of material was undertaken. Since composite materials should be used in this airframe, fiberglass was chosen to be the main material for two reasons:

- fiberglass is cheaper than carbon fiber;
- carbon fiber shields radio signals.

But some parts of the airframe had to be made of carbon fiber, for example, the tail boom, since carbon fiber has less weight with equal strength.

The construction of the model began with the manufacture of a foam matrix, which could fully match the size of the designed UAV. Next, fiberglass was impregnated with polyester resin, that was applied between layers. After this "composite" had to dry. Then, there was the step of assembly of the glider's electrical equipment (steering and engine control). The final step of the construction of the model was giving a beautiful appearance to the object (covering the aircraft with paint).

Then flight tests of the UAV were carried out, during which various shortcomings were eliminated and the controls were adjusted.

After all, the drone was considered suitable for flight and meeting the previously stated requirements.

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УДК 621.317+611.127

THE MAIN APPLICATIONS OF 3D MODELING

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A 3D model is an object representing a physical body or its software consisting of sets of points in a three–dimensional XYZ space connected by various geometric objects.

3D modeling is the process of creating a 3D model in 3-dimensional space. Such models can be created manually or automatically using various software tools.

Let us consider some modern software for creating and editing 3D models.

A good example of a program for creating and editing 3D models are programs such as Blender, 3DS max, Cinema 4D. These programs are popular with Internet users, supported by developers and various platforms, as well as by users themselves.

You can perform various manipulations with 3D scenes and models in such programs. They are used to create various animation projects, games, animations. It is easier to set materials to objects, as well as to give models various physical characteristics (for example, mass or speed).

Such programs can be used to create models for 3D printing, but for complex mechanical parts it is better to use specialized software such as Autodesk Fusion 360 or Compass 3D, since their database have many possibilities to create threads, gears, etc. You can also set more accurate dimensions of models and their parts in such programs.

Now, it seems to us essential to examine the application of 3D modeling in various fields.

3D modeling is used in various fields of science, technology and art, which in one way or another affect every day spheres of life. Almost any object in the house can be presented in 3D format or in a drawing.

3D modeling is used to represent various engine mechanisms: for the presentation and creation of spacecraft bodies, machines, PC housings, the housings of its individual components and, in general, everything that can be somehow represented in a 3-dimensional form.

3D modeling is also used by concept artists to create various cartoon scenes, create any characters, animate them, as well as transfer real or transferring different types of materials to certain objects.

Most modern computer games are based on 3D graphics. It is used to create environments, maps, character models, and animations.

3D modeling is directly related to 3D printing. 3D printing technology is relevant due to its ease of use and saving time spent on the production of products. An example of a 3D printer is shown at

Fig. 1.

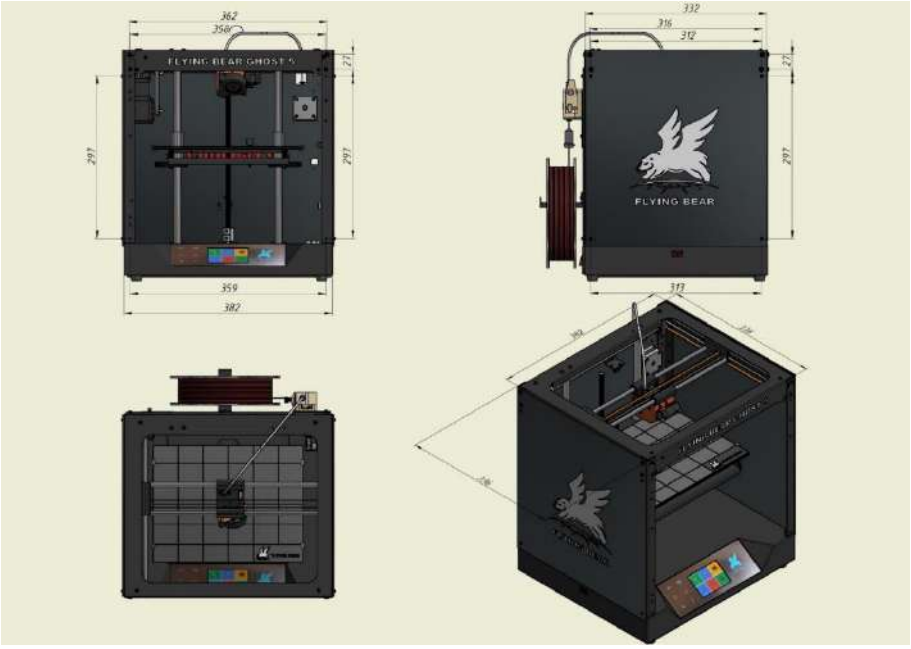

Fig. 1. 3D printer.

3D printing is used in the following areas:

1. Construction. The FDM type of printing, adapted to various construction solutions (this is when the printed material is layered on top of each other, creating a 3D model), has long been used for the construction of various kinds of structures, is a very efficient and cheap construction method.

2. Electronics. 3D printing in this field is used to manufacture very precise and time-consuming components. For example, 3D printing is used to create graphene batteries.

3. Automotive industry. The creation and testing of car models.

4. Aerospace activities. 3D printing is used to create various components of rockets, satellites and computer equipment.

5. Medicine. The possibilities of creating human organs from bioplastics, a material that can still replace some tissues in the human body, are being actively studied.

6. Advertising. 3D printing is used to print advertising and presentation models to attract investors.

7. Food industry. With the help of 3D printing you can create various very precise confectionery, sweety-jewels and etc.

It can be concluded that 3D modeling technology is demanded in modern realities and it is constantly developed. It is used in various spheres of life to simplify and reduce the cost of the production process.

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УДК 621

LASER AND ITS APPLICATION

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A laser is a device that emits a beam of coherent light as a result of an optical discomfort process. There are many types of lasers, including gas, imported, solid state, diode, excimer and dye lasers. All of these types of lasers use the same basic set of components.

Laser beam characteristics

Laser light generally differs from other light in being focused in a narrow beam, limited to a narrow range of wavelengths (often called "monochromatic"), and consisting of waves that are in phase with each other.

The output wavelength depends on the laser material, the process of stimulated emission, and the optics of the laser resonator. For each transition between energy levels, a material can support stimulated emission over a limited range of wavelengths; the extent of that range varies with the nature of the material and the transition. The probability of stimulated emission varies with wavelength, and the process concentrates emission at wavelengths where that probability is the highest.

Types of lasers

Crystals, glasses, semiconductors, gases, liquids, beams of high-energy electrons, and even gelatin doped with suitable materials can generate laser beams. In nature, hot gases near bright stars can generate strong stimulated emission at microwave frequencies, although these gas clouds lack resonant cavities, so they do not produce beams.

Laser applications

Most laser applications fall into one of a few broad categories:

1. transmission and processing of information,
2. precise delivery of energy,
3. alignment, measurement, and imaging.

These categories cover diverse applications, from pinpoint energy delivery for delicate surgery to heavy-duty welding and from the mundane alignment of suspended ceilings to laboratory measurements of atomic properties.

Here're few examples:

YAG Lasers:

YAG is formed from a mixed oxide system having a composition of Y3Al5OI2. Using Czochralski method, the crystal is grown in a specially designed furnace by dipping a rotating seed into a crucible of molten material and withdrawing it at a constant speed. Iridium crucible is used because of high melting point of YAG (1910-1970°C). The optimum concentration of neodymium in YAK is about one percent.

The YAG crystal growth difficulties limit the size of the laser rods to approximately 1 cm in diameter. However, the YAG host has the advantage of having a relatively high thermal conductivity to dissipate the heat generated, thus allowing these crystals to be operated at high repetition rates of the order of many pulses per second. With a continuous source of excitation like tungsten lamp or krypton arc lamp, continuous laser output of about 1 kW power could be obtained.

Due to these excellent properties, YAG laser is extensively used in many industrial applications like drilling of holes in solid objects, welding of metals and alloys, etc, and also in medical applications like eye surgery, treatment of cancer, etc.

Liquid (Dye) lasers

The dye lasers are used mostly for applications were tunability of the laser frequency is required either for selecting a specific frequency that is not available from one of the solid-state or lasers or

for studying the properties of a material when the laser frequency is varied over a wide range. Therefore, the dye laser becomes an important too or spectroscopy, photochemistry, pollution monitoring, Isotope separation, etc. Another important application of dye lasers is for producing ultra-short optical pulses by a technique known as mode locking. These short pulses find application in studying very fast processes in solids and liquids and perhaps also in optical communication.

Free-Electron Lasers

Free-electron lasers, discovered recently, are significantly different from any other type of laser in that the laser radiation is not obtained by discreet transitions in atoms or molecules of a material. Instead, a high-energy beam of electrons (of the order of one million electron volts (meV)) is directed to pass through a spatially varying magnetic field that causes the electrons to oscillate back and forth in a direction transverse to the direction of their beam, at a frequency related to the energy of the electron beam.

This oscillation causes the electrons to radiate at the oscillation frequency and to stimulate other electrons also to oscillate and radiate at the same frequency, in phase with the original oscillating electrons thereby producing an intense beam of light emerging from one end of the device. Mirrors can be placed at the ends of the magnetic region to feed the optical beam back through the amplifier to stimulate more radiation and cause the beam to grow. The frequency is tunable by variation of electron energy and the laser radiation can be generated at any wavelength from the ultraviolet to infrared regions.

A great advantage of the free-electron laser is that a high average output power of the range of a few kilowatts can be obtained in the continuous mode. Although still more of a laboratory curiosity, it shows good promise of high energy applications especially in the medical field.

By the information and examples that were listed above we might make a very simple conclusion that lasers are worth of improvements and researches being done to find more appliance fields for them in the future.

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УДК 629-064.5

BASIC REQUIREMENTS FOR THE DESIGN OF POWER SUPPLY SYSTEMS

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Annotation: In this article, the main requirements that currently exist in the design of power supply systems were presented and analyzed. In the future, for the sake of completeness of the study, the main stages in the design of the above-named systems are formed. Existing problems in the design are identified and ways to resolve them are proposed.

Key words: requirements design of power supply systems, power supply systems.

I would like to start studying the definition, so SES Design is understood as the development of technical documentation that ensures the creation and development of SES, based on a number of legal acts that we studied during the writing of the article [5]. The importance of the project lies in the fact that the efficiency and safety of the use of electricity directly depends on its quality. In this regard, the most important task of the energy industry is the transition to efficiency with

comprehensively developed productive forces and production processes, relationships, and well-established economic mechanisms. And this will be possible with a competent start of the actions of the specialists involved in this process.

This topic is covered by many regulations, and, in connection with this, it is more clearly and in detail regulated by law, however, there are also shortcomings, which we will discuss later. I would like to start with regulation, so the requirements for the design of SES are formed in section 1, chapter 1.2 of the rules for devices and power plants, which fix: firstly, the definition of prospects for the subsequent development of energy systems and power supply systems, taking into account the rational combination of newly constructed electrical networks with existing and newly constructed networks of other voltage classes; secondly, they must provide an integrated centralized power supply system for all consumers of electrical energy; thirdly, and importantly, they should reduce the loss of electrical energy. These requirements, in turn, should be considered in a complex external and internal power supply, taking into account the possibilities and economic feasibility of technological redundancy. This is due, in our opinion, to limited resources and the need for more competent provision of expenses for an already small amount of resources. Based on these requirements, we can also say that some freedom in the actions of specialists is at the head, since there are no exact data, they are only descriptive, which manifests itself only in the presence of general characteristics that need to be based on when designing [4].

Subsequently, based on this regulatory legal act and taking into account the Federal Law of December 30, 2009 N 384-FZ "Technical Regulations on the Safety of Buildings and Structures", we identified some general requirements, which included: requirements for electronic protection; safety requirements (mechanical, fire, for persons); performance requirements; requirements for survivability and resistance to external factors and requirements for reliability [1,2].

Conducting this analysis of requirements, we realized that it is also necessary in this study to indicate the existing stages in the design of SES. The first is the development of the terms of reference for the project, which includes: technical conditions and indicators of the maximum power allocated to the facility by the electricity supplier, as well as statements of the main consumers of electricity in the future network of the facility. In the future, it is necessary to create a project concept, which indicates the layout of the main equipment and main routes, tasks for vertical holes, as well as other details that allow you to imagine the system as a whole. But at this stage there are difficulties, because if the area of the object is more than 1500 m2, it will be necessary to prepare working documentation with its subsequent approval by Mosenergonadzor, where an examination of the entire package of documents will be carried out [3].

Thus, summing up the above, it should be said that the creation of any complex will lead to the emergence of new SES. This is due to the creative aspect of the activity, because not a single legal act contains an accurate description of the actions, they are, as previously mentioned, descriptive in nature and therefore, due to this aspect, the projects will differ from the previous ones. But this leads to complexity since there is no single complex and structure, however, it is possible to propose a way to resolve this uncertainty by creating an integrated approach, fixed in a separate NPA by introducing instructions. And this will already allow in the future to ensure the creation of new unified systems qualitatively and at the highest level.

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УДК 629.7

ELECTRIC AIRPLANES

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Not so long ago, the world was skeptical about electric cars, but Tesla made them believe in them. Now aviation is also being converted to electricity. We tell you how electric airplanes appear and why we don't fly them yet

The term "electric airplane" is understood as an electrified aircraft. Aviation experts distinguish three levels of electrification of aircraft: "more electric", "fully electric" and "hybrid".

"More electric", or an airplane with increased electrification

This device, like a conventional aircraft, is equipped with an internal combustion engine. The motor converts the chemical energy of the burning fuel into mechanical energy and creates thrust — a force that pushes it through the air flow. But most of the equipment work (wing adjustment, landing gear release, and so on) perform electric drives. They are powered by the power supply system and convert electrical energy into mechanical energy.

"Fully electric aircraft"

An aircraft that does not have internal combustion engines, and all equipment runs on electricity. To create traction in such aircraft, electric motors are used, which are powered by batteries.

In the early 2000s, a boom in the creation of "all-electric aircraft" began, where lithium-ion batteries were the main source of energy.

The use of batteries as the main sources of energy limited the capabilities of aircraft — range, flight time, payload. Therefore, experts in the field of aviation began to consider alternative options for obtaining energy. Among them:

solar panels — convert radiation energy into electricity;

fuel cells — convert the chemical energy of the fuel into electrical energy without gorenje processes; most often hydrogen is used as fuel.

"Hybrid aircraft"

Equipped with a hybrid power plant. It converts energy twice: first into mechanical energy with the help of internal combustion engines, then into electrical energy with the help of generators.

Why should we switch aviation to electricity?

The obvious reason for the increased demand for electrification is ecology. According to the International Air Transport Association IATA, commercial aviation accounts for about 2-3% of carbon dioxide emissions. Moreover, in one short flight, for example from London to Rome, 234 kg of carbon dioxide is generated per person — more than citizens of some countries produce in a whole year. Switching to electricity will help solve environmental and other problems of modern aviation.

Reducing the amount of emissions into the atmosphere

"Fully electric aircraft" does not create exhaust. But it is not yet considered absolutely environmentally friendly, since the production of batteries pollutes the environment, and because of their structure and chemical composition it is difficult to dispose of them.

Airbus has presented a project for the development of aviation of the future "Smart Sky". According to her forecasts, by 2050, aircraft with hybrid power plants and electric motors will be distributed. Airports will abandon internal combustion engines even on the ground: unmanned electric tractors will deliver planes to the runway and back. All this will help to reduce the amount of emissions into the atmosphere.

Lower fuel costs

It is this prospect that motivates many large airlines to invest in the development of electric aircraft. Fuel costs account for up to 30% of their costs and significantly affect profits. In 2020, magniX and AeroTEC Cessna 208B electric aircraft made a successful 30-minute flight. Executive Director Roy Ganzarski noted that the price of the flight was only $6. And if they used conventional motor fuel, the flight would cost $300-400.

Reducing the amount of noise

Electric and hybrid aircraft are much quieter than conventional ones with internal combustion engines. For example, a helicopter at an altitude of 500 m creates a sound of 60 dB, which in volume can be compared to a passing motorcycle. And the Heaviside electric airplane (developed by Kitty Hawk) creates a sound of 38 dB during flight at the same altitude — about the same volume level as during a conversation between people. As a result, the transition of aviation to electricity will help to combat noise pollution and build airports closer to the city.

Reduced operating costs

Electric motors are simpler than internal combustion engines. They have fewer moving and touching parts, which means they are less susceptible to wear. Aviation industry experts suggest that electric aircraft will need less maintenance, which will reduce operating costs.

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УДК 620.92

PROSPECTS FOR THE DEVELOPMENT OF HYDROGEN ENERGY

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One of the main ideas in the modern race of environmentally acceptable energy technologies was the desire for further decarbonization of atmospheric air (reducing the share of "greenhouse" carbon dioxide emissions). For these purposes, the consumption of fuel oil, oil and coal is being reduced. Their replacement with environmentally acceptable natural gas continues. Hydrogen is an ideal source of energy and an environmentally acceptable fuel.

There are three main sources of emissions contributing to climate warming in the world: transport, electricity generation and industry. Hydrogen can be used in all three areas. When used in fuel cells, hydrogen energy leaves minimal losses, and after use as a by-product, only water remains, from which hydrogen can be extracted again.

In 2018, hydrogen consumption in the world amounted to about 74 million tons. It was used mainly in oil refining, chemical industry and metallurgy. By 2030, we can expect an increase in its annual demand to 100-114 million tons of hydrogen (+35-55% compared to 2018) with a production cost of about 2$ for 1 kg. Experts of the Hydrogen Technology Council in their recent report claimed that by 2050, hydrogen will account for 18% of all energy needs of the world.

Large-scale introduction of hydrogen energy will require large-scale development of the following production technologies for hydrogen production:

1) creation of a special infrastructure for the transportation and storage of hydrogen;

2) production of hydrogen in the process of steam reforming of methane with the collection and disposal of carbon dioxide emissions;

3) the use of hydrogen in industry, in transport (land, air, water and underwater), in public utilities;

4) separation of hydrogen from extracted natural gases.

In the list of chemical elements included in the minerals of the Earth's outer shell (lithosphere and hydrosphere), hydrogen takes second place (after oxygen). Its most widespread and mobile formation is water — an almost inexhaustible natural resource for the production of hydrogen and oxygen.

At the same time, all practically used hydrogen today is produced only by industrial (artificial) method. The expansion of the energy use of hydrogen and the organization of the search for natural deposits of this gas require state support. Japan was the first country to form its national hydrogen strategy in 2017. In 2019, the "Strategic Roadmap for Hydrogen and Fuel Cells" was adopted here. In 2019, the Republic of Korea revealed strategic plans for the development of hydrogen. The views of these major developed importers of traditional energy resources on the role of hydrogen are similar: improving energy security through diversification of energy sources, focusing on importing hydrogen, developing technologies for export and fulfilling climate commitments to protect the climate. In 2019, the national hydrogen strategy was adopted by Australia, the largest exporter of energy resources, which organized a partnership with Japan to develop a pilot project to create hydrogen supplies and signed an agreement of intent with the Republic Korea on the achievement of cooperation on the export and import of hydrogen. In March 2020, the strategy of the Netherlands was approved, in June — Germany and Norway, in July — Portugal and the EU, and in September — France.

In Russia, hydrogen is mainly produced and used in the oil refining, chemical and petrochemical industries. In the Energy Strategy of the Russian Federation for the period up to 2035 (ES-2035), hydrogen energy is designated as one of the promising areas of energy development. In October 2020, the Government of the Russian Federation approved an Action Plan ("roadmap") for the development of hydrogen energy for the period up to 2024.

Hydrogen has a high potential for use as a means of energy storage and storage, as well as load balancing of power grids in conditions of instability of electricity consumption during its generation using renewable energy sources.

In conclusion, it should be noted that the success of the milestone transitions of mankind to new and new types of fuels and energy (from firewood to coal, to oil and natural gas, and finally to nuclear energy, the 75th anniversary of which we have just celebrated), the desire for careful and environmentally acceptable development of renewable energy sources, is equal to as well as the effective development of technologies for the overdue introduction of hydrogen energy, they required and require the implementation of comprehensive measures to solve the task.

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УДК 621.31

SYSTEMS FOR INCREASING THE EFFICIENCY OF SOLAR BATTERIES

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The use of solar energy is becoming increasingly widespread in the modern world due to its general availability and inexhaustible energy of the Sun, as well as its environmental friendliness. But there are also a number of reasons why solar energy can not surpass the traditional ways of generating electricity. Such obstacles are high cost and low efficiency of solar panels. There are other, no less important reasons, for example, dependence on geographical location, weather, time of year and day. Also, there is the necessary equipment and allocate large areas for the placement of solar panels.

- Development of advanced photocell manufacturing technologies, access to reduce their costs and increase efficiency;
- use of solar radiation concentrators;
- application of tracking systems for the Sun [1].

One of the important issues in the application of solar panels is the choice of the photocell material. The most common of these are modules made using two main technologies: monocrystalline silicon and polycrystalline silicon.

The appearance of film solar panels is one of the most important steps in the field of improving the efficiency of photocells. There are batteries based on cadmium telluride, as well as copper-indium selenide.

It is worth highlighting a new kind of panels - polymer solar panels made of polymer materials, such as polyphenylene, furrellen, copper phthalocyanine.

Let's summarize in the table the main advantages and disadvantages of the raised materials.

Table 1. Advantages and disadvantages of materials used as photocells

Material	Advantages	Disadvantages
Monocrystalline silicon	High efficiency - about 20%	High cost of technology for growing crystals
Polycrystalline silicon	Production technology is less expensive than the previous one	Low efficiency - up to 18%
Based on cadmium telluride	Wide spectrum of absorbed solar radiation	Low efficiency - about 10%, the toxicity of the material
Based on copper indium selenide	High efficiency - about 20%, low cost	There is no single technological process suitable for mass production
Polymer compounds	Availability of materials, low cost, no harmful fumes	Low efficiency - 5%

Let us consider the main types of solar panels with radiation concentrators.

A parabolic cylindrical concentrator is a sheet of a reflective material of a parabolic shape. The installation focuses the solar energy in the center, where the heat medium, placed in a metallic black tube, is heated to a temperature of 300-390 ° C. After the coolant, which can be oil, is used to generate electricity in the Stirling engine.

A flat mirror reflector with Fresnel mirrors consists of a set of flat mirrors that concentrate radiation on the surface of the photoelectric element or on the top of the tower structure with the receiver where the coolant is located.

The parabolic concentrator is made in the form of a paraboloid of revolution. This setting is guided by two coordinates when following the Sun. Solar energy is focused on a small space. The Stirling engine or the photoelectric element is fixed to the bracket in the focus of the reflector. It is necessary that the Stirling engine be located so that the heating region is in the focus of the reflector.

Solar towers have the form of solar stations, in which the receiver is located on the central tower.

Such a system consists of a field heliostats - flat reflectors, controlled by two coordinates and capturing the sunlight. The heliostats direct the rays of the sun to the receiver, which is above the heliostat field, in order to prevent the influence of mutual shading. It is used to store energy, which causes the turbine to move. Often, large turbogenerators are used at such stations [2].

Since recently, tracking systems have started to be used, which have already proved their effectiveness, increasing the efficiency of panels to 50%.

Such a system can be either single-axis or double-axis. The two-axis mechanism, in contrast to the single-axis mechanism, can move the panel in two directions, that is, to navigate the sun in azimuth and zenith. The installation should have a lightweight metal frame, which does not interfere with the movement.

All solar tracking devices consist of two parts: a control circuit and a mechanism that rotates the system. The control system monitors the Sun. The rotating mechanism can be implemented on the basis of servo drives with brushless motors. The advantages of this scheme are the simplicity of design and assembly, as well as low cost. The disadvantage is that this scheme is inappropriate to be used on an industrial scale due to its low power [3].

Thus, among the solutions for the application of new materials, the most advanced is the use of film panels based on copper-indium selenide, the development of mass production technology of this material will bring great success in improving the efficiency of solar panel systems. Among installations with radiation concentrators, the most efficient are the parabolic concentrator and solar towers, which have successfully proven themselves in practice in some countries of the world. For devices with a tracking system, it is more productive to use circuits based on microcontrollers, which greatly simplify assembly and are already pre-programmed to track the Sun.

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УДК 621.382.2/.3

INNOVATION IN ELECTRONICS DESIGN WITH THE USE OF MODERN TOOLS

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Nowadays, production level has increased drastically, which allowed industry to make a huge step forward. It leads to the improvements of electronics production and increased density of

integral circuits, later it will be considered as IC. Let us describe existing IC making machines, what they can do.

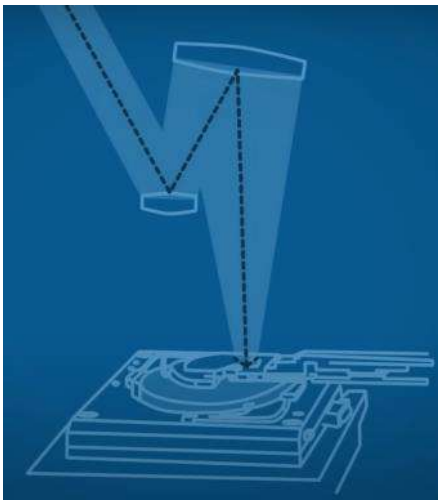
Today, at the chip making market, four big companies are taking the lead: AMD, Intel, TSMC, Nvidia. In order to make those chips, they buy expensive lithography machines, the only company, which produces them is the ASML - Advanced Semiconductor Materials Lithography. This company was established in 1987, Dutch company, and the largest manufacturer of lithographic equipment for the microelectronic industry, which is also necessary for the manufacture of VLSI, memory chips, flash memory, and microprocessors. ASML lithography machines are used in the production of integrated circuits. In such installations, the process of optical projection of special partially transparent templates (masks) onto the surface of a semiconductor wafer, covered with a thin film of light-sensitive material (photoresist), takes place. For each plate, this procedure is repeated several dozen times. After each projection, the plate with the applied photoresist is processed, during which the electronic structures of microcircuits are formed. The optical method used in ASML installations has become used for the production of almost all integrated circuits [2].

Table 1 – description of chip making machines with resolution and accuracy.

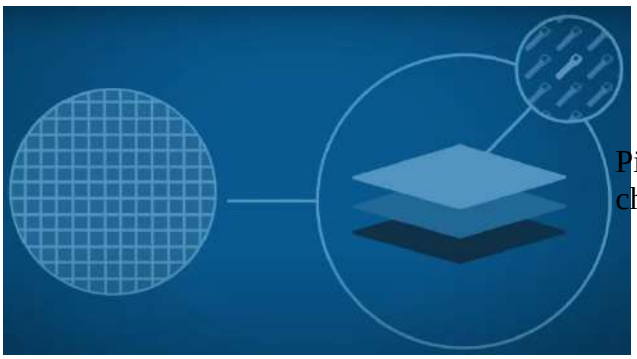
Machine name	**Year of production**	**Resolution**	**Accuracy**
PAS 2000	1984	1 um	250 nm
PAS 5000	1989	0.5 um	100 nm
PAS 5500	1990	400…90 nm	100…12 nm
TWINSCAN NXT	2000	100…38 nm	20…2 nm
TWINSCAN NXE	2010	38…19 nm	3 nm
TWINSCAN NXET	2022	10…5 nm	2 nm

Definition and Description of chip making process.

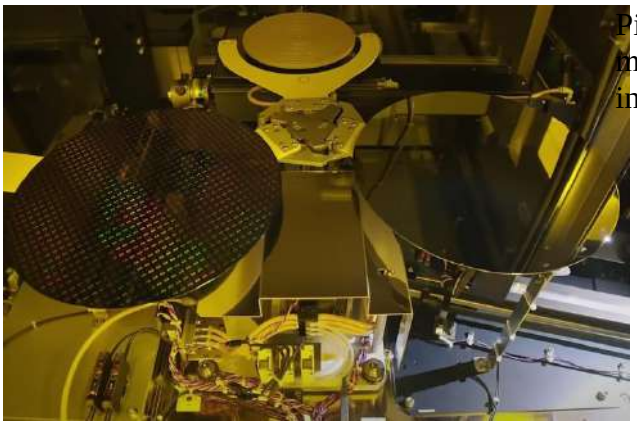
Chips are made from silicon, an abundant material, which can be found in rock, sand. Then, it's purified and melted down and sliced into circular wafers. Then each wafer is loaded to the lithography machine, which prints circuits on the layer of wafer with the help of strong laser (Pic.1). Each machine has laser with the exact laser wavelength, what enables to print small objects with the size almost equal to the size of the human DNA. Each wafer contains several layers (Pic.2), which then cut and sent to the electronics manufacturer, which make electronic devices, like: IPhones, tablets, IoT devices.



Pic.1 – Lithography machine.



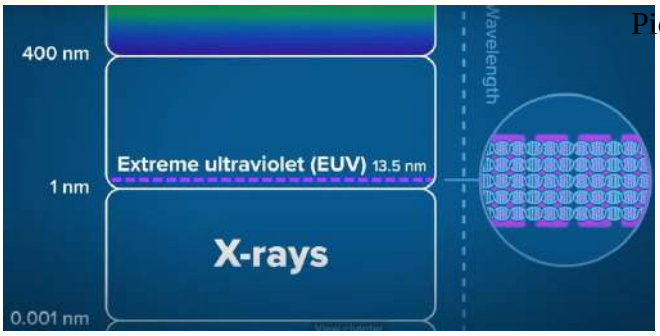
Pic.2 – Example view of the inside look at the chips wafer



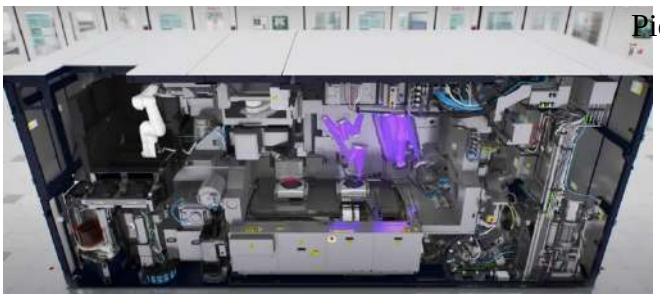
Pic.3 - Inside look of the wafer changing machine. It's main purpose to bring raw wafer into the system and move out engraved wafer.

Now, let's look at the advantage on the new ASML chip making machine. At first, it seem like the printing process is the same as well as the machine, but there is a difference in optics and laser.

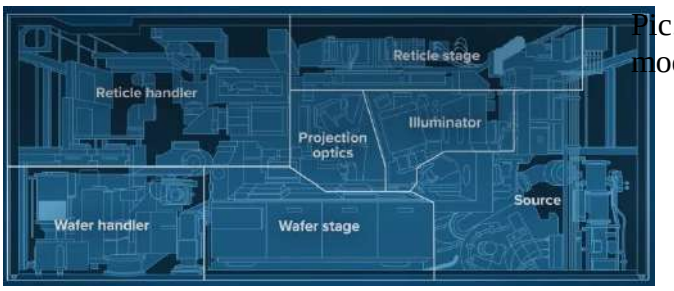
The new laser type, which is used in TWINSCAN NXE, is called "EUV" – extreme ultraviolet. The wavelength of this laser is equals to 5 DNA standing side by side (Pic.4), it's 13.5 nm, when previous machine used "DUV" – deep ultraviolet with the wavelength 193 nm. DUV wavelength is used to produce low-density electronics devices, like toasters, wifi routers and some chips for a car. Currently, new IPhones, chips for AI – artificial intelligence computers, and new embedded electronics for cars and regular customers are made with the help of EUV [3].



Pic. 4 – relative UV graph of used laser type



Pic.5 – inside of the new TWINSCAN NXE



Pic.6 – completed TWINSCAN NXE with modules location and their description

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УДК 621

WIRELESS POWER TRANSMISSION AND WAYS OF ITS IMPLEMENTATION IN THE MODERN WORLD

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Wireless power transmission can be realized with the help of different technologies based on the properties of electromagnetic fields and other means of transmitting and receiving of electric power. Such technologies are characterized by the distance over which energy can be transmitted with maximum efficiency, the type of transmission, the cost of creating and maintaining the device, as well as its technical complexity. Many leading companies are actively studying and mastering this technology for further application in their products, such as household appliances, various smartphones and even cars.

Aims of paper is to find out features of different types of electricity transmission and try to build a model using different resources. Research objectives are to study the literature on the topic; to build a model of a device showing the principle of wireless transmission of electricity. Research methods to be employed are search of Internet resources and literature, modeling, experiment, analysis and generalization of conclusions.

We considered several types of wireless power transmission and analyzed their disadvantages and advantages compared to traditional technologies.

Definitely, the transmission of energy without the use of wires is a promising trend these days, the technology is gradually taking root in our everyday life. But the convenience of its use is still limited by the efficiency of installations and their technical complexity.

The model consists of two main parts: the receiver unit and the transmitter unit. Inside the frame the halogen bulb, the switch and the wire are attached. The halogen bulb was chosen because of its sufficiently high power and light output per watt (75W), it will be enough to efficiently convert electricity into light. It is powered by 220V AC with a wire and plug, and a switch is integrated into the circuit for easier and safer operation of the model. The receiver consists of two parts: the first receives the light beam and converts it into electricity, the second part is an energy consumer in the form of a LED and a voltmeter. The role of the receiver is performed by the solar panel.

The main advantage of our model is the ability to set a much greater distance between the receiver and transmitter. Popular modern method of electromagnetic induction is effective only in

case of full contact between the transmitter and the receiver. As the distance increases, the efficiency of the installation decreases decently with each millimeter, which makes this technology less efficient. In relation to the method of transmitting energy by means of microwaves, the light technology has a lower efficiency and effective distance of operation, but there is absolutely no negative impact on people and other bodies, which is a very significant advantage.

Thus, light beam wireless energy transfer technology is the golden mean between efficiency at a distance and the safety of its use in comparison to other methods.

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УДК 608.1

WATER – FUEL OF THE FUTURE

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Have you ever thought about pouring water into the tank of a car and driving it exactly the way we currently ride cars with diesel or gasoline engines? No matter how wild it may sound, it is possible because there is nothing impossible in the world except the revival of a dead person. First of all, why do we need water-based engines when there are diesel, gasoline engines and, most importantly - developing electric vehicles. The answer is very simple, scientists have calculated that the world's oil and gas reserves will run out after about 70-80 years and electric cars will not be able to fulfil consumer’s demand. Therefore, we need a new endless and cheap source of energy, and this is undoubtedly water.

To be honest, water won't burn by itself, but we all know that water consists of hydrogen and oxygen. And we also know that hydrogen is an energy source that expels a lot of energy when burns and water is formed after combustion. Hydrogen and oxygen are interconnected by chemical bonds and in order to separate them, the same amount of energy is diverged that is produced by the combustion of hydrogen. Thus, the only problem is the electrolysis of water and in order to solve it we need to invent a cheap and qualified carburettor which could electrolyse water and send the produced hydrogen into engine.

The idea of using water as an energy source arose in 1935 and the first discoverer was Charles H. Garrett. He demonstrated a water-fuelled car which generated hydrogen by electrolysis as can be seen by examining Garrett's patent, issued the same year. The patent includes a drawing showing a carburettor similar to a regular float carburettor, but with an electrolysis plate at the bottom and a float used to maintain the water level. Garrett's patent fails to identify the new energy source.

Researches using water as an energy resource started after that. Companies such as Genesis World Energy, Genapax, Thushara Priyamal Edirisinghe and well-known brands of car manufacturers have invented machines that run on a water basis.

At the moment, the water-based engines have been tested successfully and they do not lag behind with anything from others. In some ways they are better than electric cars and, in some ways, worse, but in general, in the future I am sure that they will replace diesel and gasoline cars. At the moment they are not mass-produced due to the fact that some parts are expensive, including a carburettor that divides water into hydrogen and oxygen, but I am sure that in the future scientists will eliminate this issue and this kind of cars will be used massively. And besides the fact that such fuel is cheap, it also helps to humiliate global warming because, water is formed when hydrogen burns.

We can make a conclusion that water will be the fuel of the future and will replace diesel and gasoline engines.

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УДК 336.745

BLOCKCHAIN - INNOVATION IN THE IT WORLD

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The purpose of the work is to search the information about Blockchain - innovative technologies in science and modern society. Methodology: to study the issue, search for information, make analysis of the information found and its generalization.

Blockchain is one of the ways of distributed data storage. This technology can be used to record and track any type of information: from medical indicators to elections.

The main difference between blockchain and conventional databases is decentralization. That is, firstly, no regulator or organization monitors this process. And secondly, the information is not concentrated, say, on servers in one place, but is distributed in a huge network of computers around the world. *"What is the importance of blockchain: business depends on data. The speed of data acquisition and accuracy play a crucial role. Blockchain is ideal for providing such information, because it offers authorized network participants instant, shared and completely transparent access to information in an immutable registry," IBM believes.*

It is believed that the distributed registry technology was invented by Satoshi Nakamoto in 2008 as a registry for the first world cryptocurrency — bitcoin. However, it is not known for certain whether there is actually a person with this name or it is a nickname behind which a whole group of people is hiding.

Now let's figure out how a technology that more and more companies around the world are choosing to organize complex processes work. Blockchain is literally translated as a chain of blocks. In each of these blocks, one or another information is digitally recorded. In the case of cryptocurrencies, this is transaction data (date and time of block creation, address, etc.). Any user can view this information, but cannot change it. Each new transaction, regardless of its size, turns

into a new hashed cluster. It consists of a unique set of characters and numbers created by a specific algorithm. The new block always references the previous one, thereby creating a strict sequence.

Blockchain blocks are stored in nodes (nodes) that help to synchronize and update data in a timely manner for all participants. Nodes are complete and lightweight. Full blocks store absolutely all blocks, lightweight ones — only the latest ones, but if necessary, they can request the previous ones too. A number of events must occur before the block enters the chain.

It goes without saying that every transaction must be verified. Unlike classic transactions, which are approved by a bank or payment system, transactions in the blockchain are confirmed by a network of computers. As a rule, networks consist of thousands and even millions of machines around the world. After the transaction has been verified, the information is sent to the block. It contains the date, time, amount and digital signature of both parties. Finally, the block receives a unique identification encrypted code, as well as the hash of the previous packet added to the chain. After hashing, it can be added to the blockchain.

Once the information enters the blockchain, it cannot be changed or deleted. The key to the security of the technology is that all network users are notified of any changes.

The second condition that ensures blockchain security is the complexity of the proof-of-work process. To change the block, a hacker will need to solve a whole set of mathematical problems from nodes and miners (people on whose computers calculations and transactions are performed), which is not so simple.

And the main thing is the transparency of the network. Anyone can view information about blocks, which means full transparency of transactions. Since there are millions of computers on the network at any given time, it becomes almost impossible to hack the system and remain unnoticed.

Disadvantages of the blockchain

Most people agree that the blockchain is quite secure, but there are also disadvantages of this technology. The first problem is scalability. That is, with the increase in the number of participants, it becomes more difficult for the system to process transactions. For example, the second largest cryptocurrency by capitalization, faced this. It took several years for the company to solve this problem. Another risk is the so called "51% attack". This means that several network users with large computer capacities have agreed and can change records in a particular block. For example, the Bitcoin SV cryptocurrency faced this. Hackers were able to gain control of the network and compromise more than 570 thousand transactions.

Another problem of blockchains is that they are not used for cryptocurrencies is insufficient testing. As a rule, cryptocurrencies have test networks where developers learn about network vulnerabilities. Businesses rarely check their blockchains like this, so they are more susceptible to hacker attacks.

In conclusion we can admit that blockchain is the beginning of a new digital era for all of us, because we have become less tied to national currencies, because a standard has appeared in the form of various "coins" that the blockchain system allows us to obtain. Blockchain can be used everywhere and it blurs the boundaries between states and people, maybe in the foreseeable future blockchain will find a very worthy use and humanity will take a couple of steps forward.

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УДК 621.316.925.2

DESIGN OF RELAY PROTECTION AND AUTOMATION ON THE 220 kV OVERHEAD LINE "NEPTUNE - BLUE" (BARABASH - GOLUBEYKA)

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Relay protection and automation performs automatic detection of damages and abnormal conditions in power systems and ensures their reliable and stable operation.

In modern energy systems, the importance of relay protection increases due to the increase in the power of power systems, combining them into single electrically connected systems.

The main task of building an overhead line relay protection is to ensure its effective functioning, if possible, in case of any types of damage, to prevent the development of damage and significant destruction of the protected equipment, as well as to prevent stability violations in the power system.

The aim of the work: design relay protection and automation on a 220 kV overhead line. The design includes the calculation of short-circuit currents, the choice of remote and step protections, their setpoints. The choice of main and auxiliary equipment. Performing an assessment of the economic costs of implementing, and maintaining relay protection devices, and also electrical equipment on a 220 kV power line.

Research methods to achieve the goal include:

- research of the 220 kV overhead line scheme "Neptune - Blue" (Barabash - Golubeyko). Determination of its source data;
- calculation product (parameters of the replacement circuit, calculation of short-circuit currents in maximum and minimum mode, calculation of short-circuit currents to earth in maximum and minimum mode, equipment selection, design of relay protection, technical and economic calculation) of 220 kV overhead line;
- for the calculation of short-circuit currents, the [3] were used; for the design and calculation of relay protection, the [1] were used;
- the choice of electrical equipment depends on the values of the above calculations;
- technical and economic calculations are made based on [4].

Research results:

As a result of the research, it can be concluded that the goal has been achieved and the tasks of the work have been solved. In the course of this work, in order to increase reliability, ease of operation, as well as save space, modern Sirius-2-L terminals were used instead of the old protections presented in large relay protection cabinets.

All the selected parameters of the operation of relay protection and automation devices correspond to the sensitivity requirements set by the "rules for the device of electrical installations" and are coordinated in response time both among themselves and with the protections of adjacent connections.

Taking into account the data obtained as a result of the research, it can be concluded that this microprocessor protection can provide a sufficient degree of reliability in operation.

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УДК 621.355.9

INTRODUCTION OF NEW HYDROGEN ACCUMULATORS INTO EVERYDAY LIFE

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Abstract: This article discusses the introduction of new technologies, the work of which will be based on hydrogen energy.

Key words: hydrogen, energy, efficiency, battery, operating principle, efficiency.

Our world does not stand still; a huge number of industries are being developed, new specialists are being trained, whose professional competencies will help to improve the world even further. Unfortunately, such a great flow of new technologies requires more resources, which include: fuel, electricity, finance, materials, etc. That is why it is now very important to research and develop renewable energy sources, and hydrogen energy is directly related to this.

Hydrogen is an ideal source of energy and an environmentally acceptable fuel. Its heat of combustion (1.17 GJ/kg) is almost three times higher than that of oil, and four times higher than that of coal or natural gas. But we should not forget that hydrogen is not a new source of energy, but a recycling of basic sources [1]. In other words, hydrogen energy is a way to efficiently use available energy sources, and a good way to improve efficiency [2].

The experts of the Hydrogen Technology Council (Hydrogencouncil) stated in their recent report that by 2050 hydrogen will account for 18% of the world's energy needs. In Russia, the task of hydrogen energy development is stated in the key document of strategic planning of the industry - the updated Energy Strategy of the Russian Federation for the period until 2035 [2].

From the above it can be understood that the development of hydrogen energy is now in trend, so the replacement of various technologies, the operation of which will be based on the decomposition of water into hydrogen and oxygen, is expected in the near future. One of the current developments is computer batteries, portable chargers, etc. As the developers write, for a small portable charger will need a case with interchangeable capsules, one capsule should be enough for several phone recharges, such a charger will not be afraid of weather conditions, will have a simple design, low probability of hydrogen leakage due to low pressure, compact [4].

The principle of battery operation is based on the reversible reaction of hydrogenation of various metals, intermetallic compounds, alloys and composite materials [5]. Metal hydride batteries are the main component of backup power supply and energy storage systems, where they are connected to a hydrogen electrolysis generator and a fuel cell. In such systems, hydrogen is produced by electrolyzing water with excess electricity converted by the fuel cell into electrical energy. In this system, the battery would be charged by the electrolyzer, and the hydrogen released would be immediately used to power the fuel cells [4]. In the future, this technology could be used in the electric power industry, telecommunications, and industrial electric power industry.

Thus, based on the above words, we can conclude that hydrogen is already a sought-after product, it is actively being introduced into our daily lives and very soon, thanks to various studies, we will be able to see more efficient equipment in the home.

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УДК 620.9

THE PROSPECTS FOR THE INTRODUCTION OF A VIRTUAL POWER PLANT

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The concept of a virtual power plant is an innovative technology in the field of energy and therefore, it raises a large number of questions and disputes around itself. The virtual power plant is a cloud-based IT system. Distributed energy sources (of small power in the immediate vicinity) and consumers of this energy are connected to it. The system distributes all the energy available to it among consumers, allows it to be accumulated, exchanged and traded - both within the system and in external markets. Such a system of "smart control" - part of "smart grids" - provides additional capacity without investing in their construction. Any virtual power plant consists of:

-several (many) sources of electricity;

-consumers who are connected to the system;

-energy storage systems;

-software that controls the entire network.[1]

The digital community of decentralized generators that transmit energy to the grid combines the power of solar panels, wind farms, cogeneration, small hydro installations and other decentralized electricity producers. The source of generation does not play a role: renewable energy can combine almost any technology for generating and storing energy, whether it is a combined heat and power plant, wind turbines, solar, hydro, diesel and coal power plants, biogas or biomass.

The main advantages of a virtual power plant compared to a traditional one are:

-Virtual power plants often run on renewable energy sources, and this often allows savings, because the prices for "green" kilowatts in many countries have already equaled or become lower;

-The system has access to household energy management, and allows you to balance the operation of appliances so that it is optimal at the lowest cost;

-Energy is produced close to the place of consumption and distributed among the participants, there is no need to transport it over long distances at high voltage. In this way, the energy loss factor is reduced to a minimum or disappears altogether;

-increases system reliability by optimizing the real-time energy production process in line with demand.

The rapid development of virtual power plants is:

- decrease in the share of industrial production in the structure of GDP;

- low energy intensity of industrial production;

- weak development of distributed generation.[2]

The development of wind farms is happening all over the world. One of the most advanced countries in this field is Australia. This is due to the fact that this country has the largest number of power plants in the world, and also the largest of them. One such station is capable of connecting

50,000 households. Australia's largest wind farm currently serves 37,000 households. In addition, in Australia there are examples of virtual power plants and in the residential sector – separate homes and entire neighborhoods exchange energy that they themselves generate - both in industrial and commercial projects - to improve energy efficiency.In addition to Australia, this technology is actively developing in European countries, mainly in those countries where various sources of electricity are well developed. For example, in the suburbs of Munich, one station can serve up to 20,000 homes. Also, this technology is being developed on island states. For example, a microstation in Hawaii serves just over 3,000 homes at a time.It is most expedient to consider isolated territories as a platform for integrating a virtual power plant based on smart grid technologies, for example, the first pilot project of a virtual power plant in the Russian Federation is the project on Russky Island.[3]

Thus, the main condition for the expansion of virtual power plants in Russia is the organization of communication between all interacting subjects. To do this, it is necessary to improve the means of technical regulation, harmonize virtual power plants technologies by developing appropriate standards and rules, as well as to explore the issues of choosing the optimal combination and placement of electricity sources in microgrids.[4]

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УДК 621.3.049.75

THE APPLICATION OF EMC TO ELEMENT PLACEMENT TASK

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The relevance of the EMC (electromagnetic compatibility) study can be noticed in several drawbacks of the modern systems responsible for solving PCB (printed circuit board) element placement tasks. The considerable goal of solving this problem is the reduction of negative consequences which take place during the PCB functioning process.

Electromagnetic compatibility implies the normal functioning of transmitters and receivers of electromagnetic energy. To say more precisely, the energy of the transmitters reaches the desired receivers, the receivers only respond to the signals of the transmitters for their intended purpose. Apart from that, there are no undesirable mutual influences [1].

The placement of PCB elements is the problem of determining their suboptimal position on the printed circuit board in order to make the best conditions for solving the subsequent task of tracing connections, taking into account design, technological requirements and restrictions [4].

The main purpose of this research is the development of the software implementation of a genetic algorithm to the element placement task on the area of a printed circuit board, taking into account the criterion of electromagnetic compatibility, which minimizes the electromagnetic emission of one element to another.

In order to calculate the electromagnetic emission value of one placed element in relation to another, the additional software for CST STUDIO SUITE was developed, using VBA programming language (Visual Basic for Applications). An example of determining the suboptimal position of an element on a printed circuit board using developed software is represented below.

The initial data is represented in the table 1.

PCB width, mm	PCB length, mm	PCB thickness, mm	Grounding thickness, mm	Board material	Interconnects, base material
200	200	1.8	0.2	Fiberglass (FR-4)	Copper

Table 1. The initial data

In order to assess the interference emission of the first element on the second one, it is necessary to place the probe element, which allows to measure the value of the electric field (V/m). The figure 1 represents the model of PCB and two placed elements. The figure 2 shows the element as well as the probe, which is intended to create an electromagnetic effect.

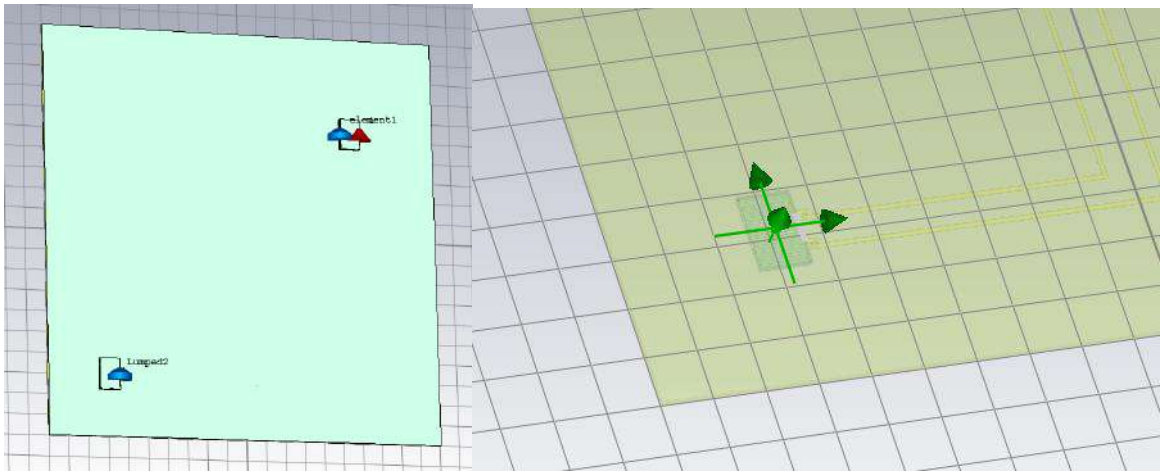

Figure 1, 2. PCB, Probe

In order to solve the intended problem, the genetic algorithm is used. At the GA selection stage, the most optimal solutions of the task are selected for the transition to the next generation of evolution using the fitness function. Thus, the program automatically selects a suboptimal position for the placed element that corresponds to the established requirements of electromagnetic compatibility. The figure 3 represents the sample of iteration of the software.

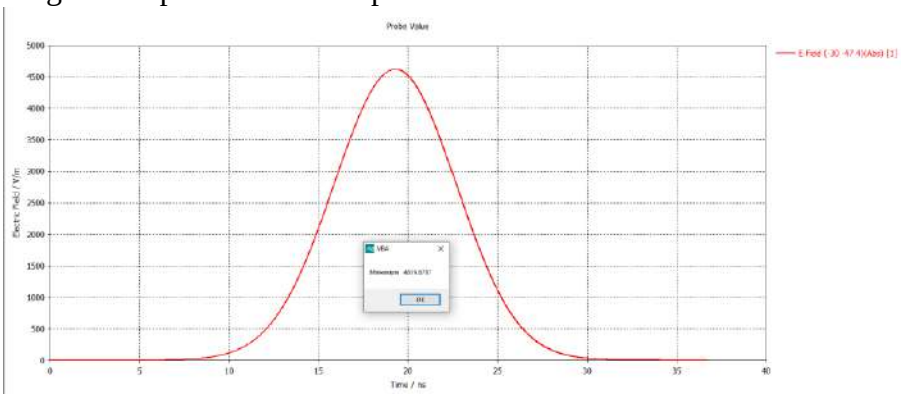

Figure 3. Electric field versus time graph

Taking into account the possible values of the objective function of each individual of the genetic algorithm, the program displays the minimum result, as well as the calculated suboptimal coordinates of the element.

The figure 4 represents the graph which illustrates the value of the fitness function (electric field) of all species created by genetic algorithm.

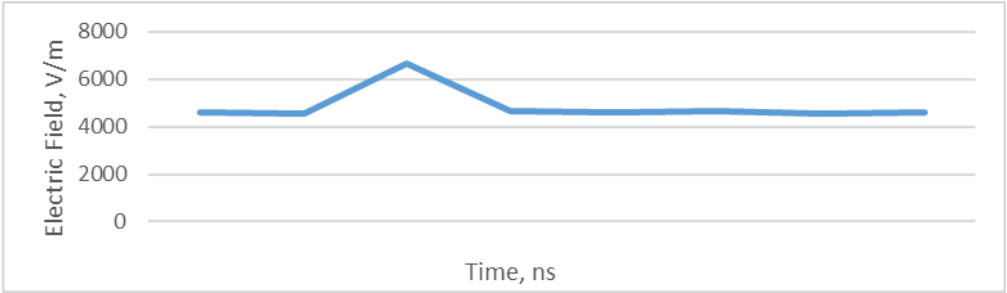

Figure 4. Fitness function values

The suboptimal coordinates of the second element (calculated by the software) and the value of electric field are represented in the table 2. From this table it is clear that the solution for the case presented in this research is the position of the element at the point with coordinates (-29; -38) and the value of electric field 4573.83 V/m.

№	1	2	3	4	5	6	7	8
X	-30	-29	-28	-27	-30	-31	-29	-30
Y	-47	-38	-36	-46	-49	-39	-38	-47
V/m	461 9.67	457 3.83	664 8.17	468 3.21	462 3.03	464 2.77	457 3.83	461 9.67

Table 2. Results of calculations

In the course of this work, an analysis of the output data was done, and the dependence of the value of the fitness function of an individual on the number of generations was established. To say more precisely, increasing the total number of generations of the genetic algorithm, the frequency of occurrence of individuals having the lowest value of the fitness function raises.

In accordance to the goal, many tasks have been completed and numerous experiments have been made. Moreover, it was found that the genetic algorithm is applicable to the problem of element placement on a printed circuit board, taking into consideration the requirements of electromagnetic compatibility. Apart from that, the software implementation was developed that allows to reduce negative consequences occurring in the process of PCB functioning.

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THE MATERIAL USED FOR MAKING HELICOPTER BLADES IN AVIATION

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The rotor blades of a helicopter differ greatly from the wings of an aircraft. The main difference is that the load on the blades is variable over time. Therefore, when choosing the material of the blade elements as the main requirements are the following several:

1) Crack propagation resistance and low sensitivity to voltage concentrators

2) Materials shall not split, deform (excluding accidents and crashes) before the specified operating time, taking into account weather conditions and temperature variations

3) The necessary technological requirements: the possibility of producing the given shapes of the cross-section of the structural elements; increasing the service life of the structural elements by hardening methods; control of the quality of the joints and the specified geometric dimensions during the construction of the structural elements during the blade assembly process; the ability to repair the blade during operation.

In addition to these three items, it is always necessary to take into account the cost of the material and process of blade manufacture, in addition to the cost of its operation.

Using the above, engineers choose the material that has the maximum specific strength and maximum specific modulus of elasticity.

In addition, when forming the longitudinal, the blades are made of hybrid composite materials and strive for maximum compatibility with the matrix material.

Although it is now widely practiced to make longitude from composite materials. But in the years of development of helicopter construction the main power element of the blade - longitudinal rod was made of such materials as wood, alloy steel, aluminum alloys, stainless steel and titanium alloys.

The central part of the spar was made of glued thin sheets of wood, the nose part of the profile consisted of a set of glued pine rails. The tail was a plywood frame glued to the foam. The surface of the blade was covered with fabric and moisture-resistant varnish.

During operation, significant shortcomings of the wooden blade were revealed:

1) Despite the moisture-resistant coating of the blade surface, the elements of the structure were saturated with moisture, resulting in a change in the center of gravity of the section, it shifted backwards, and this reduced the critical speed of the blade flutter;

2) Impregnation with antiseptics did not eliminate the rotting process of wood during operation, while its mechanical properties deteriorated.

I want to note that in the practice of the Moscow Helicopter Factory they. M.L. The mil in the blades used a mixed design, which was that the longitude was made of steel pipe, and the elements of the frame used wood and fabric.

Several years later, due to the requirements for strength, moisture resistance and flexibility of the blade design, engineers thought of using composite materials instead of plywood. They began to be used as they are the easiest in production, when compared to the production of blades from plywood. In addition, the price of composite materials is significantly lower, as is the work and production of the same composite materials.

The most used are fiberglass composite materials on an epoxy matrix. This is primarily due to the low cost of fiberglass, as I mentioned earlier.

Further development of the composite blade design is related to the use of hybrid compositions, the combination of carbon fibre with the organofilament and other similar variants.

The use of hybrid composite materials allows the main power element, the longitudinal rod, to be manufactured with almost any given distribution of masses and stiffeners along the blade length.

Due to the requirements of the blades, and taking into account the active loads, the tail sections of the blade must meet the following requirements: structural strength, minimum mass, structural rigidity, sufficient life (at least the life of the blade longitudinal), smooth aerodynamic surface, possibility of manufacture in serial production, possibility of repair in the field, etc.

In operation, the tail sections of the blade of three-layer honeycomb design are well established. This section has plating, end ribs and stringers made of technical fabric based on organic fibers and filler of honeycomb. The use of the lightest composite material in the design of the tail sections makes it possible to reduce the mass of sections in comparison with fibreglass and to increase the service life.

In the end, I will say that over all the years of aviation accumulated several important factors of selection of blades:

1) Large safety margin with virtually unlimited durability. The practical service life of composite blades is determined by the degree of their natural wear, depending on the operating conditions;

2) Increasing the service life not only of the rotor blades, but also of the entire helicopter by reducing static and dynamic loads in the carrier system, favorable frequency characteristics and reducing the vibration level of the helicopter. This is ensured by the production process, which makes it possible to produce a longitudinal with variable length and wall thickness and to use together different types of reinforcing material with different orientation. These essential qualities give significant advantages not only over metal blades, but also over other structures of blades made of composite materials;

3) High degree of repairability. Due to the valuable properties of composite materials, high resistance to voltage concentrators and low material breaking rate, it is possible to easily repair even large blade damage in the field;

4) High blade resistance to almost all types of aggressive substances, fuels, pesticides, oils and so on;

5) Stability of blade performance during long-term operation in all climatic conditions. The long-standing experience of helicopters with composite blades has shown that changes in the mechanical properties of the material are so small that they do not affect the performance or service life of the blades.

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5 G INTERNET

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Today, high-speed Internet is widespread all over the world. The so-called 4g seemed like something breakthrough and unimaginable ten years ago, but now more than 80 countries are using these benefits. And the Internet speed is estimated at 100 MB per second.

However, we are on the threshold of a new level. Already in our time, advanced countries are beginning to introduce 5g Internet. Its speed will exceed the previous threshold by dozens of times, which is already difficult to imagine, although we should not forget that people used to have this opinion too.

What is 5g Internet? This is a new generation of high-speed Internet that will allow people to use the Internet on a phone with huge data transfer capabilities. New developments work on the following principle: the higher the frequency of the signal, the more information we can put into this signal, that is, the higher the frequency, the higher the speed. It sounds simple enough, but then why won't 5g Internet be implemented in all countries for so long? The benefit of high-speed video also has a price that we pay for it: it is a low signal throughput. A signal with frequencies in GHz is not able to travel long distances. Any obstacle extinguishes short electromagnetic waves. Even ordinary rain will interfere with such a signal. This problem can be solved by creating a large number of substations that will pick up and redirect the signal. Unfortunately, this requires an impressive cost.

What is the difference between 5g and 4g? Indeed: both formats work on radio waves, but what is their difference? The difference lies fundamentally in the frequency range at which the signal can go. For example, 4g Internet operates at wavelengths up to 2600 MHz, and 5g is capable of operating at frequencies up to 100 GHz.

However, to explain the high speed of the Internet only by a large number of waves per unit of time will not be entirely correct, because the amount of information that we send to the carrier wave is enclosed in the subcarrier wave and, accordingly, depends on its range. We say that information is enclosed in frames, which consist of subframes enclosing slots. Subframes already depend on the width of this very subcarrier wave. As an example, radio stations can be cited: the quality and volume of sound on different radio stations with different frequencies do not differ in any way. Then why is it said that 5g is better than the old formats due to the frequency of the wave? The fact is that the carrier wave should be much smaller than the subcarrier, with which we provide information. Accordingly, in order to provide more information, we need to have a large spectrum of subcarrier waves, which means the corresponding spectrum of carrier waves. That is, we can feed the same information stream to different carrier waves, but in order for us to feed a large flow of information, we definitely need to have a large spectrum of carrier waves.

5g networks are already being implemented around the world. The requirements for the standards were developed already in 2015, but progress is not fast. It is worth noting, however, that this direction is already interesting to investors and other commercial figures.

Another important problem related to high–speed Internet is the approval of governments of different countries regarding frequency ranges. Not all frequencies of the state are ready to give up for civilian use. Radiophysics is a very important part of the military infrastructure, so allocating some frequencies for military structures is not a pleasant action.

There are two options for launching a 5g network: mobile and static. Mobile is used when it is required to generate a radio beam for a specific subscriber. That is, the range of the network increases significantly, but the signal suffers from such transformations. The network speed in this mode will be lower than in stationary mode. What is the advantage of stationary? The fact is that he does not have such complex actions, which means that the signal arrives quickly and clearly. The problem lies in another: since we do not help the signal reach the recipient in any way, then it will be quite easy to dispel this signal.

As an example of the successful use of 5g in real life, we should recall Samsung's campaign to advertise new developments. One of the stages of the project is that test tablets were issued at the 30,000-seat stadium on which they were able to demonstrate the match in 4k resolution simultaneously on all screens. The experiment was successful: it was shown that the network is capable of transmitting a huge amount of information to a large number of devices.

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УДК 629.7

TILT ROTOR AIRCRAFTS AND THEIR TRENDS AND DEVELOPMENT IN RUSSIAN FEDERATION

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A tilt rotor is a rotary—wing aircraft with rotary engines (as a rule, screw engines) that work as rotors during takeoff and landing, and in horizontal flight — as pulling or pushing. The lifting force is created by an airplane-type wing.

This design is functionally similar to a vertical take-off and landing aircraft (VTOL).

Sometimes tiltrotor planes are mistakenly referred to as rotorcraft, which is incorrect, since a rotorcraft has one or more propellers independent of the main rotor system(s).

The propellers used in convertiplanes are lightly loaded ones operating at a low—speed. They are similar to helicopter propellers, that allow the device to fly in helicopter mode - with a small angle of rotation of the propellers. Large tiltrotor propellers help aircrafts to takeoff at a vertical angle, but in horizontal flight they become less effective compared to smaller-diameter propellers of a traditional aircraft.

What is more, it's important not to confuse a tiltrotor with rotary mechanics and an aerogibrid with fixed mechanics (for example, a quadplane is a hybrid of a quadcopter and an airplane). All aerogibrids are a less effective solution compared to tiltrotor planes, so with comparable sizes and schemes, tiltrotor planes can outperform aerogibrids by almost 10 times.

Currently, a mass-produced V-22 Osprey tiltrotor with a flight weight of 27.4 tons and a maximum flight speed of 509 km/h in airplane mode and 185 km/h in helicopter mode is operated in the USA.

Russian projects

One of the first Russian convertiplanes was the project of the company "Aeroxo" — ERA-100, Its production started in 2012 and it was presented at the MAKS-2015 air show. Currently, Aeroxo LLC develops and operates a family of ERA-54x tiltrotor planes, that use a patented aerodynamic scheme, with a take-off weight of up to 30 kg. "Aeroxo" designed the Aviabike ERA tiltrotor, which became a finalist in the GoFly competition held by Boeing.

One of the most energy-efficient and high-tech solutions today is the ADA Aerospace tiltrotor - the TRIADA project (based on their patented aerodynamic scheme described in the patent for the invention issued to the company). The developers have solved a number of key problems of this scheme, which made it possible to achieve high flight performance compared to other solutions.

A prototype of the VRT30 experimental unmanned tiltrotor developed by Russian Helicopters Holding was presented at the MAKS-2017 air Show. Using this prototype a model, they are planning to create a military car with a take-off weight of up to two tons.

The Kronstadt group is preparing its own version of a heavy unmanned tiltrotor [9].

In February, 2021 the Kalashnikov Concern presented an unmanned aerial vehicle-the ZALA VTOL tiltrotor.

In the Arctic region, these projects are mostly awaited, as the tiltrotor practically does not require an airfield, a sufficiently equipped or improvised landing pad.

You can't but admire these "beauties". They are hybrids that are not fully helicopters or airplanes. Their configuration looks like a picture from the future. But they become a reality long time ago, thanks to the contribution of the Soviet scientists and engineers of aviation technology.

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УДК 616.31

CREATING FUTURE POSSIBILITIES. MANUFACTURE OF ARTIFICIAL ORGANS USING 3-D PRINTING

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Modern society could not exist without new technologies and scientific inventions. Some of them have changed ideas about the world or people's lives. Over the past few years, scientists have made many discoveries that have helped significantly to improve the quality of our daily life and understand how the world around us works. This can also be applied to modern medicine.

One of the important directions of modern medicine is the creation of artificial organs. Artificial organs are human–made organs that can replace the real organs of the body.

Today, many experiments have proved the possibility of growing cartilage formations on the basis of stem cells of bone marrow, liver, pancreas tissues. Using modern research methods, doctors will be able to treat people. Therefore, in our time, 3D is getting a lot of distribution and is an urgent task.

The purpose of this article is to tell about the achievements in the field of printing.

So, in 2010, with the help of 3-D Bioprinting, for the first time it was possible to print a fragment of skin, and in 2014 — a heart valve and a fragment of liver tissue. In 2011, a prototype of an artificial kidney was created using 3D bioprinting, in 2016 a section of human nervous tissue with precisely positioned neurons was printed on a bioprinter.

In 2015, the Russian company 3D Bioprinting Solutions was the first in the world to create a functioning mouse thyroid gland using 3D bioprinting.

The Russian bioprinter FABION was used to print the thyroid gland from cells taken from mice. The printed organs were transplanted into mice that were under the supervision of specialists and whose thyroid gland was destroyed with the help of radioactive iodine. Bioprinting of the organ structure of the thyroid gland was successful.

The result of the work is an undeniable breakthrough in the field of regenerative medicine.

It can be said that the thyroid gland was not chosen by chance - it is one of the most complex and at the same time important organs created by using 3D printing. [1]

The achievements of Russian science today allow us to say that Russia is becoming a world leader in bioprinting.

Thus, we can conclude that thanks to 3D modeling, we can solve the most difficult tasks and help people. Therefore, now scientists around the world are in full swing developing the technologies connected with 3D printing of human organs that will allow not only to return lost body parts or damaged organs to a person, but also to replace them with more durable and functional materials.

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УДК 621.763

AN OVERVIEW OF ADDITIVE TECHNOLOGIES

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Due to scientific and technological progress and the beginning of the sixth technological mode, new methods of production of complex products appear, including those for aircraft assemblies. The aim of the paper is to analyze the advantages and disadvantages of a new technology used for creating parts, namely additive manufacturing, which is based on layer-by-layer build-up and synthesis of the object.

Today, additive materials are already being introduced in many areas and industries. Their use makes it possible to obtain parts with complex shapes, as well as elements that are difficult to obtain using traditional casting and machining technologies. The use of composites makes it possible to reduce the number of parts in a part, thereby speeding up aircraft assembly.

These technologies make it possible to produce parts from a wide range of materials, including aluminum alloys. In addition, using powder technologies it is possible to obtain various metal matrix composites reinforced by ceramic and refractory particles. An additional advantage of this technology is a significant reduction in the production cycle of the finished product; thus, material utilization rate reaches 95%.

Additive manufacturing involves all major types of materials: polymeric materials, metallic materials, ceramic materials, and composites. Unlike metals composites are not subject to fatigue. At the same time polymeric composites have a number of disadvantages: composites are still much more expensive than metals, and their use pays off only in a long time of use.

The weak point of polymer composites is their impact strength. Due to impact microcracks form in the composite part, which causes delamination of material when cyclic loads are applied. If a composite part breaks, it has to be completely replaced with a new one. Existing repair technologies are not very reliable, and are rarely used in aviation industry. To keep track of appearance of cracks, complex diagnostic procedures are needed. For example, fiber optic sensors are embedded into composite in order to determine the integrity of material structure online.

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PROSPECTS OF USING ALTERNATIVE ENERGY SOURCES IN AIRSHIPS FOR CIVIL AND SCIENTIFIC PURPOSES

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The article uncovers the topic of using alternative energy on board airships from the point of view of its environmental potential. Nowadays, due to the tightening of environmental policy regarding fuel resources and the development of alternative energy sources, the design and usage of these machines for civil and scientific purposes that meet the needs of economical fuel consumption is very relevant. Airships meet these requirements, since the huge area of their gondola and balloon makes it possible to accommodate a large amount of research equipment, meteorological measurement devices etc. The airships' large carrying capacity in comparison with other aircraft (Table 1) can be a major advantage for long expeditions and scientific research. They can become excellent mobile bases and observation posts.

№	Aircraft	Max. Takeoff Weight	Dimensions	Payload	Max. flight time
1.	**Airship Hindenburg ***	220 tons	Length: 245m; Width: 41,2m	100 000 kilo	61 hours 40 minutes
2.	**An-225 «Kazak» An-225** (the biggest aircraft in the world)	640 tons	Length: 43m; Wingspan: 88m	250 000 kilo	18 hours
3.	**NK-1 «Spruce Goose»** (it has the largest wingspan of any aircraft)	185 tons	Length: 66,45m; Wingspan: 97m	59 000 kilo	13 hours
4.	**Airbus A380F** (the largest passenger aircraft in the world)	590 tons	Length: 72,1m; Wingspan: 79,5m	150 000 kilo	17 hours
5.	**Airship CCCP B-6**	50 tons	Length: 45,4m; Width: 10,3m	8500 kilo	130 hours 27 minutes
6.	**Airship "Moscowskiy Resinshik Himik"**	5 tons	Length: 45,4m; Width: 10,3m	900 kilo	40 hours

Table 1. Comparative characteristics of carrying capacity and maximum flight time of the largest aircraft.

Despite the obvious advantages of the flight characteristics manifested by these aircraft, the airship industry is going through hard times. However, thanks to modern technologies and

alternative energy sources, the efficiency of airships can be brought to a higher level. Still, the main task is to find a universal and environmentally friendly source of energy or fuel.

The most important advantage of airships associated with the ecological situation in the world is that they are environmentally friendly. Even the largest of the modern airships are designed to have four diesel engines, whose exhaust is much less than any of the aircraft power storage, and the large size of the airship allows, using the latest developments, to install alternative energy sources such as solar panels and wind turbines. When rising to high altitudes, the clouds will not block the sunlight, therefore, the efficiency of solar panels will increase to a maximum value, and strong wind currents will spin the wind generators installed on the gondola. This power will be quite enough to provide electricity to the ship's crew. The main problem lies in the main engines, which powers they(уточнить термин). There are two options: the installation of only electric propeller installations or a mixed system, that is, turboprop installations. In the first case, the maneuverability and speed of the airship will decrease significantly, but environmental friendliness will reach its maximum level, the airship will absolutely not affect the environment (see Table 2):

Energy source	Capacity, Watt
Solar panel	10^3 per sq.m
Wind generator	for 8 * 10^6
Diesel generator	for 2 *10^6

Table 2. Comparison of power characteristics of different types of energy sources.

The use of airships is grossly underestimated in the world. The application of the latest developments and the introduction of the correct safety measures based on previous experience will ensure the high efficiency of the aircraft and will make it possible to perform various tasks and scientific research. Also, these machines are relatively cheap to manufacture and operate, which demonstrates their obvious advantage over other aircraft types.

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УДК: 629.7

COMPARISON OF MOSTLY POPULAR USED AIRCRAFTS IN RUSSIA: AIRBUS A318, BOEING 737-500 AND SUKHOI SUPERJET 100

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Nowadays there is an acute and urgent issue with the usage of native aviation equipment.

The aim of the research work is to compare the two brightest aircrafts in the world, the Airbus A318 (further, Airbus) and Boeing 737-500 (further, Boeing), with the brightest representative of Russian aviation industry, namely, the twin-engine airliner Sukhoi SuperJet 100 (further, Superjet

or SSJ 100). The main flight characteristics, operational features, advantages and disadvantages of each of the aircraft are of the primary concern.

First, main flight characteristics of each airplane were analyzed. Secondly, the Airbus A318 was compared to the Boeing 737-500. Finally, the comparison with the SSJ 100 was made.

The analyses and comparison is made according to such flight parameters as control, safety, engines, simplicity and convenience for usage by the crew and passengers respectively.

The control is more crew-friendly for Airbus, as the aircraft is controlled by a sidestick, as opposed to a Boeing with a steering wheel. During landing, pilots have one hand on the engine control lever, the other on the aircraft controller, in this case the steering wheel is inconvenient. [1] The sidestick wins the steering wheel in terms of pilot comfort, because during long-distance flights, the pilot's legs may be uncomfortable because of the steering wheel between the legs. So, the manual control system on Airbus is more convenient than on Boeing. [2]

In terms of safety, Airbus provides the operation of the aircraft as follows: the pilot uses a sidestick to make some maneuvers, thereby giving a command to the on-board computer, meanwhile the computer analyzes this command and only then transmits it to the controls of the aircraft (wings, steering wheel, altimeter). EVERY action of the pilot passes through the "brain" of the on-board computer, so in case of a pilot error, the computer will not allow it to happen, it will simply reject the command.

Everything is much simplier in Boeing. The steering wheel is directly connected to the controls of the aircraft (wings, steering wheel, altimeter), that is, as the pilot rejects the steering wheel, no one will control it and his/her mistake will be inevitable. Therefore, Boeing is once again inferior to Airbus.

The cruising speed of the Boeing 737-500 engine is 796 km/h, the maximum flight distance is 4398 km.[2] Cruising speed of Airbus A318 is 829 km/h, maximum flight distance is 5740 km. Airbus aircraft has higher fuel consumption. The engines of Airbus are much quieter, so the flight is correspondingly more pleasant for users. [1]

By itself, the Airbus aircraft is much easier to control, as basically everything is electronic, there are just few buttons. Boeing has more mechanics in the system of its operation. On the other hand, Boeing also has advantages that makes it superior to Airbus. This is the pilot's main screen. Speed and altitude are visible on the screen up to one, it is simpler by itself, that cannot be said about Airbus. On Airbus, only approximate values of altitude and speed are given.

Also, the connection of the steering wheels with each other at Boeing aircraft should be considered. During manual piloting by one pilot, the steering wheel moves synchronously for both pilots, as they are interconnected. That means that a pilot who is not piloting at this very moment is able to view the position of his steering wheel and understand the pilot-on-charge actions. [2] There is no such function on Airbus. The sidesticks are not interconnected, and therefore, during piloting, a non-piloting person cannot see the actions of the piloting pilot on his sidestick, as the sidestick stays in stationary mode. [1]

In general, by itself, the Airbus cabin is more comfortable. It's wider, taller, it's generally larger. Also, the Airbus seats are more comfortable, there is no a “cut” in which the steering wheel is located.

The cabin of the Airbus is wider, the seats are wider as well, there is more legroom, the ceiling is higher than that of Boeing. All these make Airbus more attractive.

Therefore, according to the analysis, most of the flight characteristics are better for the Airbus A318, that makes Airbus superior to Boeing.

The last step is to make a comparison with the Superjet. The Superjet was conceived not only for the domestic market usage, but also for sale. Originally, the main criteria has been observed as the possibility of certification of components individually, and as a whole unit according to the European and American aviation safety regulations/standards). The Superjet's share of imports in 2017 amounted to 70.2%, taking into account the supply of engines, which account for about 34% of the material costs in the structure of the cost of aircraft. [3] Despite the fact that SaM146 is being assembled in Rybinsk, the company producing them, PowerJet, is registered in France. In the first

half of 2018, this share decreased to 68%. It is obvious that with the start of the import substitution program, these indicators will continue to decline in order to bring the share of American components to less than 10%, which will allow aircraft to be sold to Iran bypassing sanctions and obtaining permission from the FAA. [4] Every year the share of imported supplies decreases, and now Sukhoi Superjet NEW is being produced, which will have a minimum number of imported parts and even the engine will be Russian-made. Now the SSJ 100 is condemned for a large number of imported parts, but, for example, according to the Society of Professional Engineers in the Aerospace Industry of the USA, the Boeing 787 has foreign-made components by more than 30% - this is more than any other Boeing aircraft. In case with Airbus, the cooperation of the consortium provided for the broad participation of European countries, not only France, Germany and the United Kingdom.

If to consider the Brazilian Embraer, a direct competitor to the Embraer E-Jets Superjet, then the picture is as follows:

- if all the design and all the tests of the Superjet are carried out in Russia, Embraer do it with the involvement of foreign performers;

-the airframe, including the wing and tail of the Superjet, is completely Russian-made, while the Embraer parts of the fuselage, wing and tail are manufactured abroad;

-products made of polymer composite materials for the Superjet are produced Voronezh Stock Aircraft Building Company (VSABC), Embraer has all of them imported;

-metal for the Superjet is of Russian origin, Embraer has both rivets and metal imported. 100% titanium for E-Jets is supplied by the Russian Public Stock Company «VSMPO-AVISMA Corporation»

Public also scolds the SuperJet because of its “childhood diseases”(Childhood diseases are defects of aircraft which are recognized in starting period of maintenance after release), but a few years after the release of the aircraft, this is absolutely normal. The new airplane is flying, various kinds of errors appear in it, the company analyzes these errors and corrects them on all airplanes. Every year there are fewer and fewer mistakes, and the reliability and practicality of the aircraft is constantly growing. The same situation is with “childhood diseases” at Airbus. Because of this, aircraft companies are not willing to buy them, as there is a reliable Boeing without such problems. But a huge amount of Airbus has been purchased by the United Arab Emirates. The planes have been being operated, the “childhood diseases” have been being corrected over time and at the moment it is the most advanced and most reliable aircraft. So, the SuperJet has good prospects in the future and is quite reliable at the moment, that can be approved by statistics. For example, in total, more than 10,500 aircraft were produced during the entire production of the Boeing-737, 211 were lost in plane crashes, which is 2% of losses. For Airbus-318 (plus line of 319/320/321) this indicator is much better: more than 8850 aircraft were built, 42 of them were lost, that makes 0.47% of losses. The Superjet is in the middle in this category: 187 aircrafts were produced, of which 3 aircrafts were lost, this is 1.6%, while all three aircraft were lost not for technical reasons, but because of the human factor. The Interstate Aviation Committee’s (IAC) preliminary report on the Aeroflot Superjet crash on May 5, 2019 in Sheremetyevo confirms this fact.

Sukhoi SuperJet is also highly praised by pilots because of its comfort in the cockpit and easy handling. But engineers are a bit not satisfied with it because the aircraft is difficult in technical operation, structurally being inconvenient for technical maintenance.

Summing everything up and comparing Airbus and Superjet, we can state that they are equal according to the parameters discussed. Airbus was originally viewed as a prototype for Superjet. Both aircraft are controlled by the “fly-by-wire" system. This is a high-quality, promising and safe Russian analogue of the Airbus. It is always better to have your own production than to use foreign products. So, the use of Superjet by Russian airlines is absolutely justified, especially if to take into account the current situation economic and political situation.

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УДК: 616.1

EARLY MONITORING OF MYOCARDIAL DAMAGE AFTER COVID-19 (SARS-COV-2)

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COVID-19 is a disease caused by a new coronavirus called SARS-CoV-2. The World Health Organization first became aware of this new virus in early 2022 when a group of cases of "viral pneumonia" was reported in Wuhan, People's Republic of China [1].

The past pandemic coronavirus infection can be categorized as an example of a large-scale tragedy that had many complex and long-term consequences in all areas of life, society, and the world economy. We faced an unprecedented situation during this pandemic, with entire countries having restrictions such as curfews, school closures, and restrictions on meetings and travel. To this day, however, the coronavirus infection has not been defeated. Although the rate of infection has been greatly reduced since the beginning of the pandemic, it continues to infect people and mutate, which could create another wave of large-scale infections in the future.

According to official data, as of 06.30.2022, there were 18430239 new coronavirus infections in the Russian Federation, of which 381112 have died.

The high socio-economic significance of this disease is because up to 15% of patients infected with COVID-19 have an initial severe type of pneumonia, which may subsequently progress to acute respiratory distress syndrome (ARDS) and multiple organ failure (PON), as well as death [3]. ARDS is the most frequent complication in patients with COVID-19. In addition to respiratory symptoms, another damage (e.g., myocardial damage) has been observed [3]. There are many possible causes of acute myocardial damage in patients with COVID-19, such as acute coronary syndrome (ACS), myocarditis, heart failure, hypotension or shock, and sepsis [4]. Acute myocardial damage can range from an asymptomatic course to fulminant myocarditis and circulatory shock in patients with COVID-19.

Myocarditis is an inflammatory disease of the heart muscle (myocardium) [5]. Therefore, patients with concomitant cardiovascular diseases, such as arterial hypertension, coronary heart

disease (CHD), and heart failure against the background of COVID-19 course are more frequently hospitalized in ICU, as well as higher mortality in this group of patients is noted. It has been revealed that acute cardiac damage in patients with COVID-19 is detected in about 14-30% of cases.

The prevalence of COVID-19 in patients with cardiovascular disease is difficult to estimate because of varying degrees of national surveillance and data collection worldwide. China reports that up to 40% of patients admitted to hospitals with COVID-19 had pre-existing cardiovascular disease. A systematic review of 72 studies from different countries reported an overall prevalence of cardiovascular disease and arterial hypertension of 8.3% and 13.3% of patients with COVID-1, respectively.

The presence of concomitant cardiovascular disease in patients affects the prognosis of the disease, increasing the risk of a severe course of the disease. It has been proved that mortality in patients with CVD reaches 10.5%, and in patients with arterial hypertension - 6.0%, which is statistically significantly higher than in patients without comorbidities (0.9%).

COVID-19 infection leads to chronic and acute damage of the cardiovascular system, realized by direct damage of cardiomyocytes by inflammation mediators, interstitial myocardial fibrosis, cytokine reaction of T-helper cells, destabilization of coronary plaques, hypoxia and interferon-mediated immune response. Myocardial damage caused by COVID-19 infection increases both the difficulty of diagnosis and the complexity of treatment in this patient population. In addition, cardiac dysfunction can be masked by symptoms of pneumonia, which can delay treatment. Thus, mortality in patients with COVID-19 can potentially be reduced by labor-intensive and effective treatments. Therefore, the search for reliable and objective markers of early detection of myocardial damage and elimination of adverse cardiac events observed in COVID-19 seems relevant.

Currently, the "gold standard" for detecting myocarditis is magnetic resonance imaging of the heart. However, significant disadvantages of this study are the high cost, time of the study, as well as lack of changes on the first day of the disease.

It should be noted that there are several biomarkers related to myocardial damage and indirectly to the severity of the COVID-19 course. However, myocardial damage biomarker levels are influenced by many factors, such as infection, hypoxia, and renal function, so the possibility of "false positives" of myocardial damage in patients with COVID-19 should be considered, therefore, the criteria for choosing the use of any biomarker are high sensitivity, stability in plasma and specificity in the diagnosis of cardiac damage.

In studies of the last 20 years, special emphasis is placed on the study of neurohumoral activation from the position of the content of the N-terminal fragment of brain natriuretic peptide (NT-proBNP). According to the recommendations of the European Society of Cardiology (2005), the estimation of NT-proBNP level is included in the list of necessary research at the screening of early stages of CH, monitoring of the efficiency of carried out therapy, and prognosis estimation in adult patients with CH.

According to studies, NT-proBNP assessment in patients with COVID-19 at admission has shown that higher levels of natriuretic peptides are associated with older age, the presence of cardiac and noncardiac comorbidities, worse vital signs, frequent episodes of decompensation of heart failure, and higher mortality from various causes.

Thus, in severe cases of new coronavirus infection, measurement of NT-proBNP levels may be useful for early monitoring of the presence of heart failure, early detection, and timely treatment of cardiovascular complications.

Fortunately, biochemical blood analyzers that can easily and accurately determine the amount of natriuretic peptide (NT-proBNP) in human blood have developed very strongly these days, which in turn will allow timely detection and start treatment of cardiovascular diseases.

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УДК 62

INVESTIGATION OF ACCIDENTS WITH BOEING 737 MAX AND POSSIBLE WAYS TO PREVENT THEM BY IMPROVING THE TRAINING OF FLIGHT PERSONNEL

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Introduction

Within six months, there were 2 plane crashes involving a Boeing 737 MAX. In October 2018, such a plane of the Indonesian company Lion Air crashed into the Java sea shortly after departure from Jakarta airport, killing 189 people. On March 10, a Boeing 737 MAX flown by Ethiopian Airlines went down on departure from Addis Ababa with the loss of everyone aboard, and within a week all further flights of the 737 MAX were stopped worldwide.

The history of competition between Airbus and Boeing

To deal with both crashes, it is necessary to recall the history of the creation of the very first revolutionary Boeing 737, which initiated the process for developing civil aviation aircraft production.

In 1967 it was a small plane with small engines and with simple system of controls.

The main innovation of Boeing was that only two people could pilot this type of aircraft. This contributed to a significant reduction of ticket prices. This fact was the reason for the huge success of the Boeing Company.

When Boeing had already achieved global fame, a new company called Airbus was created in Toulouse, France. The founder engineer of this company was Bernard Ziegler, who decided to take on Boeing by creating a robotic new airplane that would require minimal piloting skills largely by using digital flight controls to reduce pilot workload. **The idea was that it would no longer be necessary to protect the public from airplanes if Airbus could get airplanes to protect themselves from pilots.**

Airbus' efforts led to the smartest airplane ever built, a single-aisle medium-range “fly-by-wire” masterpiece called the A320 that entered the global market in 1988, led the way to all other Airbus models since and has been locked into a battle with Boeing’s relatively conventional 737s for the past 30 years.

In pursuit of the championship in aircraft construction, Airbus in 2010 introduced a version of the A320 called the A320 NEO ("new engine option") that offered large improvements in fuel efficiency, range and payload.

In order not to be outdone by a competitor, Boeing quickly, within 5 years, presents its new generation of B737 MAX. To minimize the time and reduce the cost of its production, Boeing does not depart from the basics of production of the first B737 model: flight characteristics must be within the previous certification, otherwise it will take a lot of time and money to certify a new one. This is why the B737 was not considered a completely new aircraft. Airbus had similar

requirements for Neo. This avoided the burdensome new certification of the aircraft. And then there was a problem. Boeing test pilots found that the MAX had unusual stall characteristics when the flaps were down and the engines generated thrust.

The problem of installing new engines on the B737 MAX and ways to solve it

The reason for the unusual stall characteristics was the new engines, or to be more exact, their location. If you make a small comparison of the external characteristics of the A320 and B737, you can see that the fuselage and wing of the A320 are much higher than its competitor, which gave Airbus an opportunity to replace the aircraft engines with larger and, as a result, more powerful ones.

This was the easiest and fastest way to make the engine more efficient in terms of fuel consumption per unit of power. For the same reason, Boeing wanted to install huge CFM International LEAP engines in the new 737 model.

However, the original 737 by today's standards was equipped with very small engines, which made it easy to place them under the wings.

But as the 737 grew in size, its engines also grew, and the clearance between them and the ground became less and less.

According to Boeing, the correct solution to the problem was to increase the length of the nacelle and shift the engines along the longitudinal axis of the aircraft forward, which made it possible to lift them slightly higher, while not touching the ground. This has led to a shift in the centerline of thrust of the engine. Now if you increase engine power, the plane was inclined to pitch up. So, the trend to pitch up with increasing engine thrust in practice means the risk of development of stall aircraft. This development becomes more probably when the flight speed is low.

The engine nacelles are pushed so far forward and so large, they create lift themselves, especially at high angles of attack (AOA). That is, in addition to increasing the lift of the wing, there are two additional lifting forces: one of them is formed on the lower part of the nacelle, the other — on the top. Fig. 1 shows the layout of the engines relative to the airfoil on the classic version of the B737. Due to the minimum length of the lift arm, which is created by the nacelle, it slightly changes the flight characteristics of the aircraft.

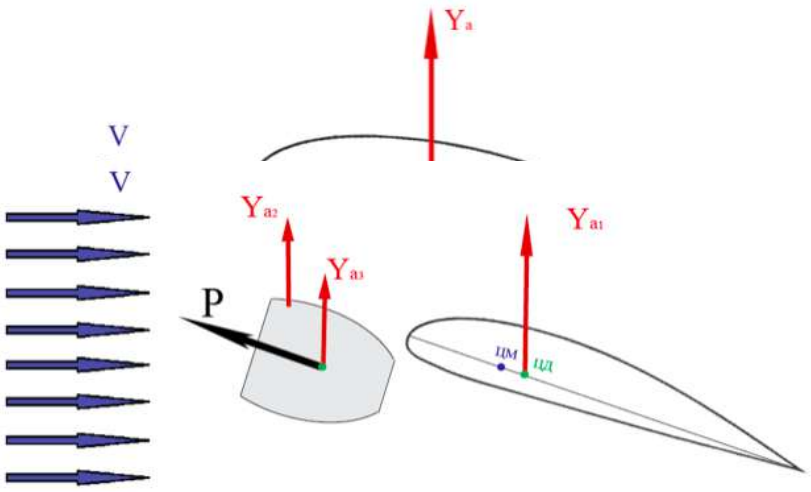

Fig.2. Engine layout on the B737 MAX at large values of AOA

Fig.2 shows the layout of the new engine relative to the airfoil of the B737 MAX. The nacelle shifted a large distance from the center of mass axis, which led to an increase in the length of the arm. This caused a significant increase in the lift moment of the nacelle. Most likely, at high AOA, the nacelle's nose up moment exceeded the wing's nose down moment, which led the Boeing company to create a "Maneuvering Characteristics Augmentation System" (MCAS).

MCAS description

What does MCAS do? This system lowers the nose of the aircraft if the aircraft is going beyond the acceptable AOA to avoid an aerodynamic stall. Boeing installed the MCAS in the 737 Max due to the fact that the larger engines and their new location made stalling more likely than in previous generations of the model.

The moment the MCAS notices that the AOA has become too high, it begins to control the runway trim, directing the aircraft's nose down. At the same time, using the "Elevator Feel Computer" (EFC), it creates a grip on the control column by setting it to the forward position.

Conclusion

A possible variant of the correct actions, which should have occurred in a plane crash:

The runaway trim is needed to remove the effort on the control column. This system has two modes of operation — automatic (electric motor) and mechanical (manual trimming wheels). The Boeing 737 FCOM says that even in the extreme position of the stabilizer, the moment created by the elevator should be enough to control the aircraft.

But in situations where the speed is too high, and the automatic trimming system for one reason or another does not work, the aerodynamic forces which are created on the horizontal stabilizer do not allow you to control the stabilizer in mechanical mode.

An experiment was conducted on the B737 flight simulator, during which a similar situation was simulated. The plane's stabilizer was fully switched to the "pitch down" position.

Experiment progress:

1. An attempt was made to trim the aircraft in mechanical mode. However, no matter how much effort was applied to the hand-trimming wheel, it was impossible to move it by a single centimeter.
2. To parry the «pitching down» moment, the control column was moved to the extreme position «towards»
3. After some time, while the control column was in this position, the captain released the control column, putting it in neutral. It was psychologically difficult to perform these actions, knowing that the aircraft stabilizer was already in the "pitch down" position
4. While the plane was descending, namely to pitch angles of -7, both pilots successfully turned the manual trim wheels, because when the horizontal stabilizer AOA decreased, thereby reducing the horizontal stabilizer lift coefficient, and therefore the entire stabilizer lift.
5. After three or four repetitions of these actions, the effort on the control column decreased and the plane safely entered horizontal flight.

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УДК 621

GENERATION OF ELECTRICAL ENERGY ON HIGHWAYS

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Abstract: The key idea of this work is to show how alternative sources of electrical energy can be used.

Keywords: energy, energy, wind generator

One of the hot topics of the modern world is the distributed generation of electricity. This principle considers the production of electricity in the vicinity of the consumer. For the most part,

these are small and compact installations designed for small capacities. At the same time, the consumer is not disconnected from the common, main network in order to stabilize the lack of energy in the absence of generating capacities of additional energy sources. Renewable energy is the main part of additional energy sources for distribution electricity generation[1].

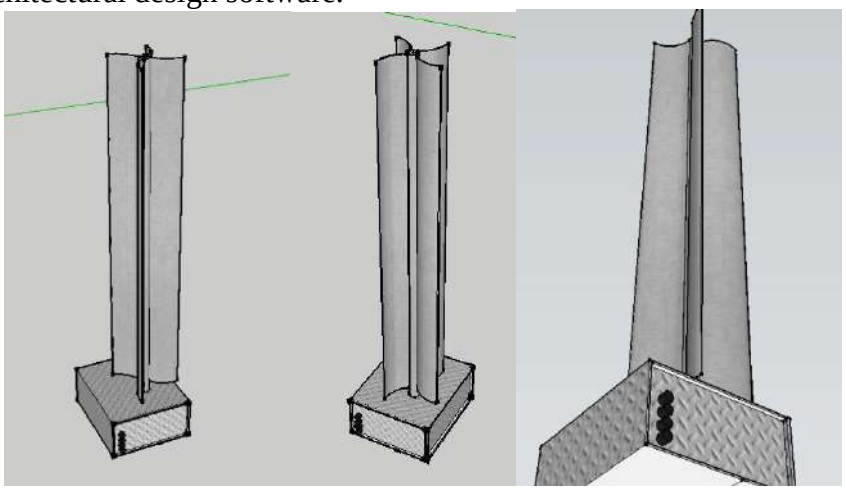
The phrase “transportation of electricity” made me think about the use of highways, or rather wind flows generated by the movement of cars, as an opportunity to produce electricity to provide electricity to the highway itself or for the needs of nearby facilities.

The wind generator is one of the installations for obtaining alternative energy. The wind turbine converts the force of the wind into electrical energy[2]. Since, in our case, there is no need for large and tall wind turbines, this simplifies maintenance, without working at height. Helicoid Rotor This type of vertical wind turbine features heavy installation work, but the rotation of this rotor is smoother and more uniform. Installed bearings remove additional load from the structure. Orthogonal rotor. For the wind turbine to start rotating, a wind speed of 0.7 m/s is required. Rotor with spiral blades. Constant axial rotation and wind flow are not dependent on each other, even if there are sharp gusts of wind, the wind generator will operate at a given initial speed (as is the case with the Savounis rotor).

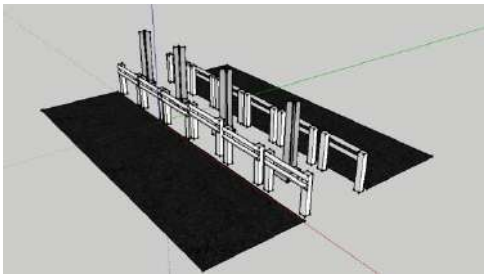
There are also other types of vertical wind generators, such as the Savounis rotor, the Darrieus rotor, the multi-bladed rotor, etc. The main selection criteria are:

- Lifetime,
- Product price,
- Operating conditions,
- The minimum air speed at which the wind generator can operate.

An important stage of this project work is the design of both the design of the wind turbine itself and its integration into the working environment (Pic. 1a., 1b.). The 3D model was created using SketchUP architectural design software.



Pic.1a. Wind turbine “WindGen”



Pic.1b. Integration of wind turbine systems on the median strip.

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УДК 681.518

FEATURES AND METHODS FOR IMPLEMENTING LIGHTING CONTROL IN SMART HOME SYSTEMS AND THE INTERNET OF THINGS

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Natural light is important for a person to improve his psychophysical condition and increase productivity. The change in the intensity and spectral composition of light, characteristic of solar radiation during the day, is a natural regulator of human life. In the daytime, sunlight is characterized by high intensity, high color temperature and a significant proportion of blue radiation. In the evening, the intensity of these components is significantly reduced. People have adapted to such fluctuations in light parameters, and their biological rhythms, on which the change in mental and physical activity during the day depends, are actually determined by three parameters: intensity, color temperature and the blue component of solar radiation. Energy saving and increasing the reliability of lamps used in home lighting is an important feature of the technical needs of modern man. There are various developments that allow, to one degree or another, to realize these tasks. Recently, indoor brightness control has gained momentum under the auspices of projects such as "Smart Home" and "Internet of Things", designed to provide automatic or automated control of household power systems and other amenities. This is due to the ease of management, the possibility of remote management and a number of many other advantages. Domestic and foreign incandescent lamp regulators have a number of disadvantages: control of only one channel - lack of brightness stabilization - the presence of interference, the ringing of lamp filaments, the buzzing of the built-in filter. An overview and qualification of the most popular and relevant lighting control devices in the "Smart Home" system is presented. They are evaluated by the complexity of implementation, cost, and technical capabilities of various types of devices. Various scenarios for automating lighting control systems based on various "ecosystems" of a smart home are also considered: Yandex UD, Apple HomeKit, Google Home, as well as via the Telegram messenger. The most detailed examples of the practical implementation of a lighting control system based on: devices based on the LPD433 radio channel, controllers based on the Atmel microcontroller, as well as controllers based on traditional Bluetooth and Wi-Fi communication standards.

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УДК 620.97

ENERGY SOURCES IN THE FUTURE

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Abstract: Modern technologies and innovative solutions in the field of alternative electricity generation.

Keywords:, innovative solutions, energy resources, energy conversion, piezogenerator, alternative energy sources.

The relevance of this topic is due to the rational extraction of environmentally friendly energy in the future. Real energy sources do not have high efficiency and seriously affect the flora, fauna and climate of the environment. In addition, these methods of converting natural energy into electrical energy significantly reduce the resources of our planet.

Energy can be obtained not only from coal, oil, nuclear power plants, solar and wind, but also with the help of pedestrians. Every person walking on the sidewalk creates kinetic energy on its surface. If we convert this mechanical energy into electrical energy, then we will get a mini power plant. Hundreds of such piezogenerators installed on a busy section of sidewalk can generate a constant current sufficient to charge a package of lithium batteries. This energy can be used to illuminate streets, bus stops, signage. This project was implemented by the British company “Pevegen systems LTD". They successfully produce and sell unique paving slabs all over the world, generating energy thanks to pedestrians walking on it. Tile developers install entire systems on the busiest areas of megacities. Since the tile is waterproof and can withstand heavy loads, it can be installed both inside and outside the room. The efficiency of the system is evidenced by the fact that its placement in a large shopping mall and some crowded streets in London during the 2012 Olympics allowed to obtain 20 MJ of electricity. This was enough to illuminate large city streets.

Electrical energy can be extracted from our daily lives using human physical strength. The principle of the bicycle is a vivid example of this. If you use a pedal drive to activate the power supply of, say, a computer or TV, then this would be beneficial both for the person himself and for the electrical system of the planet. According to research by British scientists, only a TV simulator with pedals could save $64 million a year and burn a lot of extra calories. There are also devices that generate energy due to temperature differences.; devices that allow a person to receive energy from a gravitational system based on the principle of a load falling under its weight. To activate such lighting, it is enough to lift a sandbag, which, descending, sets in motion a generator that allows the lighting to work for about 20 minutes.

In the modern world, there is an abundance of huge, glass office buildings in large cities, which are excellent for implementing a complex of integrated solar cells. In fact, it is the thinnest solar panel in the form of tinting, placed between two glasses. The translucent material made on the basis of the technology of organic photoelectric elements has a low efficiency, about 8%. But considering that there are about 10 million in each city. In total, this complex will be able to provide up to 10% of the energy consumption of a skyscraper, while reducing the increase in solar heat in the building.

Many associate the future with flying wind turbines. A conventional ground-based wind generator is ineffective, as it strongly depends on wind speed and is productive at wind speeds of more than 4-6 m/s. Hence its disadvantages. It is impossible to calculate the exact amount of energy generated. However, a flying wind turbine solves this problem. The fact is that at an altitude of 300

meters, the wind speed is consistently high, and this allows you to use the windy substation as efficiently as possible. A flying wind generator is an annular shell filled with helium, in the center of which a turbine – an electric generator is installed. The scheme is simple, the device is launched into the sky, attached by a cable to the ground, and energy is supplied via a cable from the generator to the ground. There are already a number of projects that use a kite with a 500 kg “Sky Int Power" generator. Two parachute-like kites are used here, which lift, hold and direct two wind turbines. Nevertheless, they also have disadvantages – their high cost of installation and maintenance, as well as their interaction with other flying objects.

Humanity has clearly outlined the vector of development for an alternative way of extracting energy. But development takes time and huge investments.

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УДК 811.111-26

AIRGEL - THERMAL INSULATION OF THE FUTURE

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Annotation: the article provides information on methods for obtaining airgel, as well as the use of airgels based on silicon dioxide as a heat-insulating material.

Keywords: airgel, thermal insulation, sol-gel process, silicon dioxide

Increasing the efficiency of thermal power systems is one of the main tasks of modern energy. One of the main sources of losses are heating networks that transport the coolant from the producer to the consumer. The use of high-tech thermal insulation materials will help reduce losses. Airgel is such a material.

Aerogels are highly porous materials with unique physical properties that vary within the following limits: their specific surface area varies from 500 to 1200 m^2/g, porosity reaches 98%, and density ranges from 0.003 to 0.5 g/cm^3. The thermal conductivity of airgels varies from 0.005 to 0.1 W/(m·K), and the dielectric constant varies from 1 to 2. The value of this material in thermal insulation is obvious [1].

The process of obtaining airgels includes two stages: obtaining a gel (gelation) and removing the solvent from its pores, in other words, drying it. Many elements, such as silicon, sodium and their derivatives, can act as a precursor; in thermal power engineering, gels based on silicon dioxide show the greatest efficiency. At the first stage of obtaining airgels, a two-stage "sol-gel" process was used to obtain gels [2]. During this process, reactions of hydrolysis and condensation of the precursor take place, the rate of which is controlled by catalysts. At the first stage of the process, an acid is used as a catalyst, which increases the rate of the precursor hydrolysis reaction and a sol is formed from the precursor. At the second stage, a base is used as a catalyst, due to which the rate of the condensation reaction increases, the sol particles bind through oxygen bridges and a gel is formed. Hydrochloric acid can be used as an acid catalyst, and ammonium hydroxide can be used as

the main catalyst. The gel is obtained in a solution of isopropyl or methyl alcohol. At the first stage of obtaining aerogels, the main properties of the resulting material are laid [3].

The final stage of the airgel production process is supercritical drying. The essence of this process is to replace the solvent (isopropyl alcohol) inside the gel pores with supercritical carbon dioxide. For this, an experimental installation for supercritical drying was used. Process parameters: pressure 120 atmospheres, temperature 40°C. The supercritical drying process is the main reason for the high cost of airgel.

The drying process can take place without the use of supercritical pressures, but this will significantly reduce the efficiency of the final product, due to the high surface tension, the nanoporous structure is destroyed, leading to significant shrinkage and, as a result, a decrease in thermal insulation properties [4].

Over the years of studying this material, many methods have been developed for obtaining airgel, but a compromise between cost and efficiency has not yet been reached. The high cost is one of the few reasons preventing the widespread use of airgel.

In addition to the high cost, one of the key problems is the choice of the optimal option for combining the insulation material with airgel. This stage can be conditionally divided into two options: the introduction of a substance into the airgel before drying or after it. Before drying under supercritical conditions, the introduction is carried out either at the stage of gel formation, or into a gel filled with an appropriate solvent. After drying under supercritical conditions, the reinforcing components are introduced into the finished airgel, which is most often obtained using the technology of supercritical fluids.

Both options have their advantages and disadvantages. In the first case, the energy costs for drying and the "sol-gel" process increase greatly, and the costs for precursors also increase, since the introduction of substances that increase the elasticity of the final product is required. If the finished airgel is applied to the insulating material, gel shedding can occur, which reduces efficiency, and also leads to dusting, which can adversely affect the health of personnel [5].

Despite certain problems, airgel is one of the real ways to improve the energy efficiency of existing heating systems.

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УДК 621.396

HADRON COLLIDER. BASIC PRINCIPLES AND PROSPECTS OF USAGE

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Introduction

Probably, each of you has heard the word “collider" at least once, but no one can imagine how this is one of the most technically difficult and huge scientific structures ever built by man are arranged.

Goals:

1) To understand the work and structural components of the collider.

2) Find out why the installation is able to reveal the secret of the birth of our planet, the appearance of the solar system and the entire universe in general.

3) To study all possible prospects of the collider operation – minuses and pluses.

Tasks:

1) With the help of scientific literature and add. sources to study the work
the collider from the inside.

2) To study the connection with the Big Bang Theory

3) To understand the possible risks of the collider, as well as the huge
prospects of its use.

How the Large Hadron Collider works.

This is an ordinary cylinder with compressed hydrogen, but it is with it that the work of the largest hadron collider in the world begins. Hydrogen atoms arrive in strictly dosed portions into the feed chamber of a linear accelerator, where electrons are separated from them, leaving only nuclei, that is, protons and neutrons, now the particles move further, their speed at the moment is about 1/3 of the speed of light. The first stage (preparatory) is over, now the particles are ready to enter the booster -2 stage of the collider operation. Here, in order to maximize the density of the particle flow, they are divided into 4 parts, each of which enters a separate booster ring. The length of the path that the particles travel in one circle is 150 meters, at this stage the protons do not collide, but only reach the desired speed. During the movement of particles, they are affected by a pulsating electric field, magnets help the particles to betray the right direction, powerful radiation keeps them on a circular trajectory. The ring accelerator accelerates protons to 91.6% of the speed of light and collects them into a single beam that moves on. The 3rd stage of operation is a proton synchrotron, the length of which is 628 m. Protons travel this distance in 1.2 seconds, accelerating to 99.9% of the speed of light. The energy of the electric field is added to the energy of the motion of the particles, but this does not lead to further acceleration of the particles, since their speed is already approximately equal to the highest, but as a result of such an impact, the mass of protons increases, in short, protons cannot accelerate, but become heavier.

The kinetic energy of each proton is measured in units called ELECTRON VOLTS, at this stage the energy of each particle is equal to 25 billion electron volts, while protons become 25 times heavier than at rest. Now the 4th stage of the collider's operation begins - the Proton super synchrotron - a huge 7 km ring. His task is to accept protons with such a reserve of energy and increase it to 450 billion electron volts. After a while, the beams will be ready to move to the large Hadron collider. A tunnel with a length of 27 km is hidden deep underground . Two vacuum tubes are laid in it, proton beams move along them in the opposite direction. With the help of super-complex devices, new portions of bundles enter the pipes so as not to interfere with the movement of the bundles already loaded there. The particles move clockwise along one tube, and counterclockwise along the other. These pipes intersect in four places where detectors are installed,

it is here that protons can be pushed together. The collision energy is twice the energy reserve of each proton. Within half an hour, about 2,800 portions of particles enter the collider. All this time, the collider gives additional energy to particles moving almost at the speed of light. Every second protons pass 27km more than 11 thousand times. Constantly receiving electric field pulses. The energy of each proton is already 7 tera Electron volts, and the mass is 7 thousand times more than normal. The circular motion of the particles is given by a magnetic field, which is created by superconducting magnets. Now protons collide at the intersection points. The total energy of two colliding protons is 14 Tera Electron volts.

Back to the creation of the world. The LHC and the Big Bang Theory

The Large Hadron Collider allows you to accelerate particles to about the speed of light and collide them. In a collision, before the quarks have formed new bonds, they are in a state of quark-gluon mass. When protons are in this state, with the help of detectors, it is easy to catch unconnected quarks and other previously unknown particles.

To understand why scientists need these particles and what knowledge will be revealed to us as a result of the work of the collider, we will have to go back about 13 billion years ago. According to the Big Bang theory, the universe at the time of formation was in an extremely dense and hot state, called a cosmological singularity. After the explosion, in the first millionths of a second, the universe was a quark – gluon plasma, yes, exactly what we get when particles collide in the TANK, then events developed as follows: after a thousandth of a second, quarks began to combine into protons and neutrons, after 100s the first nuclei appeared, after 380,000 thousand years began to form atoms and only then, millions of years later, the first stars and galaxies appeared. But why are the stars and galaxies exactly like that, and not some other. The answers to these questions can be obtained if we study what was at the very beginning – that is, quark-gluon plasma.

Scientists were able to prove that the physical macrocosm is directly related to its microcosm. People were able to create a mini “big bang”, rewind time and see what happened at the very beginning.

Is it worth taking the risk?

The main arguments in favor of the unreasonableness of catastrophic scenarios are references to the fact that the Earth, the Moon and other planets are constantly bombarded by streams of cosmic particles with much higher energies. Such natural particles, whose energies are equivalent (and even orders of magnitude higher) to the energies at the LHC, are detected in cosmic rays. The possibility of the formation of microscopic black holes is not denied by CERN experts, however, it is stated that in our three-dimensional space such objects can occur only at energies 16 orders of magnitude higher than the energy of the beams in the LHC. Hypothetically, microscopic black holes can appear in LHC experiments in predictions of theories with additional spatial dimensions. Such theories do not yet have any experimental evidence. However, even if black holes occur when particles collide in the LHC, it is assumed that they will be extremely unstable due to Hawking radiation and will evaporate almost instantly in the form of ordinary particles. And in order for this to happen, the microdoor must grow to a large size.

Well, if we talk directly about the need to use the Large Hadron Collider, then I can say that it is very large and significant. Yes, perhaps at the moment no discoveries, except for the discovery of some new particles, are expected at the collider, but everything is ahead. Also, we cannot say with certainty what these discoveries will be, but having studied matter at a fundamentally new level, sooner or later we will realize how to use it. It's scary to even imagine what we can expect: the discovery of new dimensions, parallel worlds, time travel and much more.

Conclusion

The Large Hadron Collider is a device that can change the world. Despite all the possible risks, the benefits that it will bring are several times more significant. The research that is carried out on the installation, at first glance, may seem useless and too risky in such cases, but this is only at first

glance. Progress does not stand still, and perhaps in the near future scientists will be able to find new particles that can lift the veil of secrets associated with the origin of everything in the world.

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ON THE SUBJECT OF THE AMPHIBIOUS HELICOPTER MI-14

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Nowadays the industry is faced with the most ambiguous and truly complex tasks, which can be realized only through the ingenuity of our engineers.

Thus, in 1965, the Navy faced an urgent need to develop an anti-submarine helicopter. So, in 1965, the designers of the Military Bureau officially began developing an anti-submarine helicopter amphibious, not inferior to the American "Sea King". In fact, work on the subject began much earlier - back in the late 1950s. Of course you can not just come up with a working machine from nothing, which is why engineer took the Mi-8 helicopter as a prototype.

Our designers decided that the best solution would be to fulfill this technical specification with a fuselage of the Amphibian type, with two inflatable barrel-shaped floats on the sides (cylinders), with a volume of 4 m^3. During the process of creation there was very little of the well-known Mi-8. A new model had two more powerful engines, new main gearbox and new arrangement of the tail rotor.

The helicopter could carry the whole complex of modern anti-submarine armament and have increased time of search for submarines, including "on the water" mode. To enable this mode, a bottom-boat with seven pressurized compartments, including a bomb compartment, and "gills" type side floats were installed on B-14. For the first time in the domestic practice of helicopter manufacturing a retractable landing gear was created for a safe landing.

The tests of B-14 lasted more than seven years, due to changes in search-and-search system and delays in delivery of new engines. Many things were done for the first time, including tests of landing on water with engines off on autorotation. The test pilot Efimov O.E. wrote, that pilots had to fly in masks with a diving gear, as the cabin of the helicopter would flood completely during a hard landing.

Only in 1976 the *amphibious* anti-submarine helicopter Mi-14PL was adopted. Serial production began at the Kazan Helicopter Plant.

It should be noted that such a helicopter became a big problem for submarines, ships and mines. There was equipment on board for detecting and attacking enemy objects.

But such a gift could not be avoided and its multi-functionality could not be ignored. Thus, soon after successful tests and commissioning, these machines were put into service of rescue teams. Instead of shells, the helicopter could lift up to three tons of payload into the air. For a while it even served as an excellent assistant at the Baikonur Cosmodrome. The helicopter was well-equipped and could both detect and rescue cosmonauts who had landed on the water.

Over the entire period 273 Mi-14 *amphibious* helicopters of all modifications were produced, most of which were exported. The Mi-14 was operated in 12 countries. Cargo-passenger and fire-fighting versions were developed. In the 1990s, Mi-14s were excluded from the Navy and the unique program of the Military design bureau for *amphibious* helicopters was shut down.

But even after its closure, many of Mil's design solutions were refined and applied in design bureaus.

In spring 2015, aviation industry sources reported that it was planned to resume the production of the Mi-14 helicopter at the Kazan Helicopter Plant.

It was believed, that the helicopter would be modified and would be used both in the military and civilian fileds.

During the International Naval Show on July 2, 2015, Russian Helicopters presented a project to resume production of the Mi-14 helicopter. It is noted that the production of the helicopter may be resumed in case of interest in the helicopter from possible customers. In case of a positive decision on the project the Mi-14 will be enhanced.

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УДК

RENEWABLE SOURCES ENERGY

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Power transformers are the most common type of industrial transformers. They are widely used to increase and decrease voltage with a constant frequency. They are an integral part of the power supply network of enterprises, residential buildings.

During the operation of any transformer, the inevitable heating of the elements occurs: the windings and the magnetic circuit, which leads to a loss of energy in them and a subsequent loss of efficiency. The limiting heating of transformer elements is limited by insulation, the service life of which directly depends on the heating temperature of the equipment. The intensity of cooling depends on the power of the transformer, the higher it is, the longer the elements will remain in a heated state.

Normal long-term trouble-free operation of power transformers is ensured under the condition of constant monitoring and compliance with all parameters, one of which is the temperature regime. Compliance with the temperature regime within the limits established for each type of transformer is individual, which must be ensured by specially provided cooling systems.

The efficiency of transformers at the moment can reach 95%. But with prolonged operation of the equipment, due to the heating of individual elements, the efficiency drops rapidly. To correct this, the concept of superheat control by the cooling system was applied. There are two main types of cooling - air and oil.

There are several cooling systems for power transformers:

- natural air;
- natural oil;
- oil with blowing and natural oil circulation;
- oil with blowing and forced circulation of oil through air coolers;
- oil-water with forced oil circulation;
- oil-water with a directed oil flow.

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УДК 681.518

SOME ASPECTS OF THE USE OF THE INTERNET OF THINGS IN THE OIL AND GAS INDUSTRY

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With the modernization of microprocessor systems and network devices, it has become possible to ensure more efficient and safe drilling, production, processing and transportation processes, thereby reducing environmental, financial and humanitarian risks at oil and gas industry enterprises [1].

The new capabilities also make it possible to monitor the state of the environment, ensure control over emissions, and waste from production. This makes it possible to increase efficiency when increasing the norm of control indicators and reduce the risks of leaks that negatively affect the environment and entail serious fines for companies [2].

At oil and gas enterprises, data processing and management is divided into three levels.

The lower level is the level of monitoring and data collection from sensors, as well as the primary processing of information. The replacement of manual control and measuring devices with sensors allows for automatic continuous monitoring. One of the main advantages of the introduction of Internet of Things technology in enterprises is the ability to remotely configure devices. This increases safety and energy efficiency.

The middle level is the level where the issues of process optimization are solved, the timing of repair maintenance is determined. By analyzing sensor data, unplanned downtime due to equipment breakdowns can be avoided, which reduces financial losses.

The upper level is the level of data analysis that coordinates the activities of the enterprise, increases the efficiency of work processes and allows you to control the safety of processes, thereby protecting employees and the environment.

In the modern world, the main factor of efficient production is the direct interaction of objects based on various sensors capable of interacting with each other and transmitting data for further decision-making. An IoT- based conceptual model can have the following structure [3]:

Level 1. Control of objects using built-in sensors.

Level 2. Control of data flows using a gateway on which primary processing can be performed.

Level 3. Real-time data processing sector.

Level 4. Cloud storage system.

To increase the efficiency and reliability of managing such systems in case of failures or channel overload, a special cross-connection of virtual networks between the corresponding nodes (sensor-sensor, gateway-gateway, gateway-cloud, cloud-cloud) is used.

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SIMULATION MODELLING IN THE TESTING OF UNMANNED AERIAL VEHICLE SYSTEMS

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Abstract. The article reveals the advantages of simulation testing of unmanned aerial vehicle (UAV) systems as an important component in the development of modern UAVs.

Key words: BLA, modelling, testing.

Introduction.

Unmanned aerial vehicle systems are being developed based on the latest advances in the science and technology sector. The continuously growing demand for unmanned aerial vehicles requires qualitative and quantitative development of production facilities from UAV manufacturing companies. With limited funding, manufacturers are forced to resort to alternative methods of aerial testing. Accompanying mathematical modelling of tests allows testers to get rid of the risks associated with loss of the model being tested, delays and large amounts of rework. Therefore, extensive use of full-scale, semi-numerical and mathematical modelling has become a necessary and non-alternative option in all phases of modern UAV development.

Objective.

At all stages of UAV design, a semi-numerical simulation with partial replacement of the main systems of the UAV under test is required in order to study the impact of all possible factors on the UAV. Information and hardware centralisation of the maximum amount of UAV data on the basis of a single software computing unit is proposed. Software development requires the selection of a structure by which it will be possible to test the software systems independently of each other.

Methodology.

On this topic, the applicants derived a methodology for accompanying flight tests, which consists of a set of methods used and experiments performed during the UAV test. Based on the results of the outputs of all subsystems and the perturbations in force

Optimisation of the test object parameters is organised, taking into account all subsystems and existing disturbances. Decomposition of the task of developing a functional model of the UAV:

1. Generating input data for the UAV dynamics model
2. Formation of input data for the highly automated on-board control unit (ACU) model
3. Creating a simulation model of UAV movement
4. Integration of the resulting models onto a personal computer or pilot stand for research purposes.

1. Formation of input data for the UAV dynamics model.

The core element in the accompanying flight test is the simulation model of the UAV motion, the accuracy of which is dependent on the validity of the model. The key input requirements for the calculation of the UAV dynamics model are:

1) Mass-inertia characteristics coupled with model geometry
2) Aerodynamic characteristics
3) Propulsion system performance characteristics
4) Autopilot algorithms
5) Initial UAV motion conditions

2. Generation of input data for a highly automated BCU model.

A model of the UAV control system is formed based on the algorithms of the aircraft control system. The model includes algorithms of aerodynamic surfaces operation depending on external factors and flight conditions affecting the model. The implementation of the UAV simulation is performed in the Matlab Simulink graphical simulation environment.

3. Compilation of a simulation model of UAV movement.

Given the requirements to centralize the onboard control system, the means to simulate the operation of the controlled object must be embedded in the onboard software. Direct flight simulation tasks can be performed either on the onboard computer or on an external system. In the case of an external system, the problem of transferring simulation parameters must be solved. In the case of an internal computer, a certain reserve of computing resources is required. Taking into account the requirements on mass-dimensional characteristics, as well as from the considerations of price and power consumption reduction, the use of external means of flight simulation of the aircraft is proposed.

4. Integration of the resulting models onto a personal computer or pilot stand for research purposes.

Performance of simulation of various flight modes with execution of steering control are created simulation models of information and control environment of the UAV complex, which contain operation of elements of indication elements in the process of simulation. Real-time simulation of the spatial position of the UAV is implemented in the Flight Gear open-source graphical environment, which displays the cockpit space taking into account the surrounding environment.

Conclusion and recommendations.

Based on scientific papers on the subject of simulation modelling of aircraft testing, the structure of the UAV complex model is derived, which is also used in solving private research problems. The simulation uses the digital environments Matlab Simulink and FlightGear

The paper outlines the basic principles of simulation modeling of the dynamics of UAV movement, as well as the main subsystems, taking into account the influencing external factors.

A qualitative approach in simulation model implementation involves addressing key target objectives throughout all phases of flight testing. In practice, simulation modeling has been proven to reduce the risks and timelines of aircraft testing, which is a determining factor for UAV manufacturing and testing companies.

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ANALYSIS OF ELECTROCARDIOSIGNALS FOR THE PRESENCE OR ABSENCE OF VENTRICULAR LATE POTENTIALS USING SPECTRAL ANALYSIS

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The leading position in mortality within advanced countries is held by cardiovascular diseases. There are about 60% of total mortality structure over the past 10 years in Russian Federation. Recently, methods for diagnosing cardiovascular diseases based on spectral analysis of electrocardiosignals (ECS) have been actively developing. In particular, a spectral analysis of ECS is performed in order to detect the presence or absence of ventricular late potentials (VLPs) [1,2].

VLPs are low-amplitude high-frequency signals that are located in late part of the QRS complex. VLPs – signals whose amplitude is not more than 30 μv. The area of their occurrence on the ECS is shown in Fig. 1

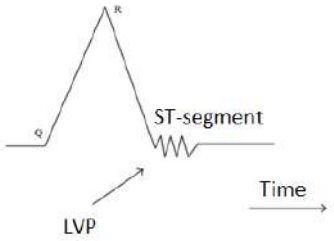

Fig. 1. Position of VLPs

The standard detection's approach is based on time averaging of signals by leads X, Y, Z [3]. In this paper we consider only signals by the X lead, since the analysis of signals by single lead will reduce the processed data [4]. Thus, it leads to increase in performance. A sample of the analyzed signal is shown in Fig. 2.

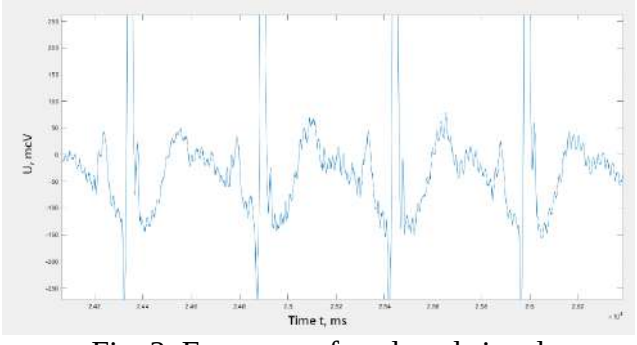

Fig. 2. Fragment of analyzed signal

In this paper signal analysis is performed using spectral analysis with power spectrum's obtainment.

Signals from the PTB Diagnostic ECG database [5] of the open access electronic resource Physionet are taken for this study. Resources of MATLAB R2022a software environment are also used.

First, signals were preprocessed with the help of digital filters (notch, bandpass). Frequency ranges: bandpass – 2÷400 Hz, notch 49÷51 Hz.

Next, we apply the Signal Analyzer application's tools to processed signals to obtain power spectrum. A sample of spectrum is shown in Fig. 3.

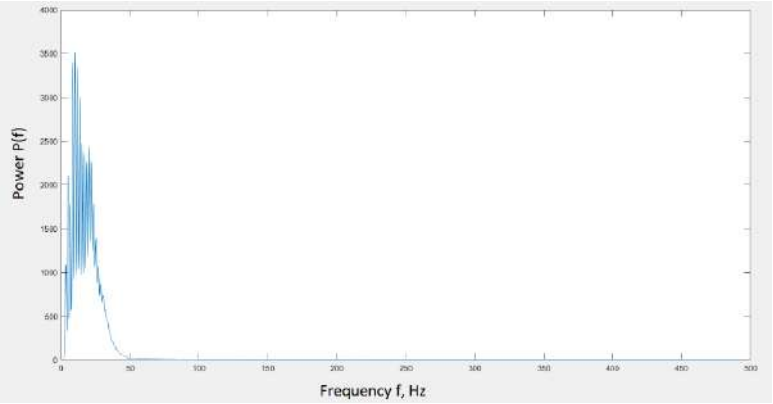

Fig. 3. Power spectrum example

As a criterion we propose a coefficient K equal to the ratio of the high-frequency band to the low-frequency band in power spectrum:

$$K = \frac{\sum_{f_{t+1}}^{f_{max}} P_i}{\sum_{i=0}^{f_t} P_i},$$

where f_{max} - is maximal frequency of signal's spectrum, f_t – is threshold frequency, P_i – components of the power spectrum.

After analyzing 100 signals, the following average values of parameter K were obtained:

- In signals with VLPs presence: K=0.12329;
- In signals with VLPs absence: K=0.20679.

After the study, it can be concluded that average value of K coefficient in signals with VLPs is less than in their absence. In the future it is planned to continue the study by increasing the number of analyzed signals.

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УДК 620.91

INTERNET OF THINGS TOOLS FOR AUTOMATING INTERNAL PROCESSES OF ORGANIZATIONS

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Annotation: This article discusses the problem of improving the inventory system by introducing QR codes.

Key words: QR code, inventory.

The purpose of this work was to investigate the possibility of using improved identifiers in the inventory process and the issue of developing an algorithm and choosing data storage methods.

The study facilities of the Kazan State Power Engineering University were selected for the study. The inventory is carried out here directly by checking the actual availability of property, after which the data is entered into the inventory inventories. There they indicate the name of the inventory values and objects, their number in units of measurement taken into account. In our opinion, there is a need to improve the inventory process in order to save time and eliminate errors. Thus, it is assumed that the essence of the process will be its automation.

At the first stage, it is supposed to solve the issue of marking inventory items and fixed assets. As a marking, it is proposed to make vinyl stickers with identifiers applied to them. The use of stickers will reduce the time for applying the inventory number to fixed assets and tangible assets. And it will also make the inventory process more aesthetic due to the absence of paint and varnish products. The first stage becomes the most time-consuming, but in the future it will facilitate the work. At the second stage, an inventory is carried out directly, during which the identifier is read from the fixed assets. And the third stage is devoted to the unloading and analysis of the work carried out and the automatic formation of all documents.

As an identifier for the selected premises, it is proposed to use a new type, which is called a QR code. Currently, it is being used more and more and are becoming more popular, so many smartphones are now available with a built-in QR code scanner. The QR code is a two-dimensional barcode that allows you to encode up to 7000 characters. This technology has a number of advantages over alternative ways of storing and displaying information. The first of them is the convenience of scanning from any angle. The architecture of the identifier carries encoded information for decoding which the following fields are used:

– search patterns – three squares in the corners;
– leveling patterns – modules;
– synchronization bands – lines of alternating black and white dots;
– mask code and correction level;
– version code;
– indentation around the code.

QR code technologies are distributed for free, there are many free software options that allow you to generate and read QR codes. All software can be divided into two types: stationary and mobile. To read using mobile devices, you need an application with a camera. The operating systems that support the installation of QR-encoded applications include: Android, iOS (Apple), Symbian (Nokia), Windows Phone, Windows Mobile, Blackberry OS (Blackberry). So the QR code gradually penetrated into all industries.

Its creators from Denso Wave made the technology of creating and reading QR codes publicly available by giving up their patent rights. This means that even now anyone can create and use their own QR code. Specialized Internet sites can be used to generate images with the code. Such sites include, for example, the website qr-code-generator.com . After performing three operations, it will

generate and offer to save the image with the code. It is worth noting that the size of the image allows you to print the code in a fairly large format and use it, for example, on signs and posters.

In the work, the approximate content of the identifier was generated for the needs of the inventory of the selected object.After assigning each object its own QR code, we started describing the algorithm of the inventory system.

According to him, the inventory will take place every six months according to the stages described earlier. After scanning, data about each object will be transferred to the cloud storage, which is a server that can be accessed on request (according to the client-server topology). The database will be built using the Microsoft Excel office program. The latter has a simple interface and ease of use. The content of the displayed information on the server will look like this: in the column on the left, information about the available equipment in the classrooms will be displayed, and in the column on the right, information will appear after scanning. After scanning, the item will be displayed in the list. Accordingly, automatically, in the absence of an item, the line in the right column will be highlighted in yellow for ease of detecting discrepancies. As a result of the research, we came to the conclusion that a sticker with a QR code leading to a web page will allow updating information about the subject. Thus, even in a small department, moving office equipment between employees will not cause problems during the next inventory. Replacing the inventory number with a QR label will:

- reduce the time spent searching for equipment several times;

– reduce labor and time costs for inventory accounting;

– provide prompt access to comprehensive information about the object subject to inventory accounting;

– reduces the risk of errors caused by the human factor when working with the same type of data.

To simplify and improve the system, the next stage of development will be the implementation of a mobile application not only for scanning and updating information about the subject, but also for the possibility of delivering notifications about the need for the following manipulations. As well as the use of radio frequency readers and radio tags. Such a system will function independently according to foggy calculations without a data processing center, if necessary, a standard protocol will be used to transfer information to the cloud system. The organization of such a network will allow you to easily become part of the computing network of physical objects – the Internet of Things (IoT) on request.

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УДК 355/359

INNOVATIONS IN THE RUSSIAN ARMY - CURRENT STATE AND PROSPECTS

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In recent years, the Armed Forces of the Russian Federation have been replenished with a wide variety of innovative types of military equipment designed to solve a wide range of tasks in almost any conditions. Ground robots and UAVs, new types of weapons and ammunition - all this is

gradually turning from exotic into everyday life. Evidence of the effectiveness of modern weapons of the Russian Federation was the "Syrian exam" and a special military operation in the Ukraine, where the latest military equipment and technologies were tested in real conditions.

Russia possesses sufficiently powerful weapons to ensure security and protect the borders of the state. These are Pantsir-SA, TOR-M2DT anti-aircraft missile systems, Topol-M, S-400, Yars, Iskander Bal, Bastion, Armata tank, MiG-29 and Su-30SM fighters, as well as many other equipment.

This article is devoted to the consideration of new innovative technologies and equipment in the Russian army. To analyze the representative material we have used the following research methods: generalization, analysis and the method of description.

Weapon evolution has come a long way from spears to fighting vehicles. Today, new technologies in military technology are increasingly inclined towards the creation of self-guided combat robots and the introduction of artificial intelligence.

One of the most advanced areas of development today is unmanned aerial vehicles, which are being introduced into the troops and the navy at an incredible speed. This area has become an indicator of the development of military-technical progress, since it uses the most advanced technologies and materials that reduce the weight of the device, the energy consumption of on-board equipment and improve flight performance. In general, it can be stated that modern UAV complexes are created as basic multifunctional platforms that can be adjusted to solve an ever wider range of tasks.

In Russia, a number of reconnaissance and reconnaissance-strike UAVs of medium and long range are currently being developed. In the coming years, Okhotnik, Orion, Pacer, Forpost-R and other models will be adopted. In terms of their characteristics, they are not inferior to foreign counterparts, and in some (for example, the maximum range of weapons) they even surpass.

Also, new robotic systems will soon begin to enter the Russian army, which will complement the Uran-9 already in service. Now the developers present ground-based specialized complexes for reconnaissance, demining, fire support and fire fighting. Under these machines, precision-guided munitions are being developed, and artificial intelligence technologies are being created that can cope with solving the most complex tasks.

In general, artificial intelligence significantly expands the capabilities of weapons, military and special equipment, which makes it possible to change the overall nature of hostilities.

At the same time, the development and implementation of a single technological platform in the field of artificial intelligence is of utmost importance. By creating a common information space, tools and standards, the faster development of new systems will be ensured. Their operation will be as efficient as possible, and maintenance - economical.

The developments currently being demonstrated are at different stages. Some samples are already completing tests and are preparing for a series and adoption, while others are still at the concept development stage. At the same time, both of them clearly demonstrate the potential of our defense industry, as well as the prospects for the army and law enforcement agencies.

So, all this shows, that the latest military technologies of the world do not stand still, and in order to keep the bar high and not allow external forces to dictate terms, it is necessary to develop and improve weapons.

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УДК: 629.7.048.3

FEATURES OF THE BOEING-787 AIR CONDITIONING SYSTEM

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The aircraft air conditioning system (ACS) is an on-board life support system and is designed to maintain the temperature and air pressure in the pressurized cabin of the aircraft at a level that allows the normal life activity of passengers and crew. The airtightness of the cabins is ensured by their structural design, the presence of seals on the hatches and doors, constant boost from the ACS.

In the modern world of civil aviation (CA), there is currently and widely used an air conditioning system of classical structure and basic operation, but in the Boeing-787 (B-787) specialists have introduced and applied a completely new ACS.

Fresh outdoor air is taken from the compressor of the turbojet engine and then enters the air conditioning unit (Air conditioning pack), then it passes through filters and mixes with the air already available in the cabin. The temperature of such air reaches 500 °C. In this case, the air is divided into 2 streams. The first stream (cold line), passing through the cooling system, is directed to the mixer. The second stream goes directly into the mixer. Both streams are mixed in the mixer, this air is sent to the pressurized cabin. Also, in airplanes, hot air is used as a component of an anti-icing system; it passes through pipes located under the skin of the aircraft and heats the surface to prevent the process of ice-formation. The conditioned air is supplied not only to the pressurized cabin, but also to the technical compartments where the electronic equipment is located, so that the normal temperature regime of the mechanisms and units is maintained. On bombers that can carry nuclear weapons, the ACS heats the entire unpressurized bomb bay of the aircraft completely, keeping the temperature above 0 °C (guided missiles with a nuclear charge have internal thermal stabilization). The presence of an auxiliary power plant on board the aircraft also implies the selection of air for the conditioning of cabins and compartments from the auxiliary power plant (APU). [2,4]

The main distinguishing factor in the Boeing-787 system architecture is the emphasis on electrical systems that replace most of the pneumatic systems used in traditional commercial aircraft. One of the advantages of the architecture of electrical systems without bleed is the higher efficiency achieved in terms of reducing fuel consumption — the architecture of the 787 systems provides a projected fuel economy of about 3 percent. The Boeing-787 also offers operational efficiency for users due to the advantages of electrical systems over pneumatic systems in terms of weight and reduced life cycle costs. The architecture of the systems without purging in Boeing-787 will allow the aircraft engines to create thrust more efficiently as all the high-speed air produced by the engines goes to thrust [1]. Pneumatic systems that divert high-speed air from engines deprive conventional aircraft of some thrust and increase engine fuel consumption. Boeing believes that the use of electricity is more efficient than the pneumatic energy generated by the engines, and expects that the new architecture will need 35 percent less energy to be extracted from the engines. Conventional pneumatic systems usually develop more power than it is necessary in most conditions, which leads to the discharge of excess energy overboard [1]. On the B-787 aircraft, the extracted air is used only to protect the engine input device from icing and pressurization of the tanks of the engine hydraulic systems. The electric power coming from the generators driven by the main engines and the APU is spent on: operation of the wing anti-icing system; engine start-up drive of high-power hydraulic pumps; power supply of the air conditioning system [3,5]. In this configuration, the energy sources for the electrical system are generators driven by engines and from the APU, while the energy sources for the hydraulic system are: a hydraulic pump mechanically driven by an engine and a hydraulic pump driven by an electric motor. Hydraulic power sources mechanically driven by an engine in a configuration without air extraction are

similar to sources in a traditional configuration. In the configuration of on-board systems without taking air from the engines, electric compressors perform the function of pressurizing the cabin, fresh air enters the pressurized cabin through pipelines and ducts [5]. According to Boeing specialists, this approach is significantly more efficient than a traditional air intake system, since there is no excessive energy extraction from engines, accompanied by energy loss in the pre-cooling units and control valves [1] In the new scheme, there is no need to fully use the compressed air coming from the engines. Instead, compressed air is produced by electrically driven compressors with adjustable flow at the required pressure without significant loss of energy. This leads to a significant improvement in fuel consumption by engines. In the traditional configuration, the engines satisfy most of the needs of secondary on-board systems for power supply (pneumatic supply); in the configuration without air extraction, the engines satisfy most of the needs of on-board systems for power supply in the form of electricity using electric generators driven by motors through spring shafts. The traditional configuration of the compressed air extraction system entails a lower efficiency of the main engines. The exclusion of compressed air extraction leads to more efficient operation of the engines by reducing power consumption at the level of the entire aircraft – the aircraft does not need such power from the engines during the flight, and therefore does not burn so much fuel. In addition, the configuration without air extraction makes it possible to significantly simplify the engine buildup, due to the absence of a pneumatic system and associated pre-cooling units, control valves and a pneumatic piping system provided. [1,3,5]

Thus, summing up everything, we came to the conclusion that the architecture of systems without purging offers operators a number of advantages, including:

- improved fuel consumption due to more efficient extraction, transmission and use of secondary energy;
- reduction of maintenance costs due to the abandonment of the pumping system, which requires intensive maintenance;
- increased reliability due to the use of modern power electronics and fewer components in the engine installation;
- extended range and reduced fuel consumption due to lower overall weight;
- reduced maintenance costs and improved reliability, since fewer parts are used in the architecture than in previous systems.

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СЕКЦИЯ 3

АКТУАЛЬНЫЕ ПРОБЛЕМЫ ПЕРЕВОДОВЕДЕНИЯ

УДК: 811.111

YOUTH SLANG. PECULIARITIES OF TRANSLATING

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Youth slang is considered to be one of the conditions for language enrichment, its diversity. Slang is extremely diverse, it is developing rapidly. Slang and various kinds of jargon are understood by many people who want to interact better with the society. Hence, there is a need to study the slang of the English language, to understand how to translate it into Russian. A large number of English slang words have passed into our daily lives, many of us use game slang on a regular basis.

There is an interesting fact! English slang counts approximately 45 thousand words!

Many slang expressions borrowed from the English language are used in their original form bypassing translation. Jargon is also understood by people who have never learned English. The correct use of these expressions can make speech less dry, less formal. Slang allows to relax and feel free. Knowledge of informal speech permits to understand better the culture and modern historical features of the language studied. It can also help not to get trapped by communicating directly with native speakers, reading books and watching movies in the original. It gives expressiveness, emotionality and makes speech more vivid if used in live communication, literary works, films, etc.

Our goal is to study the ways of translating English slang into Russian, namely, to determine slang expressions, their application in everyday life. When translating slang, two translation techniques are used: literal (direct), transformational (not direct).

Here are a couple of examples of translation: fix (fixed) – that is, fix something, but young people use this word in the meaning of ‘spam’ (spam) - unnecessary sending of information, messages; troll (troll) – ‘to joke on a person’ and even more rudely, 'to mock’.

Also in English, words are often abbreviated and they also have their own peculiarities, and such abbreviations can be considered as slang. Take the examples of SMS communication: IMHO - in my humble opinion (in my humble opinion), BRB - be right back (I'll be back soon), ROFL - rolling on the floor laughing (rolling on the floor laughing), u – you, IMO - in my opinion (in my opinion), LOL – laughing out loud (I'm dying of laughter, I can't laugh), B4N - bye for now (okay, bye), C U - see you (see you later), dunno – don't know, ASAP – as soon as possible (as soon as possible), BTW - by the way (by the way), ABT - about (about, about), gonna – going to, wanna – want to.

There are a lot of slang in computer games. For example: ‘реснуть’ – resurrect (revive), noob (noob) – beginner player (sounds like an insult), dude – ‘чувак’, mob – monster, ‘манчить’ - level up, ‘манситъ’ – dodge, WP (well played) – well played, GJ (good job) – good job, NT (nice try) – a good attempt, etc.

We believe that slang plays an important role in the life of the younger generation, as knowledge of slang helps a person to be more familiar, more tolerant for the culture of the country, and also be more capable to understand colloquial speech. Slang is used most often by the modern generation, both in speech and in SMS messages. Slang is constantly evolving and improving.

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PROBLEMS OF VIDEO GAMES LOCALIZATION FROM ENGLISH TO RUSSIAN

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English was originally the language of the developers of electronic computers. However, after a while, computers and software around the world found a dizzying success. As a result, there was a need for processing certain information in different languages and for multilingual support. The importance of this was felt by both software producers and users themselves. This is how the idea of internationalization of software products was born.

Localization is the process of adapting software to specific national rules for transforming and classifying single characters and strings; rules for the national representation of time and date, as well as floating point numbers and monetary values. On the technical side, localization is the production of individual localization objects in accordance with the requirements of a particular language. Localization is the translation and cultural adaptation of a product to the characteristics of a particular country, region or population group. Moreover, a "product" refers to any product or service [1]. Localization implies the replacement of any possible elements of the product in such a way that it matches the language of the market and its legal features, as well as the mentality and marketing goals of the acquiring company. All this lead to success in the computer games market.

"The discrepancy between the volumes of texts in different languages" is one of the most important problems of localization, as A. Pashutina notes [2].

Quite often, the main problem is the selection of a more successful synonym or text abbreviation. Although the languages of Europe have common roots, in practice the texts in them can differ by 20-25%, in some cases much higher.

There is also a more complex problem of adapting the translated text in a different language environment and culture – text design. To solve such a problem, it is no longer enough to have the skills to select more successful synonyms or some special editorial techniques. In this case, the translator must turn to special software for localizing the translation.

Here are some examples of what is different in different languages. These include formats for dates, numbers, currencies, forms of writing addresses, keyboard layouts, key names, translation etc.

1. Date and time formats. Formats of dates, numbers, currencies, forms of writing addresses - everything is different in different countries. The same written date can have completely opposite meanings in Russia and, for example, in America. If in most countries of the world (including Russia) the date format looks like DD/MM/YYYY (Day / Month / Year), and less often like YYYY / MM / DD (China or Korea), then in the USA they decided to go the third way, using the format MM/DD/YYYY, that is, the month comes first, followed by the day, and then the year.

2. Keyboard layouts. "It is advisable not to use the characters @ # $ % ^ & * ( ) { } [ ] ~ ` < >," writes Pashutina [2]. After all, it is quite difficult to estimate at what places on the keyboard in another language these characters will be located.

3. Key names. It is always worth remembering that the names of the keys in different languages sound, respectively, in different ways. An example is Alt and Shift.

4. Translation. Pashutina A. writes that "often even such a seemingly simple part of localization as translation can be complicated by the fact that the localizer simply does not know how to translate a particular word/phrase. For example, the word "attack" can be translated into Russian as "атаковать", "атака", "атакуй", "атакую" and so on"[2]. You should definitely not forget that a translator can be a person who is quite far from computer games and does not know all the specifics as the developer of the game itself knows it. In this case, it is advisable to provide comments that can explain the essence of words that have certain ambiguities for translation.

As a more detailed example of translation problems, here are variants of localization errors from the cult game of the twenty-first century GTA San Andreas. Mistakes in the proper names of some characters immediately catch the eye. So the rapper under the stage name “Madd Dogg” was renamed “Mad Cupcake” (“Бешеный Кекс”) – it is not entirely clear why the translators chose “Cupcake”. And his main opponent in the hip-hop scene “OG Loc” is called “OJ Lok” (“Оу-Джей Лок”). Translators could be justified by the weak development of Internet technologies at the time of the beginning of the spread of computer technology in other mistakes, but here шы a banal ignorance of the English alphabet. The letter "G" in Russian is pronounced as "Ji", and "Jay" is a completely different letter "J".

An example of a grammatical error is the phrase “I think I just might have found a ghost writer”, which was translated as “I think it’s time for me to find an unknown writer (неизвестного писателя).” Let's discard the lack of a worthy Russian replacement for the phrase “ghost writer” by translators, because at the moment a proper adaptation of this expression has not yet appeared in our language. In this case, the correct translation of the mentioned phrase will be the expression “It seems that I have just found a secret author for us”, otherwise, as already noted; there will be a grammatical error, because the action has already been completed, and not just implied.

The second example of a grammatical error is the phrase “We got him now!” which in Russian localization sounds like “Теперь мы его найдем!” In fact, the correct translation is the phrase “Теперь он наш!” And as the third example, we chose the sentence “Hey, CJ, strap up! It's Grove Street! ” which was translated as “Слышь, Си-Джей, зацени! Грув-Стрит! ”. This is a glaring mistake with the phrasal verb “to strap up”, which, in fact, translates as “arm yourself”, (“вооружиться”) although in the Russian interpretation it was translated with the word “check it out” (“заценить”). Ultimately, the correct translation of the sentence is “Эй, Си-Джей, бери ствол! За Улицу Рощи!” [3].

Thus, we can conclude that there are a great many derivative translations of errors in the translation of computer games. This problem is explained by the fact that computer games have a very large number of ingredients. Programmers write the executable code, interface and graphical shell, while script writers create task texts and proper names, and this, in turn, makes significant changes to the translation. However, at present, the cultures of all countries of the world have begun to be closely intertwined, and computer game developers have begun to maintain a strong connection with local translators. The combination of all these factors allows us to conclude that in the nearest future the world will completely get rid of any side effects and disorders with localization of computer and video games.

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УДК 81`25

DIFFICULTIES WITH LOCALIZATION OF VIDEOGAMES

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Modern problems require modern solutions. The same type of principle is also followed by people studying English. Movies, TV series, songs, podcasts in English can replace textbooks nowadays. But the most innovative type of work of pop-culture that can help you to learn a language is of course videogames [1]. Unfortunately, not many people know what kind of difficulties is in translating games, which can cause problems in understanding language in future. So, objectives of the article are to introduce with the process of the translation of videogames and to increase the interest in learning languages through non-standard, but more effective and practical methods. The relevance of this theme is that videogames nowadays are the most innovative, breakthrough and experimental works of modern art. Therefore exploring videogames industry will boost not only language knowledge but also enlightenment in art.

The main issue in adaptation of videogames is program codes. Every program, videogame in computer is coded in English, because of that every outward aspects of completed product such as voice acting, menu, 3d models and texts are all in this language.

Let's analyze every kind of difficulties. The first and most important – problems with video visual aspects like text and 3d models. As every kind of works of art which include text part, videogames have same type of problems, for example slang words, nicknames, context translation. But it is much more interesting in games' cases [2]. For example, in post-apocalyptic role play video game series 'Fallout' there is set of rules called SPECIAL. It is an acronym for the system of characteristics of heroes, which hugely affects in gaming walkthrough process (Strength, Perception, Endurance, Charisma, Intelligence, Agility and Luck) [3]. And in this case, because of translating, game loses context meaning in character creating, gamers lose a meaning of things, what is making their hero "special". And there are million examples like this in videogame translating industry.

There is another situation with 3d models. No problem with context but huge difficulties with technical part of localization. Local publishers simply do not have time to translate and remade all the models with to the release because of amount of work with projects.

Audio visual translating aspects of videogames are similar with movies'. Problems are related with lip syncing and mimics difficulties. And without this, a difficult change in game engine code is the reason of the loss of emotionality of face mimics and body language. The issue of localization financing is also sharply arises; only big developers companies or even corporations can afford full localization of their products.

And the most important part of the manipulating with program code is that it can cause a huge amount of bugs and freezes in gaming process which can be a result of a low critical reception and sales. That is why nowadays AAA projects are half (only text) or even not translated to other languages at all.

Whatever difficulties have arisen during videogames localization, they are solvable. There are many examples of videogames which are sold even more in other countries because of masterpiece translation. The reason of it is regional offices of developers' company that can control the process of adaptation, so that everything would be according to the canon.

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УДК 811

AN OVERVIEW OF TERMS TRANSLATION TECHNIQUES

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The paper aims to consider different ways of terms translation. As it is known, specialist terms are used in contexts of professional communication and they have their unique senses in particular industries.

"A specialist term is a word, fixed group of words or abbreviation that has a precisely limited sense and is used in that sense in a particular branch of human knowledge or practical activity, such as science, technology, art, profession, or trade" [1].

The terms must be systematic, independent of context, brief, devoid of any connotations, and each term must have only one sense with its unique interpretation [1].

There are a number of ways of translating specialist terms, such as, borrowing the term from a source language (SL), transcribing or transliterating the term, loan translation (calque), descriptive translation. The most popular ways are borrowing the term from a source language (SL), transcribing or transliterating the term.

Fast developing of Internet technology gave birth to such common terms as Internet, Internet of Things, Windows and the like. We see them in media in both forms, borrowed and transliterated that can be explained in two ways. The process of language development is complex and sometimes words are borrowed through the third-party language, but the meaning of a borrowed word does not usually exist in a target language (TL). Thus, at the first stage of borrowing the terms are mostly used in their original form, but later they can be transliterated (transcribed) when they come into everyday life of general public.

Since terms employed mostly in professional context, we see that they usually retain their original form because of pragmatic reasons. Professionals tend to use so-called "jargon", the words that are understandable only to "private circles of people". Those "secret" senses they ascribe to particular words lead to development of new trends in the field of term translation.

The terms translation process is affected by economical nature of language. The simpler the form of the term is, the easier it is to apply it for description of new ideas.

In some situations, we see that good old technique, loan translation is still in use, as in ghost cloud computing (призрачные облачные вычисления), cloud computing (облачные вычисления). The loan translation is the most productive and efficient way of translation, but in certain contexts the exact meaning of such terms can be unknown even to professionals.

In conclusion, we would like to give a tribute to descriptive translation. It is the most "wordy" way of translation that is not so popular as the above-mentioned techniques. Our point is that descriptive translation can be used in combination with other methods of translation as it is the case with the term "ghost cloud computing".

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THE PROBLEMS OF TRANSLATION OF APPLICATIONS IN THE FIELD OF IMPORT SUBSTITUTION

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Developing and creating domestic applications to replace products developed by Western companies that have left the Russian market is the most relevant. The paper is devoted to translation techniques used to render Internet of Things terms from English into Russian.

One of the products that can be employed for analysis of translation ways of such terms is described in this paper. ThingWorx is a platform designed to build and run components of the industrial Internet of Things. With its help you can reduce the time and financial costs of repairs and reduce the risks of equipment failure. The ThingWorx platform provides organizations with a unique opportunity to quickly create and launch network applications to realize new opportunities in the rapidly developing world of intelligent things.

Today most enterprises, both small and large, public and private, make use of modern technologies (CNC, automated process control systems). For long-term operation of equipment, it is necessary to take into account their current state by means of a variety of sensors. To connect sensors into a single enterprise management system it is essential to use a specialized ThingWorx platform (Fig.1.).

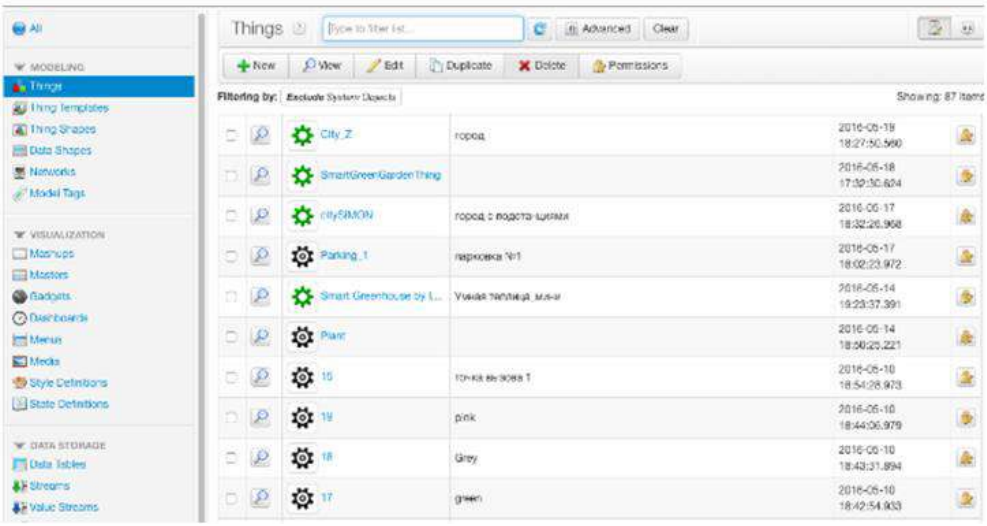

Figure 1. Thingworx interface

We analyzed key terms in that platform and translated them by different translation techniques.

‘Thing’ (Устройство) means any object that we need to manage or about which we need to collect data using the ThingWorx system. Every ‘thing’ has properties and services. The item must also have a template specified.

‘Thing template’ (Шаблон устройства) is a template in which its properties and services can be created and things can be “inherited” from this template, thereby obtaining properties and services created in the ‘template’.

‘Thing property’ (Свойства объекта) is any parameter that must be taken into account for a thing or any parameter of all things inherited from the template, in which this parameter is defined, should have.

‘Service’ (Сервис) is a function that can accept parameters and return the result of its call. The ‘service’ can be created in templates, then it will be available for all things that are inherited from this template.

‘Mashup’ (Mashup) is an application that creates a graphical interface accessible in a browser window using widgets and things services.

‘Widget’ (Виджет) is a graphic element that performs a certain functionality, embedded in the graphical interface (mashup).

As we can see, when translating terms used in professional software, various translation methods can be applied. So, if the term is actively used in different fields and is familiar to most users (such as a widget, a mashup), in this case it is better to apply calque transliteration or borrowing techniques. When translating terms like ‘thing’ we chose specification technique, since the meaning is rendered more accurately by Russian word ‘устройство’. Loan translation or calque was applied along with specification in ‘thing template’. We decided to avoid descriptive translation. It should be noted that descriptive translation should be used if only the term cannot be translated directly.

When developing domestic programs in the field of Internet of Things, a number of questions arise related to translation problems. Some of the terms can be translated by the method of calque and transliteration, others will be more understandable when specified or descriptively translated.

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MOBILE APPS IN LANGUAGE LEARNING

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Today there is a growth in needof language skillsfor specialists (engineers, doctors, social workers, etc.). Not everyone managed to study a language at school, at university or other educational institutions. There is always a lack of time, moneythe list goes on... In such cases Internet resources are helpful in mastering foreign languages.

Learning languages using the Internet resources is very convenient because students can study when it is convenient for them and at their own pace, they will not be driven by various certifications as training will take place in a fairly easy, relaxed way. This is what the creators of popular applications for learning languages focus on. Some of the most famous applications are Duolingo, Memrise and LinguaLeo.

Duolingo is a pretty simple language learning app, and it is suitable for learning English in particular. The learning process takes place in a way of games, the students go through various levels, master the basic vocabulary in different fields of life, such as family, professions, food, people, lifestyle, etc. Students also learn grammar, improve reading skills and pronunciation. Users are motivated by various competitions. It is also possible to share a personal success with others, which makes this application one of the most popular in the world.

Memrise is a platform for learning foreign languages. Students can learn words, phrases, and various terms with its help. They are offered to check their level of knowledge, and then, based on the results, select a course. Students can also choose the course they are interested in, or create their own ones. Courses, in turn, are divided into levels, a set of terms united by a specific topic. The users choose themselves in what way to study, which makes this application one of the most convenient for learning English.

Lingualeo is a very popular English learning app. It was founded in Russia in 2010 and is still in use today. The feature of this application is learning the language in a playful way. In order to start learning, the users are offered to take the entrance test and fill out a list oftheir interests. Based on students’preferences, the application selects a training program that the user can track in his

personal account. Also there is a training program for the international exam in English TOEFL, which makes it in demand in our time.

Do not forget about the various webinars conducted by experts. With their help, people learn English in order to improve their knowledge, prepare for admission to a special school or university. These webinars are either free or for a fee. Here, teachers offer students special programs aimed at developing specific skills: reading, grammar, speaking. Classes are held remotely, often without certification, at the end of training the students do not receive certificates or diplomas on successful completion of the course. This method is suitable for those who wish to learn English themselves.

In conclusion, there is a huge number of ways to learn English. Many of them are very popular, as they really do help. We have used many of these methods of learning, they are definitely great for mastering the language, for increasing the level of knowledge, or just for self-development.

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ONLINE TRANSLATION OF RUSSIAN SCIENTIFIC TERMINOLOGY INTO ENGLISH

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The purpose of our work is to study the features of technical texts, to identify the difficulties of translating Russian scientific terminology into English using online translators.

The online translation of scientific literature is here to stay. However, many online dictionaries don't possess the list of technical terms. Because of this, the translation turns out to be inaccurate. It is unacceptable in technology and science. A translation is considered to be exact if the translated text corresponds accurately to the content of the original one; the rules of the languages are strictly followed.

Translation can be carried out by different means: bilingual dictionaries, electronic translators, online translators can be used or it can be made by a linguist. The most popular means is an online translator.

Most often, it is required to translate the following types of technical documentation:

• Operating instructions;
• Licenses and certificates;
• Standards and regulations;
• Technical passports;
• Diagrams and drawings;
• Technical tasks and other types.

Features of technical literature:

1. It contains a large number of terms. Many technical terms originate from widely used neutral words, but acquire a completely different meaning in a specialized text.

2. One word has different meanings in different fields of science and can be translated in different ways.

3. The rapid development of science leads to the fact that new technical terms are constantly appearing, though they are not included in dictionaries yet. These words form slang, which is clear only to specialists of a certain field.

4. The technical text makes impossible the misunderstanding or misinterpretation of terms, since it can lead to dysfunction of equipment or disorganization of enterprises.

Before it became possible to translate literature online, only specialists could carry out a translation, but it used to take more time. Nowadays modern online translators can translate different texts in seconds, which makes the process easier. Since the technical literature contains a large amount of scientific terms, it is necessary to find their exact meaning. Online translators are set up to translate the texts "word to word", it may cause problems.

The scientific or technical text often includes phrases, their translation can be twofold. For example, the phrase '*man of war'* in specific terminology can be translated as '*sea ship'*, but the online translator defines it as '*man of war'*. Also, the word '*dead*' in the technical literature means '*de-energized'*, '*deaf*', '*not through'*, but not '*dead*' as the online translator translates it.

Problems arise in the translation of polysemous words. For example, the word '*switch*' is translated as 'выключатель', 'переключатель', and 'коммутатор'. The online translator may not understand the right meaning of a word, and then the accuracy of the text will be violated, which is unacceptable.

Abbreviations also cause problems. It is not always possible to translate them into a foreign language. For example, the abbreviation «ЕСКД» (Единая система конструкторской документации / Unified System of Documentation) is not translated into English as ESKD, but the online translator does. This proves that it is impossible to rely on online translators to translate difficult technical texts, because they make the most common translation, and not the one which is needed in a certain field.

Thus, it can be concluded that linguists should definitely monitor the translation of technical texts. The translation will be more accurate thanks to human observation, since today online translators are not sufficiently adapted to technical literature.

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POWER-ENGINEERING VOCABULARY. THE PECULAIRITIES OF TRANSLATION

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The purpose of this article is the vocabulary analysis in the field of power-engineering and its translation aspects research for student's competent using of foreign manuals and reference books.

Nowadays, there are many scientific articles, manuals, reference books and other sources of valuable information. Not only are they united by content, but also by the style. This text is presented in a scientific style that includes: first person narration, strict selection, word's unambiguity, logical sequence of presentation and athor's commitment to accuracy and brevity whilemaintaining content's density. Metaphors, metonymy, epithets are not typical for scientific style. This style implies many scientific terms and definitions, for which un ambiguity and accuracy is necessary.

The main purpose of the scientific translation is the precision of the delivery of information to a recipient. The goal is achieved by the minimization of emotional tones and focusing on logical presentation of the material.

Technicaltranslationisarelativelynewsphereoftranslationandbecauseofthatthereisa lack of knowledge of the methods of translation of scientific documentation.

During translation of power-engineering texts, translators must pay attention to following points:

1. Grammar. Scientific texts are characterized by the generalization of information and verbs in present tense and imperfect form.

Forexample:

Text: «…system's impulse shall not change, rocket shall move opposite gases' direction"

Translation: «импульс системы не изменится, поэтому ракета будет двигаться в сторону противоположную истечения газов»

There are two main mistakes: using the future form of the verb «be» and the lack of logical connection between sentences.

2. Vocabulary. The uniqueness of used words plays an important role in the technical texts, therefore it's important to remember about the existence of polysemantic words throughout various fields of scientific disciplines.

For example: engine: двигатель, мотор, машина; scale: шкала, масштаб; matrix: матрица, раствор, матка.

3. Material presentation method. In addition to previous points, it is important to exclude metaphors, emotional tones and other stylistic devices while keeping technical scientific content.

4. Recipient. Mastering the readers is also important for the quality of translation, since there are many types of scientific texts: article, manual, report, etc. Each of them implies the usage of technical vocabulary, however understanding the audience contributes to the accuracy of the translation.

Apart from the nuances translator needs to have an understanding of the scientific field of the source text to be able to use the most suitable vocabulary.

In conclusion, the quality technical literature adaptation requires not only sufficient level of knowledge of the target language, but also close attention to technical translation nuances.

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УДК 811

SLANG INFLUENCE ON YHE YOUTH`S PROFESSIONAL ACTIVITIES

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It is common for youth to use slang to express themselves to one another. To many, slang might seem inappropriate or "ghetto." However, for others, slang is the only way we like to communicate - it's a part of our culture. Even though slang is widespread, some people think it is an inappropriate distortion of the English language. Teachers, parents, the older generation do not be easy on this trend. During the conversation they may misunderstand or not understand at all what we are saying about. In fact, there is something to worry about…according to recent studies, in young people`s speech degree of using slang exceeds 50%. Young people are quite active in creating slang.

For many years, there has been an active discussion between supporters and opponents of youth slang in society and in the scientific community. All this served as a logical impetus for the

organization of the study in this area. Its purpose is to find out what constitutes youth slang, whether slang is a struggle between different generations, how slang affects the professional activity of youth.

The research method includes: analysis of specialized literature on the topic, questionnaire of students, interview with different generations.

Slang terms are often only understood by people in a certain group, using slang is, above all, a way to show that you belong. You show that you're one of the crowd by using terms that others don't understand, and you can connect with like-minded people who understand just what you mean by using the latest slang terms. Does it mean that there is only kind of slang – "youth". Adults use slang very often, they just use another kind. In every professional area peoples have group of words, terms, meanings understandable only for themselves. It's what is slang about. Also, after a little questionnaire of people after 30 they said that they had their own slang, and for another generation the same. Some of them may not to call this thing slang, but it is.

The reasons why youth uses slang are different, there is a statistic:

25% use it with a conscious purpose (to offend, not to use foul language, to speak with certain group of people). About 20% can't find synonyms to change slang terms. 12,5% use it like a habit. 12,5% use it to short the words. 12% use it just for fun .10% can't explain the reason (I'm just talking and that's it) and 10% don't use slang at all.

Also some of student said (about 70%) that they already had encountered with professional slang during study. Slang helped them to memorize, makes easy to understand and to creates associations. You can use professional slang instead difficult long terms, it would increase productivity and reduce time. So we can say that slang is not struggle between generations, between professional and student. Slang will help us in our daily life if we don't abuse it.

Over time slang terms either die out from lack of use as groups move on to new terminology, or they may become so popular that they are absorbed into the common language. In this case, everyone understands the terms, and they aren't likely to be considered inappropriate or poor grammar any longer. This is how language grows and evolves over time, as new words are added to the dictionary while old ones fall into disuse and disappear.

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PECULIARITIES OF AMERICAN SLANG TRANSLATION IN FICTION (ON THE EXAMPLE OF THOMAS PYNCHON'S NOVEL "BLEEDING EDGE")

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Slang is one of the variations of colloquial speech, which has specific and national features that are the main component of this language layer. The transmission of slang vocabulary to other languages often leads to the loss of cultural identity. Consequently, the translation of slang units presents certain difficulties [1].

We studied the text of Thomas Pynchon's novel "Bleeding edge" and its translation into Russian, made by M.V. Nemtsov, to see if they contain certain peculiarities of slang transmission. The most popular and frequently used ways of forming slang units in the novel are: compounding:

honeybunch, airhead, blockhead; borrowings: *kvell, plotz, putz, noodge*; affixation: *honky, hipyyeen, lefty, looker*; reduction: *prob, aristos, rev up*; abbreviation: *IT type, yup, on the QT, BF*; metaphorization: *moonlighting, hammered, vanilla*.

After analyzing the slang terms by area of use, we identified certain groups: action expressing vocabulary: *come up OK with, kvell, kick back, dig it*; characteristics of (professional) occupations, skills, status and worldview: *IT type, lefty, Christer, techie*; behavior characteristic: *wacky sidekick, feckless putz, grow rowdier*; criminal/illegal vocabulary: *hustler, moonlighting, goon squad, lowlife*; address words: *thing, honeybunch, dude, chick*; phonetic violations/speech peculiarities: *no prob, 'cause, oboy, da yoozh*.

Slang vocabulary is characterized by a high degree of metaphor and figurativeness. Moreover, it largely has a bright emotional coloring relative to other language styles. Precisely because of such expressiveness of slang, the translator faces a serious task of preserving the semantic and stylistic balance of slang expressions when transferring them to another language [2]. Therefore, it is necessary to choose the most suitable and appropriate way of translating slang vocabulary. Here is an example from T. Pynchon's novel "Bleeding Edge":

- *"I'll* ***e-mail*** *something to you." And soon Reg,* ***taking a quick gander*** *around at the street, has gone* ***sidling off*** *in the direction of downtown…*[3] – ***Мылом*** *что-нибудь пришлю. – И вскоре уже Редж,* ***быстро оглядев*** *улицу, пропал,* ***свинтив бочком*** *по направлению к центру…* [4]

The slang expression *take a gander* was translated as a stylistically neutral phrase *быстро оглядев*; in order to compensate for stylistic losses, *e-mail* was transferred as a Russian slang word *мыло*; and the phrasal verb *slide off* acquired the interpretation *свинтить бочком*. The method of compensation is used quite often in translating slang due to linguistic differences.

Let us consider other examples of slang units from the novel which were translated using various transformations.

- *Maxine finds…teachers* ***on wrangler duty****…* [3] – *Максин застает... учителей* ***на выпасе****…* [4]

The Russian equivalent of the phrase *on wrangler duty* would not be understood by the Russian recipient, so M.V. Nemtsov applied the substitution method, based on the action performed by the wrangler – *на выпасе*.

- ***IT maven*** [3] – ***башковитый ИТэшником*** [4].

IT was transmitted as *ИТэшник* using transliteration. The word *maven* comes from Yiddish and has the meaning "one who understands" [5]. This noun has been translated using the substitution method as the adjective *башковитый*.

- *...an IRS guy* ***moonlighting*** *as a tax preparer* [3] – *...парень из ВНС, который* ***левачит*** *по налоговой документации* [4].

The slang unit *moonlighting* means "to have a second job, typically secretly and at night, in addition to one's regular employment" [5]. When translated into Russian, it has undergone some changes using the adaptation method and has been transformed into slang *левачит*, which is familiar to the Russian recipient.

- ***Bust a cap****…* [3] – ***Вставить пистон****…* [4].

This American slang comes from the word *cap* - a copper capsule filled with gunpowder and used in capsule weapons [5]. Therefore, *bust a cap* means "всадить пулю" [5], but the translator decided to use the generalization method and translate it as *вставить пистон*.

- ***rugriders*** [3] – ***ковролеты*** [4].

Rugriders is a derogatory term for people living in the Middle East. M.V. Nemtsov decided to convey it into Russian using the calque method.

- *... a promotional* ***freebie*** [3] – *...рекламная* ***халява*** [4].

Freebie means "подарок, бонус, халява" [5]. It was translated by selecting a connotative equivalent and a more suitable synonym.

- ***airhead*** [3] – ***пустоголовый*** [4].

The slang term *airhead* characterizes a silly person. There was used the modulation method: a person is foolish since there is air/emptiness in the head.

This study has demonstrated that the transmission of slang is achieved through various translation techniques and transformations. It is undeniable that the translator's point of view plays an important role in choosing the method of transmitting slang vocabulary. The translator relies on the accumulated professional on-the-job experience and knowledge when choosing a particular method. In this case, M.V. Nemtsov presented a translation that was stylistically similar to the text of the original novel and that helps the Russian reader to feel the atmosphere of American postmodernism.

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SPECIFIC FEATURES OF METAPHORS TRANSLATION IN THE WORK «4321» BY P.OSTER

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The 21st century is an era when form is more important than content. The way in which an idea is expressed is often higher than the idea itself. In this regard, an important role is played by the language tools that the authors use to create images in their works. The image in the broadest sense of the word - as liveliness, clarity, brightness of the image - is an integral feature of any kind of art, a form of realizing reality from the point of view of a certain aesthetic ideal, an imaginary language is its particular manifestation. Artistic creativity is based on the principle of aesthetics: art is a cognitive and evaluative reflection of reality [1].

One of the most compulsive personalities in imagery expression in literary works is a modern American author P. Oster. In our research we will turn to one of his most famous novels "4321", where we would like to explore the phenomenon of metaphor. This novel is full of good examples that we can work with. Russian translation of the novel was carried out by Nemtsov M.V. [2].

Starting a more detailed analysis of metaphorical translations and the use of metaphors in the text of the novel, it should be noted once again that a metaphor is a figure of style based on analogy. It denotes one thing after another that resembles it or shares an essential quality with it. Metaphor is different from comparison; the comparison asserts the similarity while the metaphor alludes to it.

The metaphor is used in everyday speech and especially in poetic expression. One of the ways to translate the metaphor, according to Peter Newmark – an English professor, is through the process of reproducing the same image in the target language [3]. Initially, it should be noted that the novel itself can act as one "big" metaphor that personifies the author through four parallel lives described in the novel. This is evidenced by a sufficient number of aspects, such as the fact that the main character is also a writer, that he creates quite "ordinary" works, in addition, he is in constant search of "himself", etc. Starting to analyze the existing metaphors in the text of the novel, the following example should be noted:

The sound of the typewriters sometimes made him think of music, especially when the bell rang at the end of a line, but it also made him think of hard rain falling on the roof of the house in Montclair and the sound of pebbles being thrown against a glass window [4].

The author of the translation presents the following interpretation of the analyzed passage [2].

It is obvious that the transfer of the metaphor into Russian is due to the reproduction of the same image, which is presented both in the original text of the novel and in the translation. In this example, author compares the sound of typewriters to a melody/song that is so pleasing to the protagonist that it makes them "throwback" into their past and remember the most pleasant moments, such as rain pounding on the roof of the Montclairs.

You can consider another example, which contains several metaphors [2].

In this example, there are several metaphors, such as:

- By replacing the image depicted in the source language in a standard way in the target language [3].

1. Had already been burned by the fires of a passionate love - *опалило пламенем страстной любви.* Naturally, what is singed with flame is used from a metaphorical point of view, and love is not a fire that can physically scorch or burn a person.

2. She had no appetite for socializing anymore - *но вот аппетита выходить куда-то и с кем-то общаться у нее уже не было* shows that the author replaced the usual word "desire" with appetite, thereby giving a brighter color to the sentence. The translation of the metaphor is quite accurate, with a slight change in word order, but this is due to the stylistic features of the Russian language, which requires some adaptation for the Russian-speaking reader.

3. The blind date - *свидание вслепую* is a description of someone setting up a date for two complete strangers and they did not see each other until the date. It is also worth noting that in the process of translating the text into Russian, the translator used tracing, a literal "interpretation" of the metaphor.

- Through translation using comparison, while preserving the image [3].

1. The world around him was continually being shaped by the world within him, just as everyone else's experience of the world was shaped by his own memories – *мир вокруг него постоянно лепится из миров внутри него, ровно так же, как переживание мира кем угодно лепится из его собственных воспоминаний.* Consequently, the world that Ferguson saw, which surrounded him, is presented in the form of a sculpture/figure that is "molded" / "created" in the process of time moving in "two directions". These metaphorical personifications are translated by means of comparison, while the image originally laid down by the author is preserved.

While working with this novel, 50 metaphors were studied. As a result, it was concluded that in the process of transferring the text from the original language into Russian, the translator used all the methods of transferring metaphors, namely: tracing, replacement and deletion, saving the image with explanations, replacing the image while preserving the meaning of the original text. Replacing the image while maintaining the meaning inherent in the text is the most common way to convey metaphors in this work. This reason can be explained by the fact that the metaphorical nature of the original language cannot be accurately translated into Russian due to the fact that the target language does not have a full or partial equivalent.

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УДК 81-26

TRANSFER OF STYLISTIC FEATURES IN TRANSLATION WORKS BY R. RIGGS

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An urgent problem of linguistics is the problem of preserving the authenticity of the text during translation. The diversity of the language pictures of the world of the author and the translator, provided that they belong to different language families, should be smoothed out as much as possible by translating not only names, realities, but also recreating a special emotionally expressive coloring of the text in accordance with the author's position. The author's peculiarity is extremely palpable in literary texts both at the level of manifestation of the author's consciousness, its moral and moral criteria, and at the level of the writer's form, idiostyle. In translation practice, the following evaluation parameters for the transfer of means of speech expressiveness are accepted: - presentation of the semantics of the text by means of speech expressiveness of the target language; - expressions of emotional and expressive coloring of the text; - adequacy of the transfer of expressive information; - adequacy of the transfer of aesthetic information [4].

In our case, the translation of stylistic features has acquired its own set of distinctive features.

Using specific private examples from the works of authorship by Ransom Riggs, we wrote out stylistic devices that were translated from English into Russian to a fairly complete extent, where the translation is more consistent with the "correct" good translation.

Metaphor

Artistic language is distinguished by the performance of its aesthetic function. The embodiment of this function means the representation of the surrounding reality in a figurative, concrete-sensual form. The words that are characteristic of fiction are descriptive, not just informative. These words explain the fact that they have the ability to give an object a characteristic that becomes additional to those that were originally assigned to a given vocabulary item in dictionaries.

By metaphor it is customary to understand a word or turn of speech that is used in a figurative sense to define an object or phenomenon on the basis of some analogy and similarity.

«*I was too dazed to follow right away, because there was something new happening, a wheel inside my heart I'd never noticed before, and it was spinning so fast it made me dizzy. And the farther away she got, the faster it spun, like there was an invisible cord unreeling from it that stretched between us, and if she went too far it would snap — and kill me.*

I wondered if this strange, sweet pain was love» [3].

«Я никогда еще не испытывал ничего подобного. В моем сердце возник и стремительно раскручивался вихрь, и от этого у меня голова шла кругом. Казалось, у меня в сердце разматывается катушка с намотанным на нее невидимым шнуром. Этот шнур соединял меня с Эммой и натягивался все сильнее по мере ее удаления от меня. Казалось, отойди она еще немного — шнур лопнет и убьет меня.

Я не знал, что означает эта странная сладостная боль. Возможно, это любовь?» [2].

In this example, the author uses an extended metaphor that describes the complex chemistry of the characters' feelings, Jacob Portman had a chance to experience his first love, and using an extended metaphor, the author describes the entire range of the character's emotions that develop into a "whirlwind", the author calls the bitterness of a temporary separation "a strange sweet pain", the connection between the author called the "cord", which is rather fragile and is about to "burst".

«*We crested the wave like a roller coaster, my stomach dropping into my legs»* [3].

«Мой желудок рухнул куда-то в ноги, и мне показалось, что угодил на какие-то чудовищные русские горки» [2]. It should be noted that in this example, the author uses a

metaphorical comparison of "sea waves" and "roller coasters", however, in translation into Russian, the author translated as "monstrous Russian roller coasters".

Irony

The main mechanism for the existence of irony is a game with meanings. In this game, the true meaning is not the direct meaning of the statement, but its opposite, implied by the author indirectly and expressed by him in various linguistic ways. The greater the contradiction between what is said and what is implied, the stronger the irony is felt. As a rhetorical figure, irony enhances the statement by deliberately re-emphasizing its meaning [1, p.315], often creating a comic effect. The semantic ambiguity of a text with an ironic orientation has the peculiarity that it is created intentionally by the author in order to cause a certain stylistic effect. Irony is transmitted through the speech of the author or characters and gives the image a comic coloring, meaning, unlike humor, not condescending approval of the subject of conversation, but, on the contrary, its implicit delicate rejection [1, p. 316]. A special expressiveness of stylistic irony (both in oral and written speech) is given by a mocking intonation, since, as you know, even a written text "sounds".

«*We rowed until our arms ached and our shoulders knotted. We rowed until the morning breeze stilled and the sun blazed down as through a magnifying glass and sweat pooled around our collars, and I realized no one had thought to bring fresh water, and that sunblock in 1940 meant standing in the shade. We rowed until the skin wore away from the ridges of our palms and we were certain we absolutely couldn't row another stroke, but then did, and then another, and another».*

«You're sweating buckets," Emma said. "Let me have a go at the oars before you melt away» [3].

«Мы гребли до судорог в руках и плечах. Мы гребли, несмотря на то что утренний ветерок стих и солнце обрушило на нас весь свой испепеляющий жар. Мы обливались потом, и вдруг я с ужасом осознал, что никто не догадался прихватить с собой воды и что в 1940-м году не существовало солнцезащитных кремов. Кожа на ладонях вздулась, а затем полопалась, и мы поняли, что больше не в состоянии шевелить веслами, но все равно продолжали грести».

«— С тебя льет ручьем, — заметила Эмма. — Пусти меня на весла, пока ты окончательно не растаял» [2]. In this situation, the heroes have a hard time, the author emphasizes this with the words of the heroes, exhausted, they still need to continue rowing to their intended goal. Irony is added by the fact that a hero from the future who finds himself in the past has a hard time in the current conditions. Emma, on the other hand, presses on a sarcastic wave, wishing that the oars would be handed over to her so that Jacob would not completely "run out", hinting at his softness and vulnerability.

Based on the analyzed material, it was found that the main elements for creating the effect of "fantastic" are all kinds of metaphors, ironies and their lexical substitutions, which help to better and more clearly define the semantic shades of expression, bring diversity to literary works of art. Considering linguistic and stylistic means using examples from the books of the American writer R. Riggs, the following methods are revealed, with the help of which linguistic and stylistic means such as metaphor, irony are often found in works of fiction, and such artistic means as comparison are especially common. An analysis of translations of works has shown that when translating texts of the fantasy genre, translators face difficult tasks - correctly translate the source text, convey to the reader a sense of the unreality of the world created by the author, and preserve the effect of unusualness.

Thus, the actual problem of translation is the literary text, which is filled with various means of expression. It is not always possible for the authors of translations to accurately convey the idea of the author of the original work, by transferring meanings to the target language.

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FEATURES OF TECHNICAL TRANSLATING

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Technical translation in one form or another has to be done by specialists. Sooner or later you will get your hands on a book or technical documentation on your specialty in English, which you will need to read and translate. A person may need to have a conversation with foreign specialists on a topic of his interest or translate such a conversation. In all these cases, this person will encounter the peculiarities and difficulties of technical translation and colloquial expressions, without knowledge of which one can make many mistakes, even if he speaks a foreign language well.

If you have to deal with general technical literature, which includes instructions for devices with a description of the technological process, patents, then you will need a technical dictionary because the translator will not be able to translate such literature correctly. Unlike the Russian language, colloquial expressions can be used in such descriptions, as well as completely new "invented" words (the so-called "technical jargon") that are not registered by dictionaries. Due to the rapid development of technology, new terms (neologisms) are constantly appearing in the scientific language, which even the latest dictionary does not have time to fix. Neologisms often present great difficulties in translation.

When working with scientific or technical English special attention is given not only to scientific, narrow-profile technical terms, but also to colloquial expressions. It is difficult to determine scientific words as the specific terminology of the technical text and, accordingly, the development of options for their translation into Russian is also required. Since the Russian scientific vocabulary differs significantly from the English technical lexical forms it presents a certain difficulty. Russian translations of sentences that show the use of these technical terms in the contexts, of course, mainly reflect the essence of the author's sources, but special English terminology must be translated taking into account the general context of the original source.

The same thing may occur in technical English texts, but it is used in different semantic meanings depending on the area of technical knowledge in which it is used.

When working with text, the translator should, if possible, avoid his own seemingly acceptable vocabulary, for example: industry — ‘индустрия’, but not as ‘промышленность’, as a term that the translator can use; ‘overload prevention device’ as ‘устройство для предотвращения перезагрузки’; X-ray thickness gauge ‘рентгеновский толщинометр’; two-stage single-cylinder air-cooled reciprocating compressor ‘двухступенчатый одноцилиндровый компрессор с возвратно-поступательным движением поршня и с воздушным охлаждением’ Recently, the tendency to form new words by shortening has intensified, and often such a new word does not look like an abbreviation. For example: laser is an abbreviation of‘light amplification by stimulated emission of radiation’, ‘lube’ is of‘lubrication’.

However, if the term and its specific semantic load are more common in the Russian language, then the term in the English technical literature can have an extremely multifaceted meaning: from a specific translation to a translation requiring general technical scientific literacy of the translator

However, in Russian language the specific semantics of the term are more common, then in the English technical literature the term can have an extremely multifaceted meaning: from a specific translation to a translation requiring general technical scientific literacy of the translator.

Thus, the general technical training of the translator is the key factor in good translation of technical literature.

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УДК 811

HISTORICAL FACTS AS THE BASIS OF PHRASEOLOGICAL UNITS

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The proposed article is devoted to the study of the influence of history on phraseological expressions. I have read some similar articles, but I wanted to go deeper into the subject and give some interesting examples I found. Learning languages is always a challenge. We always want to learn a language thoroughly. Unfortunately, the path to learning foreign languages is always thorny. It is not enough to learn words and grammar. Understanding the origins of a language, traditions and ways of thinking is an essential part of learning a language. To understand the logic of a language, one can read some historical references, and literature on language choice. While studying a foreign language (e.g. English) we can come across such phrases as idioms or phraseological units. Phraseological units are set phrases consisting of two or more words. Being culturally based, some of them are impossible to be translated into other languages -for a foreigner, such a translation will sound strange and incomprehensible. Phraseological - is a stable word combination in a particular language, the meaning of which is not determined by the meaning of components making up the unit. Phraseology - the way in which language, especially in the choice of words and expressions . To illustrate the features of, let us look at some phraseological units and explain their meanings.

«It’s not my cup of tea» In principle, quite normal and even understandable phrase. Only if there really is a cup nearby. But in English this phrase is most often used to mean "It's not my type. For example: "He is not my cup of tea" - "He is not my type. English tea drinking is the most famous of British traditions. However, tea was introduced to England relatively recently, in the middle of the 17th century. Its popularity grew rather slowly, spreading from Asia to Europe at the end of the 16th and beginning of the 17th centuries, when supplies of tea by Dutch and Portuguese merchant ships became regular. But still the British are proud of their status as a "tea country", and this is not a stereotype: the average citizen of the United Kingdom drinks about 2 kg of tea per year (we are talking about brewed tea). It is interesting that the country with the highest tea consumption per capita does not grow tea itself. [3]

«Caught red-handed» Caught red handed — caught in the act, caught at the very moment the act was being committed,caught at the very moment of … [2] The idiom means “to be caught red-handed. This idiom comes from the Old English law, according to which a man who cut up the meat of an animal that did not belong to him was to be punished. The only way to prove that he had committed such a crime was to catch him red-handed, that is, with his hands red with animal blood.

Idiom - a group of words used together with a meaning that you cannot guess from the meanings of the separate words. [2] Example usage:

- How did you know he was the one who stole your phone?

-He was caught red-hande.

«Barking up the wrong tree» - (be barking up the wrong tree - to have the wrong idea about how to get or achieve something.) [3] When a hunting dog is chasing its prey, which has climbed a tree, it starts barking at the tree, waiting for the prey to come down, but in the meantime the prey is long gone from the tree the dog is barking at.Hunting has been practiced in Britain since prehistoric times; it was the most important activity of hunter-gatherer societies before the domestication of animals and the birth of agriculture. The earliest known attempt to specifically hunt foxes with hounds was made in Norfolk, in the east of England, in 1534, when farmers began hunting foxes with their dogs as a form of pest control. England is home to some of the most famous hunting dogs. These include the English Springer Spaniel, the English Cocker Spaniel, the English Poynter, the Clumber Spaniel, and the English Setter. English Springer Spaniel. Example: You accuse me, but I'm just a victim of circumstances, you have no idea who committed the crime… you're barking up the wrong tree, my friends!

In this paper I have studied phraseological expressions with references to historical facts. These idioms describe some traditional situations from the past, which are hidden in language units. It is impossible to count the number of phraseological units in the English language. However, this was not my intention. For me it was important to show the importance of some knowledge of language and the relationship of modern language to the past . And how certain traditions and habits affect language.

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LEXICAL, SYNTACTIC AND MORPHOLOGICAL FEATURES OF THE LEGAL TEXTS TRANSLATION FROM FRENCH INTO RUSSIAN

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According to François Rigaud, one of the conditions for the proper functioning of a law is syntax, that is, the rules and methods for organizing discourse and presenting the normative provisions that underlie a particular decision. The conservatism of the legal language is manifested in the preservation at all levels of linguistic forms that have long been abandoned in other registers of speech. The reluctance to use other language forms is due to the reliability and efficiency of the structure, which eliminates the possibility of misunderstanding of legal documents. Characteristic of the lexical level and syntactic structures, conservatism is the result of adherence to established standards for writing special text and a reluctance to use new forms of expression [3].

The study of the syntactic structure of the legal documents' language reveals some features: the absence of pronouns that perform the functions of correspondence within sentences and between them, and in connection with this, the repetition of lexical units and whole phrases, as well as the use of parallel structures; a large number of passive constructions; unusually branched nominative phrases; archaic syntactic forms; sentences with inversion and etc.

Long sentences are self-contained units that have a holistic meaning and, therefore, they do not require close connection with sentences before and after them. The connection between a simple sentence and a complex one is carried out by repeating lexical units, which also ensures the accuracy of the transmitted information [2].

Lawyers do not use anaphoric links between sentences, as there is a high risk of mistranslation of its meaning. They are replaced by multiple repetitions of lexical units, which eliminates the ambiguity of the meaning.

The meaning of a French word may have a corresponding equivalent in Russian. For example: *Le juge peut désigner un médiateur avec l'accord des parties, c'est ce qu'on appelle la médiation judiciaire* [4].

When translating this phrase we use ready-made dictionary matches since there is an equivalent already fixed in the Franco-Russian dictionary: *Судья может назначить посредника по соглашению сторон, это называется судебным посредничеством.*

The technique of omission and addition are one of the key ways to solve translation problems: *... en application de l'article 515-9 du code civil en raison de violences commises par son conjoint, son concubin ou le partenaire avec lequel elle est liée par un pacte civil de solidarité* [4].

Due to the fact that this sentence contains redundant components of traditional word usage, the method of omission was applied when translating this example: ...*согласно статье 515-9 Гражданского кодекса по причине осуществления насильственных действий со стороны супруга или сожителя.*

When translating legal texts, it is important to pay attention to the distinctive features of Russian and French legal discourse:

S'il lui apparaît qu'une telle mesure est susceptible d'assurer la reparation du dommage causé à la victime, de mettre fin au trouble resultant de l'infraction ou de contribuer au reclassement de l'auteur des faits [4].	Если оказывается, что такая мера способна обеспечить возмещение ущерба, нанесенного потерпевшему, способна ликвидировать последствия правонарушений или способствовать исправлению правонарушителя …

In this example, lexical transformation was carried out and contextual translation was applied.

In the case when the semantic meaning of the term is not clear or it is rarely used, one should resort to the method of indicating the formal definition of the term, or clarify the content and replace the term with a commonly used word or phrase.

In the following passage the semantics of the concept cannot be reflected by literal translation and, in this regard, may be difficult for the addressee to understand. In this case, transcription is used in combination with descriptive translation:

Justice pénale à plusieurs facettes: justice rétributive et justice restaurative [4].	Различные аспекты правосудия: ретрибутивная и реститутивная юстиция, ставящие целью нахождение возможности социальной компенсации причиненного вреда в результате правонарушений.

In the Russian language there is no term or expression that corresponds to their designation, and in this case one should resort to a descriptive translation or to convey the meaning as accurately as possible. A descriptive translation is usually presented as a footnote.

The following sample illustrates the intricacies of a country's legal system, and also confirms that sometimes it is impossible to find lexical equivalents that fully correspond to the original wording of the law, and specific terms that are not available in the legal system of another country: *Remettre au greffe du tribunal de grande instance son permis de chasser.* When translating, it should be borne in mind that the French judicial system is multi-layered. Criminal cases are heard

by the police tribunal. These tribunals are divided into the Civil Chambers and the Correctional Court *(tribunal de grande instance).* Since this reality is unfamiliar to the Russian legal system and may be obscure to the addressee, a translator uses the method of generalization: *Передать водительские права в канцелярию суда* [1].

Thus, according to the given examples, we can conclude that the features of the syntactic structure of the legal documents' language are subject to the requirements of a clear and understandable presentation of the material. When translating legal terms, a translator may encounter the following three main situations: when there is a full dictionary match of the term in the target language; when several words correspond to an unambiguous or polysemantic French word in Russian – variant analogues; when the translator resorts to the use of various translation transformations and techniques.

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ANALYSIS OF ABBREVIATIONS TRANSLATIONS FROM ENGLISH INTO RUSSIAN IN GAMING DISCOURSE

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The relevance of the research being studied is due to the fact that computer games today are rather popular among young people around the world, and communication in game chats consists mainly of acronyms and abbreviations that are formed and used by players of different linguistic ethnic groups. Today, particular attention in linguistics is paid to translating abbreviations and acronyms thanks to the development of computer game programs, their improvement and the development of new terminological dictionaries and translation textbooks.

The object of the research is the translation of abbreviations from English into Russian on the material of the texts of the game discourse.

The subject of the study is the methods of translating abbreviations.

The purpose of this study is to identify the most common techniques of translating abbreviations.

The **objectives** of the study are the following:

1) to study the specifics of abbreviations and acronyms translation;

2) to consider abbreviations and acronyms in game-related texts;

3) to analyze the translation of abbreviations.

In the course of our research, we have studied foreign portals of the gaming industry such as *PCgamer*, *Polygon* and *Eurogamer,* selected 60 abbreviations belonging to the game discourse, then we classified them according to their categories and finally identified the following six groups of abbreviations: type of game; properties of the character's equipment items; actions performed in the game; type of characters; types of battles and abbreviations used in player messages during the

game. Almost all the abbreviations we have considered were created by letter abbreviation. The main methods of translating abbreviations include: transliteration, loan translation, full-form translation and descriptive translation.

The dominant technique is descriptive translation, e.g.: *AoE (Area of Effect) – атаки, которые покрывают определенную область с разрушительным эффектом; XP (Experience Points) – опыт, получаемый персонажем в течении игрового процесса; SS (miss) – отсутствие вражеского героя на линии в Dota и других MOBA-играх; QTE (Quick Time Event) – элемент компьютерных игр (появление на экране комбинации клавиш, которые необходимо нажать); PuG (Pickup Group) – группа, состоящая из игроков, случайно выбранных пикапером; PK (Player Killer) – антисоциальный тип, чинящий беспредел в игре, убивающий других игроков исподтишка.*

The descriptive translation is used in cases when there is no equivalent abbreviation in the target language. The technique is widely used to translate abbreviations of video game terms due to the specifics of games in different countries and, accordingly, the absence of culture specific elements in video games.

The translation of the full form turned out to be the second frequently used method of translating abbreviations in video games. This is a translation of the original unit which should be as accurate as possible? E.g.: *RNG (Random Number Generation) – генерирование случайных чисел; PvPvE (Player versus Player versus Environment) – игрок против игрока и против окружения;PvE (Player versus Environment) – игрок против окружения; MOBA (Multiplayer Online Battle Arena) – многопользовательская сетевая боевая арена; LFM (looking for member) – ищем игрока (сокращение, используемое при поиске игроков для набора группы).*

One more frequently used technique is loan translation, e.g.: *DPS (damage per second) – ДПС (характеристика, обозначающая примерное количество урона, которое персонаж способен нанести за единицу времени); B (back) – назад; Crit (critical hit) – КУ (критический удар); LOS (line of sight) – ЛОС, линия видимости.*

The transfer of the source language abbreviation by a Russian equivalent presupposes its presence in the target language. It is desirable that the corresponding abbreviation be an established unit. This technique is often used both in video games and in other areas.

Меньше всего в ходе анализа было выявлено приемов транслитерации. Транслитерация является передачей с помощью средств переводящего языка графического (то есть буквенного) состава слова языка оригинала. Мы нашли только два случая использования данного приема: *GS (game sage) – Гейм Сейдж (игрок, оказывающий добровольную помощь проекту, а так же помогающий нубам освоиться в игре); GM (game master) – гейм мастер или администратор игры.*

Transliteration is the transfer by means of the word's graphic composition of the original language. We found only two cases of transliteration, e.g.: GS (game sage) – Гейм Сейдж (игрок, оказывающий добровольную помощь проекту, а так же помогающий нубам освоиться в игре); GM (game master) – гейм мастер или администратор игры.

Thus, the descriptive translation is the most common way to translate game abbreviations and acronyms from English into Russian. We attribute this to the fact that there are no equivalents in the Russian language for many lexical units in video games due to their foreign origin.

The greatest difficulty in translating game abbreviations is created by the discrepancy between the lexical systems in the source language and the target language. The translation of language terms in this vocabulary class does not provide a complete understanding and sufficient use of language units without direct experience and further explanation, since the semantic structure of the vocabulary used in translation can be reinterpreted within the framework of the game conditions.

During the analysis, we determined that the main ways of translating game abbreviations are loan translation, transliteration, translation of the full form of the abbreviation and descriptive translation. The percentage ratio between these techniques was distributed as follows: descriptive translation – 38%, loan translation – 25%, full-form translation – 34%, transliteration – 3%. Thus, it

can be concluded that descriptive translation and full-form translation are the most common translation strategy used in the translation of abbreviations and acronyms in video games.

We can attribute this to the fact that there are no equivalents in the Russian language for many lexical units in video games due to their foreign origin. Therefore, in order to translate the abbreviation associated with the gaming industry as correctly as possible, the translator has to describe it with the appropriate vocabulary.

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СЕКЦИЯ 4

ПРОБЛЕМЫ ПЕРЕВОДА СПЕЦИАЛЬНОЙ
НАУЧНОЙ ЛИТЕРАТУРЫ

УДК 811.112.22

METAFORICAL TRANSFER OF ICHTHYONYMS IN THE ENGLISH AND RUSSIAN LANGUAGES

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In recent years the study of a linguistic picture of the world is among the priority topics in modern linguistics. It is a product of consciousness inevitable for mental and linguistic activity arising in the process of interaction between thinking, reality and language as a means of expressing thoughts about the world in communication. Metaphor, in turn, is one of the most productive figures of speech, which forms names in creating a linguistic picture of the world in a particular language [1].

The relevance of the article is due to the fact that fishing vocabulary is closely connected with the history, mentality and ethnography of the people. The external world and its internal understanding are factors that generate the linguistic picture of the world of any national language. The analysis of fishing vocabulary seems to be necessary for biologists, ichthyologists, linguists and translators to identify and rationalize as many fish names as possible.

The purpose of the study is to compare ichthyonyms in English and Russian and to identify specific features of terms with transparent internal form. Method: method of comparative analysis, continuous sampling method, descriptive method.

In the research 200 lexical units of English and Russian were considered. According to the analysis the following groups of metaphorical transfer were distinguished:

“Fish – subject”

Tripod fish (ходульный бентозавр). The main feature of this fish is that the extremely elongated rays from its three fins form a tripod on which the fish lean, sinking to the bottom [2].

Dollar hatchetfish (прозрачный топорик). The appearance of this fish resembles an ax. In Russian language the emphasis is on the fact that this fish emits a greenish light making the fish invisible. In English language the description of “dollar” explains the dark olive-green color of the fish [2].

“Fish – heavenly body”

Half-moon fish (Полумесяцехвостая бойцовая рыбка). The nomination was given for the special shape of the magnificent veil and large caudal fin in the form of opened by the crescent of the fin [2].

“Fish – mythical creature”

Goblin shark (акула-домовой). The nomination is due to its bizarre appearance. The snout of this shark ends with a long beak-shaped outgrowth and long jaws can be extended far [2].

“Fish – scientist”

Agassiz’s smooth-head (гладкоголов Агассица). The fish is named after the Swiss-American zoologist and geologist Louis Agassiz [2].

“Fish – food”

Cucumberfish (огуречная зеленоглазка). The appearance resembles a cucumber because of the pimply body with small spines [2].

“Fish – human activity”

Pilot fish (рыба-лоцман). The first version of nomination is due to the fact that pilots often swim near bow of the ship directing it to the port. The second version is connected with sailor’s belief that the fish directs the sharks to prey [2].

“Fish – animals”

Elephant-snouted fishes (слонорылы). The lower jaw of this fish is similar to trunk [2].

The results of the study show that the appearance, size, color and shape are the main features in the nomination of ichtyonyms in Russian and English languages. Moreover, lexemes that denote any subject, animal, person, human activity, mythical creature and heavenly body are important in both languages. The study may be useful for ichthyologists, zoologists, aquarists, lecturers, students, librarians, editors and other specialists who are interested in science. The research is of particular interest to translators who translate scientific literature and encyclopedias.

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УДК

LEXICAL FEATURES IN THE TRANSLATION OF TECHNICAL LITERATURE

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In the modern world, where the development of international relations of intercultural communication is flourishing, the expansion of economic, financial, scientific and technical ties between countries, the importance of a foreign language (namely English) as an instrument of communication and information exchange between representatives of different peoples and cultures is increasing. To maintain the pace of development of modern technologies, specialists are required who understand not only their profile of scientific knowledge, but also have practical skills in translating scientific and technical texts. In order to possess such skills, students have to deal with foreign articles on a certain profile already during their studies at higher school.

Active knowledge of the main types of speech activity, such as reading, speaking, listening and writing, also includes skills and abilities to work with a foreign text in order to extract information and formalize this information in their native language.

Translation of scientific and technical literature is a special type of translation activity, characterized primarily by interpreted materials. Presented by texts on scientific and technical topics, in particular, research work, engineering and design documentation, various dictionaries, business contracts, and so on, it requires the most complete reconstruction of its form and content in its native language when translating.

One of the key problems of translating scientific and technical literature is the lexical feature of a foreign language. Since most of the published materials are written in English, we will analyse its lexical features when translating technical texts.

The translation itself must meet the following requirements: adequacy, informativeness, content, consistency and clarity of presentation. Accuracy in translations of technical literature is important, since the slightest translation errors can disrupt the logical structure of the material and change the semantic load of the entire text.

List of the main lexical difficulties in the translation of scientific and technical literature:

1. The ambiguity of words. The English vocabulary is characterized by a developed ambiguity, which adds significant difficulties in translation. Often the meanings of words can be determined only based on the context. Example:

Atmosphere - the mixture of gases around the earth. Also, atmosphere is the character, feeling, or mood of a place or situation [1].

Nose - part of a face. Also, nose - front part of a vehicle [2].

lead - to control a group of people, a country, or a situation. Also, lead - a wire covered in plastic and used to connect electrical equipment to the electricity supply, in addition, lead - a chemical element that is a very heavy, soft, dark grey, poisonous metal, used especially in the past on roofs and for pipes and also for protection against radiation [1].

Face - front part of the head. Also, face is the front or surface of an object [1].

2. Translation of international words. Special terms and words of non-Anglo-Saxon origin (usually Greek or Latin etymology) are common in the vocabulary. And in this you can see both pros and cons. On the one hand, international words contribute to the understanding and acceleration of the translation process due to the instant selection of dictionary matches. Example: ecology, fluctuation, radius and others. On the other hand, there is a high probability of encountering the translator's "false friends" or pseudo-internationalisms and making a mistake. For example: resin, servant, cession, fabric, accurate and others.

This also applies to words of Anglo-Saxon origin. So, for example, oxidative stress. Such borrowings lead to the "clogging" of the Russian language with foreign-language vocabulary units and, sometimes, to complicate the perception of the resulting text.

3. Plural of nouns. Ignorance of the plural forms of some words can lead to difficulties in translation: phenomenon - phenomenon, erratum - errata, radius - radii, vertex - vertices [3, p. 5].

Also, since the leading form of scientific thinking is a concept, almost every lexical unit in a scientific text is expressed by special lexical units — terms. Terms are words and phrases that denote specific objects and concepts that are used by specialists in a certain field of science and technology. Both words used almost exclusively within the framework of this style and special meanings of commonly used words can be used as terms. Coherence, klystron, microsin — it is difficult to meet the limits of scientific materials [3, p. 6]. Therefore, the main mistakes that a translator can make when translating a scientific text are related to unwillingness or inability to use a dictionary and, no less important, misunderstanding of the subject situation — ignorance of what the term means, even in their native language. In quantitative terms, in scientific-style texts, terms prevail over other types of special vocabulary (nomenclature, professionalisms, professional jargon, etc.).

Thus, the translation of scientific and technical literature requires a certain vocabulary, including terms, to navigate in a specific area of scientific knowledge to which the translated text belongs. It must meet the requirements of equivalence, informativeness, adequacy, logic, coherence and clarity of presentation and at the same time must not violate the norms of the language into which the translation is being made. Only by solving these complex tasks, you can get a full-fledged professional translation, which plays a key role in the interaction between all participants of the scientific and technical community.

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TRANSLATION OF SCIENTIFIC AND TECHNICAL LITERATURE SKILLS ACQUISITION

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An important part of the technical specialist professional training process is the study of a foreign language. The purpose of acquiring the skills of translating scientific and technical literature is the development of foreign language competencies, which contributes to the specialist's professional skills implementation. It is necessary to take into account the factors influencing the "ambiguity" of translation in the learning process.

The skill of technical translation is necessary primarily for students and beginners in the field of special scientific literature translations. It should be noted that the translation of scientific and technical literature must be carried out in accordance with special requirements. A distinctive feature of scientific and technical literature is informativeness and consistency. The informativeness of the scientific style lies in the coherence of the text and the technical terms accurate translation. The consistency of the text is a strict sequence of statements reflecting the main idea. The emotional component of the text should be replaced by an accurate description of the action, process or object. In the scientific and technical text, the main ideas are conclusively stated, specialized terminology, abbreviations and symbols are used. The vocabulary in scientific and technical literature consists of commonly used words and special terms. The main purpose of translation is to transfer all information into another language without changing or distortion.

The factors influencing the "ambiguity" of the translation can be caused by various reasons. Difficulties in translating technical texts arise due to the fact that the same term has a different meaning in different fields of science or even within the same field, a large number of new terms appear.

Translation recommendations are aimed at developing the competencies necessary for professional activities, as well as developing professional communication skills. The translator must simultaneously use industrial and explanatory dictionaries. It is important to know different translation methods and be able to apply them in practice.

Thus, it is important to have the necessary professional skills and knowledge for high-quality translation of technical texts. The presence of these competencies will allow a specialist to translate scientific and technical literature and achieve success in this area.

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УДК 81

THE FUNCTIONING OF SYNTACTIC AND LEXICAL MEANS IN "SHADOW AND BONE" BY L. BARDUGO

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Fantastic literature combines not only epic action battles with incredible landscapes, but also detailed characters with a beautifully described world inhabited by a huge variety of unusual creatures and races. In this paper, we will pay attention to various means of expression that will help the reader immerse himself in magical worlds. The study of stylistic and lexical means of the fantasy genre is relevant, as it allows you to evaluate the skill of the author of their use.

The theoretical and methodological basis of the research consists of scientific works that address the problems of the functioning of syntactic and lexical means [1].

In the process of writing the course work, the following methods were used:

– analysis of the literature devoted to the peculiarities of the functioning of expressive means;
– abstracting, taking notes, quoting;
– when establishing semantic and structural features, a statistical method is involved.

Considering the work of Leigh Bardugo "Shadow and Bone"[3], we found many lexical means, the most obvious were archaisms and historicisms of Russian realities. For example:

«kefta» - «кефта», «banya» - «баня», «oprichnik» - «опричник», «blini» - «блины», «kvas» - «квас». The function of these techniques is to create a characteristic color of a particular time, so the reader understands that the action of the novel takes place in an alternative Russian Empire.

Syntactic constructions are used to enhance the expressiveness of the utterance. So, the author uses an anaphora: "I'm sorry I left you so long in the dark. I'm sorry, but I'm ready now». In this case, the author creates the effect of a gradual injection of meaning, and also participates in establishing a logical connection of meaningful fragments of the text [2].

Thus, syntactic and lexical means and their functions play a huge role in creating a special atmosphere of the world described in the fantasy novel.

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УДК 81.25

TRANSLATION OF SCIENTIFIC LITERATURE, ITS CURRENT PROBLEMS AND POSSIBLE WAYS TO SOLVE THEM

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Annotation: With modern day science's pace there are some problems with translation of scientific literature which make the whole process more difficult and time-consuming. Can those problems be solved in the nearest future? What possible solutions could there be?

Key words: translation, dictionary, term, problems.

In the modern day science moves forward with a fast pace producing dozens of scientific texts such as articles, reports, monographs, e.t.c. With English being the global language the availability of scientific literature depends on its translation from original language to English. But this raises several problems.

First of all, when a scientist comes up with a new term, which most probably is a new word, there's an issue of if it's going to have an English equivalent or not. It can become a completely new word in English or it can be transferred having its spelling and pronunciation changed following the rules of English phonetics. Here comes up another problem. For example, let's look into one of the Japanese syllabaries called katakana. The katakana syllabary consists of 48. Since the 20th century, katakana have been used mainly to write non-Chinese loan words, onomatopoeic words, foreign names, in telegrams and for emphasis (the equivalent of bold, italic or upper case text in English). [1] For instance, English word "translation" will be transcribed as "to-ra-n-su-re-i-sho-n" according to katakana syllables. It can lead to some issues as Japanese language doesn't have such consonant as "l" and therefore syllables with this consonant are transcribed as syllables with the same vowel and "r" consonant instead. It can lead to confusion as some words are transcribed the same: both "really" and "lily" can be transcribed as "ri-ri". To conclude this example it has to be said that languages are very different phonetically and that's why "moving" words from one language to another without translation can surely lead to confusion and misunderstanding thus making translating process even more complex. Second, the complexity and specificity of scientific speech and writing in every language can be seen as an obstacle for scientists who do not possess advanced knowledge in English. Third, there's a lack of thorough and strict unification in the process of preparing scientific texts, for example, its structure, throughout the world.

Are there any possible solutions? After all it all comes down to "sticking to dictionary" during the process of translation. It would be unfair to say that it hasn't become easier to use dictionaries nowadays when the majority of planet's population has access to Internet. Nonetheless, many of them are more convenient for everyday use rather than translating scientific literature and on the other hand the ones which provide useful resources for that are less convenient and much more time to use. Making these resources more user-friendly and advanced might be one the solutions to process of translating scientific literature being hard. The second much less possible solution is creating a universal scientific language which will contain all scientific terms. This solution has a major flaw. Science existed almost as much as humanity hence the number of scientific terms is simply enormous and all of them will have to have a universal equivalent in this new language. Also it's likely it will share the fate of Esperanto: it will be accepted by a small group of people and won't be as widespread as English. [2]

What to do now? The global status of English isn't going anywhere soon, so the majority of scientific literature will be still translated to it. It's also in our hands to make scientific speech and

writing more available by simplification of them. The simpler the structure of a certain text in its respective language, the easier it is to translate it to English or any other possible global language.

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УДК 81.373

THE SPECIFICS OF THE OFFICIAL BUSINESS STYLE

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Annotation: The article is devoted to the analysis of approaches to determining the specifics of the official business style of communication. A brief excursion into its essence is given. Examples of style integration into everyday life are considered. Based on the analysis of relevant sources on the problem, it is concluded that it is necessary to highlight the key indicators of this style.

Key words: communication style, features, official business communication, genres of style.

Changes in social and linguistic development have led to a wide interest in language learning in various professional fields. The development of professional communication leads to the study of a professional language as a component of a general linguistic system. This is a feature of the official business style. It is dry and tasteless, all the turns in it are unambiguous and constant. Official business style is the style of documents: international treaties, state acts, legal laws, regulations, charters, instructions, official correspondence, business papers, which has been formed over the years [1].

Its characteristic feature is the constancy in the use of the same words and lexical phrases. Which each person periodically meets in his life, should be clear and unambiguous. Any document should be interpreted in only one way. In an official business style, the use of ambiguous words, as well as words in figurative meanings, is unacceptable. Style vocabulary, like any other, official business in business texts, it uses a standard set of lexemes and phrases. First of all, these are words from the branch of official communication: prescribe, allow, notify, plaintiff, head, law, and the like. In other styles, they are used much less frequently [2].

The second characteristic feature is the use of constant expressions and clichés of speech. This makes any text predictable, but at the same time completely unambiguous: based on, considering, according to. And, of course, more than once in my life I had to write a statement or protocol. At the syntactic level, first of all, there are small constructions, simple sentences, a minimum number of complications, such as homogeneous members of a sentence [3].

Relations between states depend on the correctness of documentation in this area. One wrong comma or word can cause a global conflict. Genres in Practice, Formal Business Speech has a wide range of example texts. Legislative documents include law, act, decision, decree. They are compiled at the highest levels of management by specially trained people. In the field of jurisprudence, the genres of official business style in Russian are represented by verdicts, court decisions, cassation complaints, search warrants or arrest warrants. Administrative documents are among the most common. This includes an application, CV, order, recommendation, fax, phone message, receipt, and many more. In diplomacy, treaties, pacts, agreements, conventions are most often used [4].

This is a long established, stable and rather closed style. The features of the official business style of speech are quite recognizable and easily applicable in any area related to compliance with established norms and procedures. Learning how to write business letters can seem like a daunting task at first, but once you learn the options, you can learn formal messages much sooner than expected. To an outside observer, it may sometimes seem that such an overly dry style contains only instructive information and has nothing to do with the real state of affairs. Actually, it is not. Just the business style involves a detailed and scrupulous immersion in the situation, a detailed study of all the details [5].

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THE PROBLEM OF ADEQUACY AND EQUIVALENCE IN THE TRANSLATION OF A SCIENTIFIC AND TECHNICAL TEXT ON THE EXAMPLE OF THE BOOK "FRICTION AND WEAR IN MACHINES"

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Abstract: The relevance of the study is due to the study of the adequacy and equivalence of translations from English to Russian of scientific and technical literature.

The aim of the work was to identify the degree of accuracy of translation of the Englishscientific and technical text based on the analysis of transformations of text units, which was carried out on the basis of the approach proposed by L.S. Barkhudarov.

Keywords: language units, adequacy, equivalence, transformation of units, translation.

This work is devoted to the study of a book (from the University of California [2]) related to the oil supply of turbines [1], on the adequacy of the translation into Russian. Adequacy and equivalence in scientific and technical texts is associated with the replacement and rearrangement of words in translationfor a better understanding of native speakers.

The analysis will be carried out on the basis of the unit transformation methodology presented by L. S. Barkhudarov [3].

A fragment of the analysis can be seen in Table 1.

Table 1. Analysis of the adequacy of translation.

Original	Translation	Analysis
Another approach is to form a protective film by chemical attack, a small quantity of a suitable reactive compound being added to the lubricating oil.	Другой подход заключается в образовании защитной пленки путем химического воздействия, при этом в смазочное масло добавляется небольшоеколичество подходящего реакционноспособного соединения.	Rearranging «to the lubricating oil» at the beginning of the sentence in order to adapt the translation to a standard sentence for the Russian reader.
The most common materials are additives containing sulfur or chlorine or both.	Наиболее распространенными материалами являются добавки, содержащие серу или хлор, или обакомпонента.	The word "components" was added to the phrase "sulphur or chlorine or both" to clarify the meaning.
When the system is open: Do not work with compressed air.	При открытой установке: Не работать со сжатымвоздухом.	The phrase «When the system is open»:- «когда установка является открытой» is replaced by «при открытой установке».

Comparative analysis of the texts allowed us to check the correctness of thetranslation and identify the percentage of transformations:

1) Permutation (46%).
2) Substitution (32%).
3) Omission (12%).
4) Supplement (10%).

The conducted research allowed us to come to the conclusion that adequatetranslation in the field of scientific and technical literature requires the transformation of the text. Transformation is necessary to comply with the rules of the Russian language and preserve the meaning of the text in the Russian language. Thus, we can conclude that the adequacy of the text is measured in preserving the meaning for the reader, but requires reducing the equivalence of the text.

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LEXICO-PHRASEOLOGICAL FIELD "MORALITY" IN THE WORK BY M.M. DODGE "THE SILVER SKATES" AND ITS TRANSLATION A.N. ROSHDENSTVENSKOI: COMPARATIVE ASPECT

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Abstract: The relevance of the study is due to the expansion of international relations, which requires a deeper understanding of other cultures, which contributes to the improvement of translation practices.

The aim of the work was to identify the degree of accuracy of the English literary translation based on the analysis of the semantic field “Morality”, which was based on the concept proposed by S.O. Kartsevsky.

Keywords: lexical and phraseological units of the language, semantic field, field core, field periphery, translation.

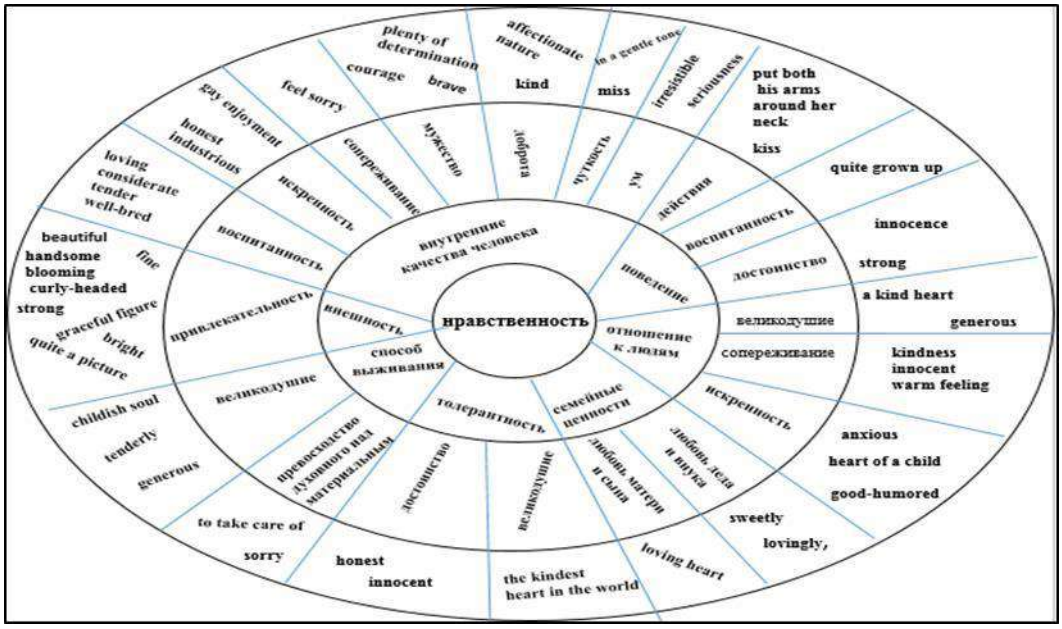
This study is devoted to the comparison of lexical and phraseological unitsin the work of M.M. Dodge "Silver Skates" [1] and in its translation into Russianby our philologist and translator A.N. Rozhdestvenskaya [2]. The main task was to make similar structure’s comparative analysis of the semantic field of assessingthe personal characteristics of the characters of the texts M.E.M. Dodge and A.N. Rozhdestvenskaya at the lexical and phraseological level to determine the translation’s correctness degree of the English text into Russian (using traditionallinguistic dictionaries).

The analysis of the semantic field was carried out based on the concept proposed by S.O. Kartsevsky [3], which presupposed the isolation of the lexeme’ssemantic core and the definition of its semantic periphery.

We have identified phraseological units identical to the concept of "Morality" and created the field "Morality". In its core we use the lexeme "Morality" (characteristics associated with the generally accepted behavior of people); the structure closest to the core consists of a description of the human behavior’s assessment: attitude to people, family values, tolerance, etc.; the periphery is occupied by lexemes defining the qualities of human morality:

sensitivity, kindness, dignity, generosity, sincerity, etc. others. Schematically, thissemantic field is presented in Fig. 1.

Fig.1. Semantic field "Morality".



Phraseological units comparison of the semantic field "Morality" in English and Russian translated texts by the degree of correspondence of its lexical and phraseological units (by semantics and structure) showed the following:

1) Completely matching in semantics and structure (63%).
2) Partially matching in semantics, but not matching in structure (15%).
3) Completely matching in semantics, but not matching in structure (15%).
4) Complete discrepancy in semantics and structure (7%).

The conducted research allowed us to come to the conclusion that there is a possibility of a more accurate translation. This involves taking into account thespecifics of the culture to which the original source belongs, its value priorities; paying attention in the process of translation to the central and peripheral positionsof the semantic field of the word and ensuring the transmission of nuances of meanings; striving for adequate translation without elements of the translator's self-expression, which ensures maximum accuracy of the translated text.

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LEXICAL AND GRAMMATICAL FEATURES OF SPORTS DISCOURSE

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The relevance of the work is explained by great interest of millions of people to sport and the influence of sport discourse on the formation of the reader's attitude to the event.

The object of the research is lexical and grammatical features of Russian and American newspaper articles describing sports events.

The subject of the research is the transfer of lexical and grammatical features of Russian and American articles about sport in translation.

The objective of the research is the analysis of translation techniques of the media text on the example of sports articles.

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

1) to identify the linguistic features of newspaper texts;
2) to perform a comparative analysis of articles from different sources;
3) to identify translation peculiarities of the newspaper text.

The research is based on text analysis, semantic analysis and comparative analysis.

To identify the newspaper text features in its translation, it is necessary to distinguish between the differences in their presentation in both countries, the style which the authors use in their texts, what they focus on and what they prefer to ignore. To achieve this, it is necessary to make a comparative analysis of articles from Russian and American sports media devoted to the same event in various sports. The articles from the largest American sports news resource "ESPN" were taken as the research material as well as articles from popular Russian sports media "Чемпионат" and "Sports.ru".

The articles are devoted to the first round play-off series of National Hockey League from 10 May 2022, between Colorado Avalanche and Nashville Predators.

Anton Rudnev's article on the portal "Sports.ru" begins as follows: "Colorado" is some kind of a crazy machine that lives exclusively on attacks." It is safe to say that from the very beginning the author focuses the reader's attention on the team's role, namely on the high commitment to the aggressive style of play, comparing the team with the machine, most likely, a scoring machine. It is worth noting that comparative construction of this type is often found in Russian sports media. Most likely, this is due to the nickname of the USSR national hockey team, called the "Red Machine" all over the world for its high efficiency and accuracy of actions on ice.

Another interesting means in the very first paragraph is the idiom "they hurt their fists", noting the fact that attacking teams are most often among the first to leave the relegation stage, even if during the regular season this style brought results. Then the author uses the expression "there was an intrigue", which you definitely will not find in foreign media in this form, and the expression "half a deck", emphasizing that the players of "Colorado" did not seem to make any incredible efforts.

A. Rudnev makes another emphasis on the whole team, and more specifically, on Nashville's efforts in defense, noting that the team tried to build a "cemented defense with a strong goalkeeper", later adding the following:

- *It didn't work out at the level of the idea: the 17th regular season team in terms of conceded goals with the third goalkeeper at the base cannot suddenly become an ultra-reliable and disciplined mechanism. Although the Predators, of course, tried - look how they are waiting for the start of the opponent's new attack (well, they seem to be carefully carrying out the shift) in the fourth match* [2].

The author's comment is one hundred percent evaluative; it tells the reader that the team, although doing everything right in theory, in practice is simply not talented enough, which reflects the statistics of missed goals for the regular season.

Then the author makes the following significant semantic emphasis on the wages of athletes, there are two such moments in the article:

- *Filip Forsberg, who makes 6 million a year, scored the first goal in this playoff"; "Yakov Trenin, who scored 3 of 9 Nashville goals in this series, is preparing for the holidays. His contract ends this summer, and it seems that he has proved that he deserves a new one - and not for 725 thousand, but for a noticeably larger amount [3]*.

These two passages are opposite in meaning, the author emphasizes the insignificance of the actions of a higher paid player who scored only one goal out of 9, while an athlete with a much lower salary scores 3, emphasizing which of the players is more valuable and important for the future of the organization.

The title of the article *Trenin carried Nashville to the fifth match as best he could, but Nichushkin ruined everything. Colorado in the second round*! deserves special attention. The title is bright and flashy, perhaps even too long and detailed, but the main players of the meeting and the final result were noted in the title. Lexically, it is interesting in that it is almost completely written using colloquial vocabulary, mixing it with the usual colloquial one. The headline is simple and understandable even for those who are not familiar with the nuances, except for the names of two athletes and the names of the teams playing, the headline does not use other words inherent exclusively in sports journalism. The most interesting expressions are: "carried", meaning he tried his best, and "ruined" in the literal sense of the word.

Summing up the intermediate result, the article from the Russian resource “Sports.ru” is characterized by the use of:

1) colloquial vocabulary;.
2) phraseological units and metaphors;
3) particular emphasis on the only Russian hockey player;
4) references to statistics, both for the entire regular season and for this particular playoff series;
5) assessment of the team’s actions and their individual members;
6) detailed and flashy title;
7) evaluation of the players’ effectiveness and comparison of their wages on the principle of price-quality.

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PROBLEMS OF TRANSLATION OF SPECIAL SCIENTIFIC LITERATURE

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In the modern world of scientific and technological progress, global communication and trade and economic relations between the countries of the world, the importance of language as an active factor in international communication and a means of communication between representatives of different peoples and cultures is significantly increasing. Accordingly, translation and, in particular, “translation of specialized scientific literature” plays an important role.

As **A. L. Pumpyansky** said, “Translation of scientific and technical literature is a special discipline that arose at the intersection of linguistics, on the one hand, and science and technology, on the other”. Therefore, the translation of scientific and technical literature should be considered from both linguistic and scientific and technical positions. Translation of scientific and technical texts must meet the following requirements: equivalence, adequacy, information content, consistency and clarity of presentation. In order for the translation of a scientific and technical text to be adequate and equivalent, i.e. of high quality, the translator needs general and specific knowledge, skills and the following skills:

Theoretical - about the phonetic, lexical and grammatical structure of a foreign language (lexical units, grammatical rules, word formation)

Practical - about the features of the translation of scientific and technical texts (types of translation transformations and correspondences)

Linguistic practical knowledge (methods of translation: transliteration, tracing, substitutions, permutations, additions, omissions, methods of descriptive and antonymic translation)

Extralinguistic knowledge (possession of sufficient information for the translation of a specialized text), which is necessary in the process of translating the text and constructing meaningful and adequate sentences in the target language.

Terminology. Since the leading form of scientific thinking is the concept, almost every lexical unit in a scientific text is expressed by special lexical units - terms. A term is a denoting word or phrase characteristic of a given branch of science and technology. It has clear semantic boundaries. Accordingly, terminology is a system of concepts of a given science, fixed in an appropriate verbal expression. If in a common language (outside this terminology) a word can be ambiguous, then, falling into a certain terminology, it becomes unambiguous, and the translation uses a meaning that

is different from the use in everyday life. Therefore, the main mistakes that a translator can make when translating a scientific text are related to the unwillingness or inability to use a dictionary and, no less important, a lack of understanding of the subject situation - not knowing what the term means, even in the native language.

Grammar. The style of scientific communication has its own grammatical features. For example, there is a tendency to lose lexical meaning and increase the abstractness of verbs, as well as to more frequent use of linking verbs. Also, scientific style tends to use impersonal and indefinitely personal forms of the verb: “distillation is done - distillation is being done”(перегонкупроизводят — перегонкапроизводится); “you can draw a conclusion - a conclusion is drawn”(можновывестизаключение - выводитсязаключение), etc. It is interesting to note that, according to linguistic studies, the percentage of present tense verbs is three times higher than the percentage of past tense forms, accounting for about 70% of all verb forms. Also in academic texts, the passive voice is quite often used: “the following conclusion can be made here…”

Summing up, we can say that in order to successfully translate scientific literature, a translator needs to have a certain vocabulary, including special terms; know the specific grammatical constructions of the scientific style of a foreign language; know the lexical, grammatical and stylistic rules of translation; features of the construction of the dictionary and be able to use it; navigate in a specific area of scientific knowledge to which the translated text belongs.

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УДК 81

FEATURES OF THE TRANSLATION OF SCIENTIFIC TEXTS FROM RUSSIAN INTO ENGLISH LANGUAGE

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The task of a translator of literary texts is fundamentally different from the task of a translator of scientific texts. A translator of a scientific text works with texts in which there is practically no emotional coloring, so the main task is to accurately convey the thoughts of the author and preserve the style of narration. However, not everything is as simple as it seems at first glance, because in order to accurately convey the meaning, the translator must understand this topic at the level of the author of the text: he must know the terminology, understand the features of the English-language article, and be fluent in both his native and foreign languages. Below, we will consider the main features of the translation of Russian-language academic texts into English and the problems that a translator may face [1].

As for the translation of the title, one of the main mistakes in translation is the use of transliteration. This transformation is allowed only when translating proper names, devices and other objects that have untranslatable names; also, you cannot use slang that foreign experts cannot understand. The main feature of the heading is brevity and informativeness, therefore it is necessary to avoid cumbersome grammatical constructions, they can be replaced by attributive groups that are typical for an English scientific text. Moreover, some words can be omitted if they do not distort the meaning. You should also remember about quotation marks, since different characters are used in English and Russian texts: Russian quotation marks are « » , English quotation marks are “ ”.

As you know, when translating from Russian into English, the scientific text is reduced by about 10%. Moreover, many foreign scientific journals recommend shortening the title to 12 words [2]. This means that part of the words of the Russian heading cannot be translated if this does not affect its meaning. For example, such words as "concept", "theory", "image", "aspect" cannot be translated if they are specified in the Russian tex [3]t.

There are a number of clichés in Russian that do not need to be translated by tracing. One of the typical mistakes is the translation of the phrase “to the question of something” as “to the question of smth.”. In English, this cliche is conveyed by the preposition “on”, just like any headline that begins with “about something”. Other commonly used phrases are “by the example of something” or “by the material of something”. Many translate them literally, although the correct translation of these clichés is “a study of smth”, “a smth-based study”[3].

When translating an abstract, it is important to remember the following: the phrase "abstract of a scientific article" is translated into English in one word: abstract. Typical mistake: annotation (in English, this word means "explanation to the text").

The annotation often contains general scientific words, expressions and phrases that can be used to describe the study. The word “research” is often found in the abstract of a scientific article, and several synonyms are used in its translation, the most frequent being “research” (extensive, global research). Although most often the authors mean only the work that they personally did and which represents only a part of a large study carried out by other scientists before him, in this case the word should be translated as “study”. There are also translation options: survey (research-survey), test (research-testing of materials), analysis (research-analysis), etc.

Another typical mistake is the translation of the phrase "this article" as "the given article". In English, the definite article or the demonstrative pronoun this is used to denote "given/given". As for the translation of keywords into English, the main mistake is the use of the article. Keywords should not contain articles, as they were taken from dictionaries [4].

The introduction should also be short and concise. Most scientific journals require that it be no longer than 500 words, so do not repeat the statements in the abstract. Present Simple is used in the introduction for:

• descriptions of well-known facts;

• expressing agreement with the authors of previous studies, that is, recognizing their achievements as scientific truth;

• descriptions of what the article is about.

Present Continuous is not found in scientific texts as often as Present Simple. This tense is mainly used to describe current trends. However, according to some linguist researchers, continuous forms are now becoming more widespread in scientific English text. If you need to indicate a scientific contribution or indicate the starting point of the study, it is recommended to use the Present Perfect. When presenting the topic of the work, it is possible, but less typical, to use the predicate in the active voice with the subject expressed by the personal pronoun of the 1st person plural or the noun the author (authors), as well as the nouns study, investigation, paper (article), experiment, theory, hypotheses, etc [4].

In Russian and English, an action can be expressed by a verb, for example, study - to study, measure - to measure, and a verb-nominal combination, which is a semantic unity: make a study - to conduct research (explore), make measurements - to make (carry out) measurements (to measure). Since such pairs, that is, a verb and a combination of a verb with a noun, are equivalent, then when translating into English, the choice of a verb or a verb-nominal combination will depend not on how the concept in Russian is expressed “explore” or “conduct research”, but from the order of the English sentence and the entire English text.

In order to correctly understand and translate a Russian-language academic text into English, it is necessary, as mentioned earlier, to have a good knowledge of this subject. In addition, in order to correctly convey the content of the text into English, the translator must understand the relevant Russian and English terminology and have a good command of the English literary language.

Translation using a dictionary of unfamiliar unambiguous terms, such as oxygen (oxygen), ionosphere (ionosphere), is not difficult. The situation is different when several Russian terms correspond to one English term. In this case, the conscious choice of an analogue can be dictated only by a good knowledge of the subject, as well as the frequency of its use [5].

Special attention should be paid to such words as, for example, everyone and student. In English, they are usually referred to as male, therefore, in order to avoid "gender bias", it is not recommended to use these words in translation (Every scientist should be aware of his responsibilities - All scientists should be aware of their responsibilities). This recommendation also applies to the pronouns he/she, the words and phrases spokesman, mankind, man-made, woman scientist, etc. If possible, these words should be replaced with "gender-neutral".

In conclusion, as a rule, authors use Past Simple to summarize the results obtained, and Present Simple or modal verbs to explain what these results mean.

Thus, the translation of scientific texts is a very responsible task, as it requires a large preparatory base from the translator. Of course, this stage is important for interpreting any style of text, but when preparing to translate a scientific text, the translator must be well-versed in its topic, otherwise he runs the risk of interpreting the meaning incorrectly, distorted, or not understanding the subject of discussion at all. In addition, a person involved in translations should be savvy in matters of information about the author of the text, as well as the current state of his works, their relevance today.

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УДК 81

IT-TERMS TRANSLATION FEATURES

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The field of information technology (or IT-sphere) is a rapidly developing branch of human activity and covering an increasingly wide range of people. For example, while information technology was used a rather narrow circle of specialists a few decades ago, nowadays in is an integral part of our lives: many people can hardly imagine life without such achievements of IT-sphere as computers, smartphones, internet, etc.

As any branch of human activity develops, new terms emerge that are specific to it, and the IT-sphere is no exception. As it develops, there are many different terms, and as the main language of the field is English, they all need to be translated into Russian.

Translation of IT-terms belongs to the translation of scientific and technical literature and, therefore, their translation should use unambiguous correspondences (equivalents) rather than words close in meaning [1]. However, due to the rapid of information technologies and the

emergence of new terms, the selection of Russian equivalents to the new English terms has a number of problems:

- the lack of a generally accepted established terminology in Russian;
- a large number of Russian-language terms that are borrowed;
- blurred boundaries between Russian-languages terms and IT-slang;
- higher level of terminological and narrative imagery of English-language IT-texts [2].

The following methods are used to translate new IT-terms from English into Russian:

- borrowing without translation;
- transliteration;
- selection of the semantic equivalent;
- morphemic calculus [3].

Borrowing without translation implies a complete borrowing of an English word, i.e. transferring it into Russian without any changes. Examples of such borrowings are «Paint» (graphics editor), «Android» (operating system), NFC (wireless communication technology), Bluetooth (wireless communication standard), etc. All the terms that have entered the Russian language in this way are used unchanged and have no translation. For example, Paint, NFC, and Bluetooth.

The second method, transliteration, involves replacing characters from one language's alphabet with characters from another language. For example, blockchain, internet, domain, router, etc.

The third way is to find equivalents. For example, bus, network card, keyboard», etc.

The fourth way is morphemic calculus – word-for-word translation. For example, database, motherboard, hyperlink, etc. [4].

Let us illustrate the use of translation methods on specific examples [5].

1. Each end of a bus network must be terminated with a resistor to keep the signal that is sent by a node across the network from bouncing back when it reaches the end of the cable.

This example illustrates the method of translation by selecting semantic equivalents.

2. A Bluetooth connection is wireless and automatic, and it has a number of interesting features that can simplify our daily lives.

This example illustrates the way of borrowing without translation. The English term «Bluetooth» is used without change in the Russian text.

3. You've probably heard of several protocols on the Internet. For example, hypertext transfer protocol is what we use to view Web sites through a browser — that's what the http at the front of any Web address stands for.

This example illustrates three ways: borrowing without translation, transliteration and morphemic calculus. Borrowing without translation is represented by the use of the term «http» in the Russian text. Transliteration is used to translate «Internet», «browser», «web». «Hypertext transfer protocol», «Web sites», «Web address» are morphemic calculus.

Thus, these examples clearly illustrate the peculiarities of translate them from English into Russian.

In conclusion, we can conclude: due to the specificity of information technology, the translation of its terms has its own individual features, which must be taken into account when translating.

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COMPARATIVE ANALYSIS OF TERMINOLOGY TRANSLATION (BASED ON «THE THEORY OF EVERYTHING: THE ORIGIN AND FATE OF THE UNIVERSE»)

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The relevance of the study is due to the growing public interest to science fiction. Stephen William Hawking is famous for his explaining tricky things in a simple way. That is why his books are understandable even to non-specialists; and the number of his readers is constantly growing, although scientific texts have the abundance of terminology transferring key information. This paper discusses the comparison of various translations of the book.

The object of this research is popular scientific terminology.

The subject of this research is the analysis of scientific terms translation from English into Russian.

The research material is the book *«The Theory of Everything: The Origin and Fate of the Universe»*.

The purpose of the study is to identify terminology translation in the astrophysics and cosmology.

The tasks of the research are the following ones:

1) to define terminology components as a separate lexical category;
2) to describe scientific terminology features;
3) to compare the two versions of translation.

The research methods include semantic analysis and comparative analysis.

In 1996, Stephen Hawking published seven lectures, compiled into a book «The Theory of Everything: The Origin and Fate of the Universe». It describes the development of the concept of the universe from the time of Aristotle to the present day, covering the theory of the universe expansion and the first postulates that the Earth has a spherical form. The main purpose of this book was to unify all physical theories into one theory of everything.

I. Ivanov and E. Shimanovskaya presented the most popular translations of this book to the Russian audience. This study presents its comparative analysis with the English version of the book.

Both translators use transliteration as the most frequent transformation technique. For example, English terms «*spherical*», «*cosmological model*», «*in ellipses*» are translated as «*сферический*», «*космологическая модель*», «*эллиптический*»:

1. «*…Земля имеет сферическую форму…*», «*…в целостную космологическую модель…*», «*…а по эллиптическим орбитам…*» (Ivanov).

2. «*…Земля имеет сферическую форму…*», «*…Птолемеем в целостную космологическую модель…*», «*…а по эллиптическим…»* (Shimanovskaya).

The word «moon» in the English language sometimes means a satellite. S. Hawking writes: *«... several small satellites or moons ...»*. Despite the fact that this meaning is not typical of the Russian language, the translators did not use the omission technique and translated this word using loan translation: «*…несколько небольших спутников (лун)…*». However, next time translators use the word *«спутник»*. For example, the translation of the passage *«...the moons of Jupiter moved on...»* in the English version of the book is as follows:

1. «*…а спутники Юпитера движутся вокруг нее…*» (Ivanov).

2. «*…а спутники Юпитера движутся по крайне сложным траекториям…*» (Shimanovskaya).

Loan translation is used in translations of physical laws. For example, the *«law of universal gravitation»* in both Russian versions looks like *«закон всемирного тяготения»*. At the same time, there is a syntactic assimilation, one of the translation techniques, in which the syntactic structure of the original language is transformed into a similar structure of the target one.

The word *«matter»* used as a noun in the sentence: *«The light from distant stars would be dimmed by absorption by intervening matter»* is translated variously:

1. «*Свет далеких звезд тускнеет, поглощаемый материей, которая встречается на его пути*» (Ivanov).

2. «*Свет далеких звезд ослабляется из-за поглощения веществом, находящимся на его пути*» (Shimanovskaya).

Thus, during the translation of the lexeme "matter" I. Ivanov used the transliteration technique, while E. Shimanovskaya chose another equivalent to this word in Russian, which means *substance*.

Similarities in translation techniques can be found by analyzing the Russian-language equivalents for measures of dimension. Both translators choose the same measure of speed in the following extract: «... a certain critical speed - about seven miles a second ...». Furthermore, there is clarification for Russian audience given in parentheses:

1. «*…при скорости выше некоторой критической величины (около 11,2 км/с)…*» (Ivanov).

2. «*…если ее скорость превышает некоторое критическое значение (приблизительно 11,2 км/с)…*» (Shimanovskaya).

Thus, we can emphasize that transliteration and loan translation as the most frequently used translation techniques. Also, most of the terms that denote the celestial bodies are translated identically. Moreover, translators add extra details in translation of measurement system. It is rather significant in scientific texts. Taking into consideration all mentioned above, it can be assumed that both translators had common views on translation of scientific literature because a large number of similarities were noted in the use of Russian equivalents for English terminology in astrophysics and cosmology.

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AEROSPACE ENGINEERING VOCABULARY GROWTH WHEN WORKING WITH AIRFOI_EDITOR AND XFLR5 VIRTUAL SOFTWARE COMPLEXES

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Students' mastery of highly specialized aerospace terminology, which is increased from year to year while studying at university, is one of the most important component of communication skills in future professional collaboration of engineers.

The relevance of this work is based on the need to possess special purposes vocabulary on the subject of "Aerodynamics" in order to obtain applied knowledge when using virtual software complexes with an interface in English (Airfoil_Editor and XFLR5) [1]. These computer programs

reflect the influence of Mach and Reynolds numbers on the main aerodynamic characteristics of an aircraft depending on the geometry of the airfoil.

The purpose of the work is to unify the dictionary of highly specialized terms of the Airfoil_Editor and XFLR5 programs basing on the principal vocabulary on the topic "Aerodynamics".

Research methodology:

1. Generalization of engineering terminology based on textbooks by Orlovskaya I.V., Samsonova L.S., Skubrieva A.I.

2. Analysis of the frequency of the vocabulary on the topic "Aerodynamics" based on textbooks by Avdeiko S.A., Lyubaeva G.V., Kochurova N.E. and open internet resources.

3. Generalization of the most used terms in the Airfoil_Editor and XFLR5 programs.

Stages of research.

1. The examination of general technical vocabulary, reflected in Table 1, has been carried out.

The general engineering vocabulary includes many physical, mathematical and science terms, as well as terminology on medicine, ecology, and social profile [2]. The scientific and technical vocabulary, even the basic one, is huge. The authors included in Table 1 examples of some intersectoral general engineering terms showing the objectivity, formality, specificity, and consistency of vocabulary.

Table 1

The most common words	**Translation**
Edge / Leading edge	Кромка, край, лезвие / Ребро атаки
Friction	Трение
Frequency	Частота; частотность
Hull / Airframe	Корпус, каркас
Hypersonic (above 5 Mach) / Supersonic	Ультразвук (выше 5 Махов) / сверхзвук
Instant	Мгновение; моментальный
Jet / Jet nozzle	Струя, реактивный самолет / реакт. сопло
Ratio	Коэффициент
Rate	Темп; скорость
Resistivity	Удельное сопротивление
Thrust / Specific thrust	Тяга / Удельная тяга
Toughness	Ударная вязкость, жесткость, прочность
Visible	Видимый

2. The highly specialized terms of the Airfoil_Editor program are analyzed (the pressure distribution of the specified airfoil in different modes, depending on the Mach, Reynolds numbers and angle of attack (the program interface is in English) [3]. The data are summarized in table 2.

Table 2

The most common words	**Translation**
Mach number	Число Маха
Angle of attack / Angle of incidence	Угол атаки / угол заклинения (установки)
Re number	Число Рейнольдса
Lift coef. (coefficient)	Коэффициент подъемной силы
Drag coef.(coefficient)	Коэффициент сопротивления (интеграл Cp)
Max thickness	Максимальная толщина
Lref (reference length)	Характерный линейный размер
Sref (reference area)	Характерная площадь крыла
Tref (temperature reference)	Температура на бесконечности

3. Frequency terms of the XFLR5 program (analysis of airfoil by pressure distribution plots) are collected (the program interface is in English). The results obtained are presented in Table 3.

Table 3

The most common words	Translation
Lift / Upward acting force	Подъемная сила
Drag / Backward acting force	Лобовое сопротивление
Yawing moment (around vertical axis)	Момент рыскания
Rolling moment (around longitudinal axis)	Момент крена
Pitching moment (around lateral axis)	Момент тангажа
Alpha / Angle of attack	Угол атаки
Aspect ratio	Удлинение крыла
Taper ratio	Сужение крыла
Root to tip sweep (backward swept wing /forward swept wing)	Стреловидность (прямая/обратная)
Root chord / Mean chord	Корневая хорда / Средняя хорда
Wing span	Размах крыла
Wing area	Площадь крыла

4. During the research, the following features of the vocabulary on the topic "Aerodynamics" were identified:

a) The regularity of expanding the aerospace vocabulary from basic terms to highly specialized ones is shown [4]. Chains of words have been compiled showing the special purposes vocabulary build-up training. For example: Drag / Shock wave unstable drag / Hydrodynamic drag coefficient / To reduce inductive and parasitic drag of the aircraft.

b) The ambiguity of terms is analyzed, for example: Drag / Frontal resistance / Pressure resistance – different types of the term «Сопротивление» translation; Root chord / Medium aerodynamic chord / Tip chord – variability of the translation of the term «Аэродинамическая хорда».

c) The synonymy of terms on the topic "Aerodynamics" has been studied. For example: Twist at tip / End twist / Twist angle about x-axis at the tip [5].

d) The antonymy of terms is analyzed, for example: Wing extension - Narrowing of the wing - Aspect ratio (коэффициент относительного удлинения крыла). Sweep: Forward swept wing – Backward swept wing (прямая / обратная стреловидность).

Conclusions:

1) The vocabulary of highly specialized terms compiled by the authors for working in Airfoil_Editor and XFLR5 programs based on the basic dictionary on the topic "Aerodynamics" increases the efficiency of special purposes vocabulary mastering.

2) The ways of highly specialized vocabulary unification proposed by the authors can be used as an algorithm for students for replenishing the aerospace vocabulary.

3) This research is important for the formation of communication skills in future professional collaboration of engineers

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УДК 81`25

DIFFICULTIES ENCOUNTERED IN THE TRANSLATION OF SPECIAL SCIENTIFIC LITERATURE

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Our country deals with new information received by scientists from all over the world every day, so it is very important to be able to translate it correctly into Russian in order to be aware of all events and discoveries. Therefore, the need for translation of scientific literature is currently huge.

The main stylistic feature of a special scientific text is an accurate and clear presentation of the material with almost complete absence of emotional saturation. Therefore, the main task of a special scientific translation is to bring the reported information to the reader in an extremely clear and accurate manner. [1]

What difficulties can arise when translating special scientific literature?

1. The ambiguity of words. The English vocabulary is characterized by a developed ambiguity, which leads to significant difficulties in translation. Often the meaning of a word can be determined only based on the context. If a word is taken in quotation marks, it means that it is used in a meaning other than the dictionary, for example: hand of curve — направление поворота (Russian).

Often words acquire a new meaning because of the imagery that is inherent in the English language, for example: walk-up building — дом без лифта (Russian).

Another difficulty is the translation of homonyms (words that sound the same, but have different meanings), for example: can — мочь, жестяная банка (Russian), and homographs (words with the same spelling), for example: lead — вести, свинец (Russian).

2. Translation of neologisms. A neologism is a word that has arisen to describe a new meaning. When translating it, it is necessary to take into account the morphemes of the word.

The most common form of word formation is suffixal, for example: the suffix -ability creates the words buildability — a factor of manufacturability in construction.

There are words landscape, seascape, which mean «ландшафт», «морской пейзаж» (Russian). However, American architect Frank Lloyd Wright created a new word townscape, which can be translated as «пейзаж, созданный трудом человека» (Russian).

3. Translation of international words. International words are words that appear in several languages in approximately the same sound and graphic form and with a similar meaning.

These often are terms borrowed by Russian and English from Latin or Greek, or these are words that have penetrated into other languages from English or Russian.

Examples of words borrowed from ancient languages are the words radius, democracy. Examples of words of English origin that have become international are: sport, president, football, and words of Russian origin such as sputnik, tsar, collective farm. In the original language, many words are polysemous, and in the language where they came later, they are unambiguous. This is the difficulty of translating them. An inexperienced translator knows that the word "revolution" means «революция» (Russian), and in a certain context this word can mean «коренное изменение» (Russian) or «один оборот» (Russian).

In the Russian language, the word "satellite" can mean "a random companion", " life partner" and "spacecraft orbiting the earth". In English, the word "sputnik" is only "spacecraft".

4. Pseudointernational words. They have completely different meanings in English and Russian, despite their external similarity. These are the so-called false friends of the translator.

Here are a few examples of such words:

resin— «не резина, а смола» (Russian);

actual — «не актуальный, а фактический» (Russian);

accurate— «не аккуратный, а точный» (Russian).

5. «Culture-specific lexicon», lacunae. In any language there are thewords that do not have the one-word translation in other languages, for example: the words «крикет», «шиллинг» (Russian) are not translated into other languages, forming a layer of borrowed words. This is «culture-specific lexicon».

Along with them, there are lacunae — this is the absence of words for meanings expressed in other languages, for example:

two English words "bank" and "shore" correspond to a Russian word — "берег".

6. The difference in the meanings in British and American English.

Some meanings in English sources are expressed in one word, and in American — in another.

For example: аккумулятор (Russian) – accumulator (British English) - storage battery (American English) [2]

It can be concluded that the translation of such literature requires a special approach and special training from the translator. The translator must possess methods, techniques and forms of scientific thinking, as well as extensive scientific knowledge and erudition. Scientific texts are difficult to translate not by their grammar and style of presentation, but by their requirements for the translator's proficiency in general scientific vocabulary and the level of knowledge in each specific scientific field, therefore, the translation of scientific literature should be considered both from the standpoint of linguistics and from scientific and technical positions.

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СЕКЦИЯ 5

ФУНДАМЕНТАЛЬНЫЕ И ПРИКЛАДНЫЕ ИССЛЕДОВАНИЯ В НАУКЕ

УДК 682.518.5

NUMERICAL CALCULATION OF NATURAL VIBRATION FREQUENCIES OF BEAM FORMS IN THE PIPELINE

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Abstract: In the work, Lamb waves propagating both in the form of transverse and longitudinal waveforms were studied to a greater extent. The wave, the vibrations of the particles of the medium of which occur in perpendicular directions to the direction of propagation of a vibrational or acoustic wave, is called transverse [1].

Keywords: vibration diagnostics, non-destructive testing, natural frequencies of vibrations.

A wave whose particles oscillate in the direction of wave propagation is called a longitudinal wave.

There is a relationship between the spatial periodicity in a vibrational or acoustic wave at different radii and the number p is determined by the ratio shown in the formula below:

$$\frac{2\pi}{\lambda_1}R_1 = \frac{2\pi}{\lambda_2}R_2 = \frac{2\pi}{\lambda_3}R_3 = p,$$

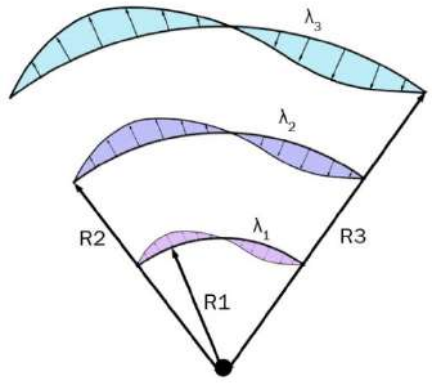
where λ_i is the length of the *i*–th wave corresponding to the oscillation of the wave at the *i*-th radius of the i-th circle R_i, p is the angular wave number that characterizes the wave phase onset during the passage of a single angular interval [2].

The figure below shows the relationship between the frequency of acoustic or vibrational waves in space at different radii of the pipeline under study.

For clarity, different colors in the figure show different relative values of the oscillation amplitudes, at different radii [3].

Fiberglass composite pipe with epoxy impregnation with technical parameters and characteristics corresponding to GOST R 53201-2008 "Fiberglass pipes and fittings" was used as the object of research and calculations.

In this paper, we consider one of the methods for calculating the natural frequencies of vibrations, based on the values of the moment of inertia and the modulus of elasticity.



Picture 1 - Dependences of transverse wavelengths on the radii of the pipeline circles: R_i – radii of the corresponding circles; λ_i – wavelengths of oscillations of the corresponding circles of the pipeline

Calculation of natural oscillation frequencies (beam shapes)

The natural frequencies of longitudinal vibrations (beam forms) are determined specifically for each pipeline during testing, *Hz* [4]:

$$F_n = \frac{m^2}{2\pi l^2}\sqrt{\frac{EJg}{q}},$$

where *m* is the coefficient for a multi-span free–lying pipeline with one compensator at the end, equal to 1,62; 3,49; 6,38 and 9,70, respectively, for the 1st – 4th forms of vibrations.

l – span length between intermediate supports, cm;

E – modulus of elasticity, kg/cm^2;

J – moment of inertia, cm, $\pi(D^4 - d^4)/64$;

D – outer, *d* – inner diameters of the pipeline;

g – gravitational constant, cm/s^2;

q – the total mass of the object per centimeter of linear length, $q = q_{ст} + q_в$;

$q_{ст}$– the natural mass of the pipeline shell, coming per centimeter of linear length, kg/cm;

$q_в$ – own mass of water enclosed in the pipeline, per centimeter of linear length, kg/cm;

The natural frequencies of the beam shapes of the fiberglass pipe used in the experiment are calculated.

Initial parameters of the pipe under study:

Modulus of elasticity, *E* = 9,6 *GPa*;

Span distance between pipeline supports, *l* = 27 *cm*;

The total length of the pipe under study, *L* = 40,05 *cm*;

Outer diameter, *D* = 7,34 *cm*;

Inner diameter, *d* = 6,24 *cm*;

The mass of the pipe under study, *m* = 871 *g* = 0,871 *kg*;

Decision

The intrinsic mass of the shell of the pipe under study per centimeter of linear length:

$$q_{ст} = \frac{m}{L} = \frac{0{,}871}{40{,}05} = 0{,}021\ kg/cm.$$

Since the pipe under study is not filled with water during the experiment and calculations, $q_в$ is considered equal to zero, thus, $q = q_{ст}$ = 0,021 *kg/cm*;

Modulus of elasticity: *E* = 0,6 *GPa* = 97892,75645 kgf/cm^2;

Moment of inertia: $J = \frac{\pi(D^4 - d^4)}{64} = \frac{3{,}1415(7{,}34^4 - 6{,}24^4)}{64} = 68{,}055\ cm^4$;

The natural frequency obtained by the first calculation method:

$$F_п = \frac{m}{2\pi l^2}\sqrt{\frac{EJg}{q}} = \frac{6{,}38}{2 \cdot 3{,}1415 \cdot 27^2}\sqrt{\frac{97{,}75645 \cdot 68{,}055 \cdot 981}{0{,}021}} = 4958\ Hz.$$

Conclusion. The disadvantage of this technique is the lack of the possibility of finding the modes of the calculated frequency. The main advantage of this technique is the ability to calculate a loaded pipe filled with water or other liquid. In this paper, the calculation was carried out for an unloaded pipe.

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HYDRAULIC RESONANCE AS CALCULATION OF NATURAL FREQUENCIES OF PIPELINE VIBRATIONS

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Abstract: Oscillation methods, or, in another way, resonance methods, combine 2 main methods of oscillation of an object or its parts: the method of forced oscillations and the method of free oscillations [1].

Keywords: non-destructive testing, natural frequencies of vibrations, pipelines.

It is to the forced oscillations that the concept of resonance is more relevant - the coincidence of the excitation frequency with the natural oscillation frequency of the system.

This formula implies a simplified ratio of the radii of the circles to the wavelengths running through the layer, indicated in the following formula:

$$\frac{R_1}{\lambda_1} = \frac{R_2}{\lambda_2} = \frac{R_3}{\lambda_3} = const,$$

where λ_i is the length of the i–th wave corresponding to the oscillation of the wave at the i-th radius of the i-th circle R_i.

A fiberglass pipe with technical parameters and characteristics corresponding to GOST R 53201-2008 "Fiberglass pipes and fittings" was used as the object of the study [2].

In this paper, one of the calculation methods based on the velocity of the shock wave propagation in the material of the pipeline under study is considered.

Calculation of natural oscillation frequencies (hydraulic resonance)

If the frequencies of the disturbing forces are close to or multiple of the frequency of the pressure wave (shock wave), then hydraulic resonance is observed.

The velocity of the shock wave (the speed of sound), determined approximately by the following formula, m / s:

$$C = \frac{1425}{\sqrt{1 + 0{,}1A \cdot \frac{D}{\delta}}},$$

where D is the diameter of the pipeline under study, mm;

δ is the thickness of the pipe shell, mm;

A is a coefficient equal to 1.0 for a pipeline without stiffening rings, 0.3 – 0.4 for pipes with stiffening rings [3].

At the same time, the natural frequencies of oscillations are determined by the following formula, Hz:

$$F = \frac{kC}{4L},$$

where *F* is the natural oscillation frequency, Hz;

k = 1, 2, 3... – harmonic number;

C is the velocity of the shock wave, *m/s*;

L is the length of the pipeline under study, *m*;

The initial parameters of the pipe:

The outer diameter of the pipeline, *D* = 7,34 cm = 73,4 *mm*;

Pipeline wall thickness, δ = 0,55 cm = 5,5 mm;
Harmonic number, k = 1;
Coefficient A = 1,0;
The length of the pipeline under study, L = 41,05 cm = 0,4105 m.

Decision

The velocity of the shock wave (the speed of sound in the density of the pipe) [4]:

$$C = \frac{1425}{\sqrt{1 + 0{,}1A \cdot \frac{D}{\delta}}} = \frac{1425}{\sqrt{1 + 0{,}1 \cdot 1 \cdot \frac{73{,}4}{5{,}5}}} = 932{,}6393\ m/s,$$

Natural frequencies of oscillations, based on calculations for the 9th harmonic:

$$F = \frac{kC}{4L} = \frac{9 \cdot 932{,}6393}{4 \cdot 0{,}4105} = 5112\ Hz,$$

Results of calculations of natural frequencies of oscillations for various harmonics:

F, Hz	C, m/s	D, mm	δ, mm	A	L, m	k
567,99	932,64	73,4	5,5	1	0,4105	1
1136	932,64	73,4	5,5	1	0,4105	2
1704	932,64	73,4	5,5	1	0,4105	3
2272	932,64	73,4	5,5	1	0,4105	4
2839,9	932,64	73,4	5,5	1	0,4105	5
3407,9	932,64	73,4	5,5	1	0,4105	6
3975,9	932,64	73,4	5,5	1	0,4105	7
4543,9	932,64	73,4	5,5	1	0,4105	8
5111,9	932,64	73,4	5,5	1	0,4105	9
5679,9	932,64	73,4	5,5	1	0,4105	10
6247,9	932,64	73,4	5,5	1	0,4105	11
6815,9	932,64	73,4	5,5	1	0,4105	12
F, Hz	C, m/s	D, mm	δ, mm	A	L, m	k
7383,9	932,64	73,4	5,5	1	0,4105	13
7951,9	932,64	73,4	5,5	1	0,4105	14
8519,8	932,64	73,4	5,5	1	0,4105	15
9087,8	932,64	73,4	5,5	1	0,4105	16
9655,8	932,64	73,4	5,5	1	0,4105	17
10224	932,64	73,4	5,5	1	0,4105	18
10792	932,64	73,4	5,5	1	0,4105	19
11360	932,64	73,4	5,5	1	0,4105	20

Conclusion. Comparing the calculated natural oscillation frequencies of a fiberglass composite pipe, it is possible to determine the advantages and disadvantages.

This method of calculating natural frequencies allows you to find different harmonic numbers, expanding the calculation possibilities.

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УДК 662.756.3

INTRODUCTION OF AN EMERGENCY FUEL JETTISON MECHANISM ON A NEW GENERATION OF CIVIL AIRLINERS AS A CURRENT NECESSITY

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Generally, the necessity for an emergency fuel discharge system is significant at the present stage of civil aviation development in our country. This paper touches upon the problem of the lack of emergency fuel drain on most modern passenger aircraft. This issue is especially relevant in today's realities. The topic comprises both an environmental component and a component of people’s safety, as well as the preservation of aircraft integrity.

Currently, many passenger aircraft produced by both Russian and foreign manufacturers do not have such an important function as emergency fuel dumping which is undoubtedly vital.

The purpose of this article is to clarify the importance and necessity of the emergency fuel drain function on modern medium-haul narrow-body passenger aircraft, on which this function is not currently provided. The methods used in the current research are comparative analysis, synthesis and fieldwork data comparison.

First of all, it should be mentioned that aircraft generally have two types of weight restrictions: *maximum takeoff* and *landing weights*. Overall, the maximum takeoff weight is much greater than the maximum landing one. Moreover, there are strict restrictions on the weight of an aircraft landing and it is impossible to exceed this limit in any case, since this situation can cause an airliner to crash. We should not forget that during an airplane landing, the aircraft undergoes additional loads, there is a certain impact of the landing gear on the ground, while the load goes to the wing, to the fuselage, and to the landing gear itself. If the aircraft weighs more than the allowed weight during landing, then some structural elements may not withstand the stress and break, thus an explosion or fire may occur on board.

An emergency landing is the premature landing of an aircraft in an emergency situation. The most common reason for an emergency landing is the medical emergency of a passenger on board. If an aircraft has to run out of fuel for several hours before such a landing, a passenger in need of emergency medical care might not have a chance to receive it quickly and efficiently. Therefore, in many cases, emergency fuel dumping is so necessary.

Emergency fuel dumping is a procedure used in an emergency by an aircraft to quickly reduce its weight by dumping fuel. It is worth noting that emergency fuel dumping is not performed if an emergency situation on board allows you to reduce the amount of fuel by running out of fuel in the holding area. In the event that an emergency fuel drain is unavoidable, the aircraft commander (AC) must contact the controller and then follow the instructions from the flight manual (LR).

During a fuel dump operation, precautions are taken to ensure that other aircraft do not enter such areas. Emergency defueling must be performed at the altitudes and speeds specified in the flight manual for the aircraft in question. Usually at a fairly high altitude (minimum 6000 feet, AGL). Fuel ejected at this altitude will dissipate before it hits the ground.

The absence of this function in modern medium-haul narrow-body aircraft is largely due to the fact that they are designed for the possibility of overweight landing, of course, this is done only in cases of emergency, and after which various maintenance checks are required.

So, even if the plane makes a successful landing in excess of the maximum landing weight, it will still require its expensive examination. It should be noted that after such a hard landing, structural damage to the aircraft may occur, which in the future may lead to the write-off of the aircraft, but most importantly, passengers on board may suffer.

Unfortunately, one of these situations happened quite recently, namely on May 6, 2019. The Sukhoi Superjet 100 aircraft following flight SU1492 (Moscow-Murmansk) requested an emergency landing five minutes after takeoff due to critical circumstances. Since this aircraft was a medium-haul narrow-body aircraft, it did not have an emergency fuel drain function, which is why the pilots had to land the aircraft with a landing weight exceeding the allowed one, i.e. with almost full tanks. As a result, during landing, the aircraft suffered enormous loads on the landing gear and fuselage, and the rear of the aircraft caught fire. The cause of the fire, according to the captain of the aircraft, Yevgeny Evdokimov, was full tanks. As other independent experts have stated: "The scale of the tragedy was exacerbated by the fact that the plane was fully refueled." As a result of the tragedy, 41 people died. [4]

Perhaps if this aircraft had an emergency fuel drain function, then it would be possible to empty the tanks and land the aircraft with an acceptable landing weight. In this case, the landing would not have been so hard and many casualties could have been avoided. Table 1, that I took from Tu-214 instruction manual shows aircraft specifications.

Takeoff maximum weight:	110 750 kg
Landing load:	93000 kg
Maximum mass of fuel on board	17750 kg
Average fuel consumption per hour	3700 kg/hour

Therefore, it is possible to conclude that such an aircraft as the Tu-214 must also contain the function of an emergency fuel drain. According to the calculations presented in the paper, the aircraft will need about 5 hours to completely run out of fuel on board, provided that it is fully refueled.

110750−93000=17 750 (kg); 17500÷3700= 4,7972972973~5 (hours)

In connection with the above, I believe that the emergency fuel dump function should be provided for on modern medium-haul narrow-body passenger aircraft, such as the Tu-214 and SSJ 100. Based on the situation, pilots will be able to decide themselves to dump fuel, land with an excess landing weight or run out of fuel, flying in the waiting area. In the future, I would like to consider this issue in more detail and start deriving a formula to determine the need to implement this function on an aircraft.

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УДК 351.814.4

ASSESSMENT OF INFLUENCE FACTORS IN A SYSTEMATIC APPROACH TO THE AVIATION SECURITY MANAGEMENT PROCESS

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Security management is a continuous process that combines many functions and elements, the purpose of which is to ensure an acceptable level of security in conditions of limited resources. At the same time, from the standpoint of the system approach, each element, function, communication, subsystem influence the operation of the entire system as a whole [2].

Influence factor in the process of aviation security management is understood as a property, process or phenomenon that will matter in the decision-making process.

The purpose of this study is to assess the factors influencing the decision-making process in security management. To achieve the goal, the analytical method and the factor analysis method were used.

Traditionally, groups of factors are distinguished by the source of occurrence: technical, human, socio-economic and etc.; by materiality: primary and secondary ones; in relation to the study object: internal and external ones. The classification of factors in relation to the subject of the study will be more important in the research of the influence of factors on the decision-making process.

When considering the security system in detail as a unit, it becomes clear that the concepts of internal and external influence are not enough to describe the factors which effect on the security system.

The security management system in general and particularly the aviation safety management system can operate at three levels: the level of threat prevention, the level of direct threat control and the level of minimization and elimination of consequences, or in accordance with the Decree of the Government of the Russian Federation of 29.12. 2020 № 2344 - level 1 - protection against probable threats, level 2 - protection against imminent threats, level 3 - protection against direct threats [1].

It is important to notice that when the level of functioning of the security management system changes, its main indicator - the target function, which is the goal that must be achieved in the process of management and decision-making, also has to change.

The change of the security level most often occurs under the influence of external factors (geopolitical situation, terrorist threats, military conflict).

If we assume x_1 x_2 x_3 environmental factors affecting the level of security of transport infrastructure facilities, then the target function for each level we will describe ($F_{1,}$ $F_{2,}$ $F_{3)}$ can be expressed as the dependence of the target function on the values of external factors corresponding to a certain level.

$F_1 = F(x_1)$ is the target function at the level of threat prevention;

$F_2 = F(x_2)$ is the target function at the level of threat control;

$F_3 = F(x_3)$ is the target function at the level of minimization and elimination of consequences.

When the level of operation changes, the internal parameters of the system, and accordingly the internal influence factors do not change. The probability of their impact on the decision-making process remains constant, because there are no changes in the structure and organization of the system itself: the category of the transport infrastructure object, the number of employees, their level of training, the certification category, technical means, material support remain unchanged at all three levels of operation. At the same time, the ratios in the number of groups, the volume and form of additional security procedures change, and these factors cannot be attributed either to internal or external factors of influence. At this stage, it is proposed to introduce the term functional affiliation factor (a_i), that is, a factor due to the target function of the system at a particular time. As

mentioned above, the internal factors of the system remain unchanged when the level of functioning changes, but due to the influence of functional factors, the internal factors influence on decision-making and on the implementation of the target function change. By accepting these changes, we can express the target function of the system at any level of functioning as follows:

Fi = F(xi, yi(ai), ai), where

F_i - the target function of the security system at a certain security level;

x_i - environmental factors at a certain level of safety;

y_i (a_i) - internal factors of the system, as a function of the factors of functional affiliation;

a_i - factors of functional affiliation.

Thus, it is possible to formulate the following conclusions:

1. Moving from one level of security or functioning to another (changing the target function of the security system) is a function of external influences.

2. The target function of the security system at any level of functioning is dependent on external factors, internal factors influenced by the factors of functional affiliation, and the factors of functional affiliation themselves.

Determination of relationships, coefficients of dependence, weight of certain factors in the decision-making process in aviation security management systems will be the issues of further researches.

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УДК 681.7

SPECTROGRAPH WITH A COMPOSITE GRISM

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We present an optical design of imaging spectrograph for the visible domain, based on a grism, which uses 4 independently optimized gratings. It’s shown that this element has a high efficiency and allows to improve the image quality by 40%.

The combination of a diffraction grating and a prism (prism i.e. grism) allows one to build optical designs with zero deviation and separately observe the spectra from different points of the slit. Such imaging spectrographs are used in various fields, including biomedical research [1]. At the same time, the operating conditions of the grating in such a component change across its surface due to dispersion in the prism and aberrations of the preceding elements. In this study, we consider the possibility of compensating these effects by using a composite hologram [2], i.e. It is divided into several elementary fields, in each of which the aberration properties and the properties of the holographic layer change independently.

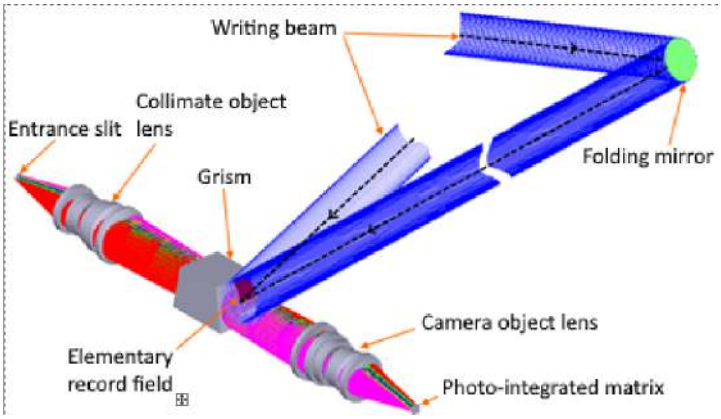

Fig. 1. Combined scheme of the composite grism recording and operation

As an example, the scheme, operating in the range of 400-675 nm with a relative aperture of 1:2.9 is considered (see Fig. 1.). The scheme uses commercial Helios-44 lenses (58 mm, 1:2), a K8 glass prism with an angle of 10.1° and a 308mm-1 transmission holographic grating. The grating is divided into 4 quadrants, and is recorded by two parallel beams from an Ar laser (488 nm). An auxiliary deformable mirror is installed in one of the beams, the shape of the surface of which is optimized separately for each quadrant. The spectrograph has a linear field of view of 5 mm and an reciprocal linear dispersion of 51.6 nm/mm.

Calculations based on the formulas of the Kogelnik theory [3] show that the diffraction efficiency over the operating range is 83.7-98.9% with the layer thickness of xx microns and the index modulation depth of 0.04. Image quality analysis showed that when the auxiliary mirror is deformed by less than 2.5 microns, the RMS radius of the spot diagrams can be reduced from 16.2-20.6 to 9.7-16.7 microns for the center and edge of the field of view, respectively (Fig.2).

Thus, high transmission of the optical path and an increase in image quality characteristics up to 40% are provided.

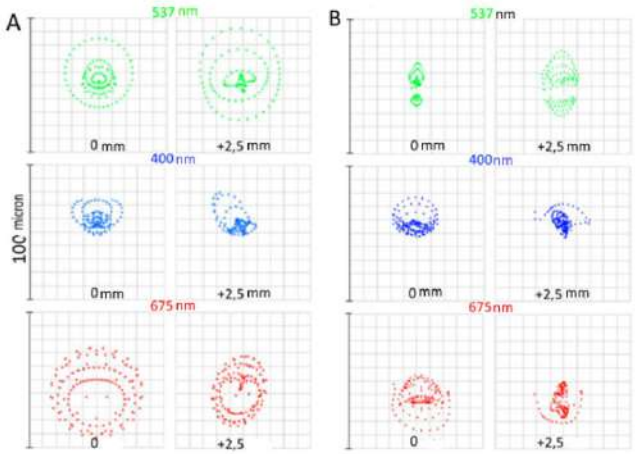

Fig.2 Spot diagrams of the spectrograph: A – without correction, B – with deformable mirror

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УДК 159.99

QUALITY OF INTERPERSONAL RELATIONSHIPS AND SATISFACTION OF MARRIAGE WITHIN YOUTH GENERATION

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Marriage is one of social institutes which is served to order different kinds of relationships between man and woman. Main goal of marriage is family's creation. Marriage leads to common responsibilities and rights. We are considered family's crisis problem from the point of youth generation in this study: which reasons and factors are impacted on quality of relationships.

1. Lack of understanding and knowledge about family values.

Family is first social group in huma's life. Due to the family human joint to culture values, learn first social roles, gain experience of social behavior. Any family is created to satisfy their members' significant needs which are complimented by common and social needs. Family values include:

- love and respect to each other;
- common interests;
- common moral values and etc.

In our opinion, main problem is related with change of values and priorities in modern young families. Nowadays family is not the priority for many people, traditional values are going to background, motivation is decreased.

2. Inability to build family's life.

Every family is created its own way, values, forms to interact with each other and distribution of duties. However, many of young persons are not understood how to realize elements which are mentioned above. Despite the fact that this problem is very relevant, it can be solved in some cases during life experience.

3. Financial and psychological difficulties.

There are many difficulties that young people face: financial insolvency, buying own housing, personal psychological problems, high stress level, problems with work and medicine. All mentioned difficulties are negatively impacted on family's psychological well-being and balance of relations.

Thus, it leads to stress and conflict between partners. It is often can be heard that there is not enough money in the family, husband/wife does not want to get a job and does not perform daily duties.

4. Social muddle.

By using this term we mean inconsistency of modern society's impact on families. Family values are actively propagandized from the government. However, it is realized on very superficial level. Let's concern some examples which deserve individual discussion.

Problem of maternal capital. From one side it is definitely can be helpful for young families. But from the other side there is a negative: lack of financial comfort leads to situations when families have children only because of maternal capital.

Maternity leave for man. It there any inconsistency with traditional values? Is it negatively when opportunity for leave is supported to man (which is traditionally main person in the terms of financial well-being) and woman have to work? Is it justice?

There are disciplines which are related to spiritual and moral education in the field of overall education. However, in the past few years these disciplines are forced to teach. Thus, it might be negatively evaluated by part of society.

5. Satisfaction of marriage.

Young family is social phenomenon because it faces with many social problems due to inexperience and must rely on government's help.

Analysis of literature which is related to research of marriage's satisfaction in young families shows that spouses face a lot of problems at the stage of role relationships' establishment and family values' development. Sometimes these problems cannot be solved only by spouses or they do not have enough resources to solve it or it is necessary to consult the specialists [3].

As a result, the number of incomplete families is increased; number of divorce is also increased and rate of birth is decreased.

In conclusion we would like to share that this study is realized not only as a result of literature review but also from the point of our view. Life experience and acquisition of information about young families by dialogue are also related with realization of this study. We are directly interacted with youth due to our age and professions: in particularly, one of authors worked at the factory and now working in the bank, second is teacher in kindergarten and third one is teaching students in university.

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УДК 62-621.2

THE MODELLING OF LIQUID DISPERSION IN GASIFICATION TECHNOLOGIES

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Steam droplet flows are widely spread in both nature and technology. Based on hydro- and thermodynamics of steam-drop systems, technological processes in power and mechanical engineering are being developed, ensuring reliable and safe operation of various installations. For this reason, there is a strong interest to the problem of modeling hydro- and thermodynamics of vapor-drop structures in science and technology. This work is devoted to the modeling of liquid dispersion in gasification technologies.

Numerical modeling is an integral part of the description of processes in technical devices as well as in natural phenomena and has a number of advantages as a method of knowledge. It allows us to predict the behavior of the system, reduce the number of physical experiments, which are more expensive, time-consuming, and not always safe.

Liquid dispersion is the crushing of larger droplets into small ones, or the transformation of a continuous flow of liquid into a drip.

The processes of evaporation of dispersed liquids play an important role in the mixing in furnaces of boilers, in the regasifiers of a heater [1].

In this paper, as a model of liquid dispersion, namely droplets, a model of crushing of droplets of the poppet type was chosen (Fig. 2.4 a)) and a mathematical description of the model is given [2].

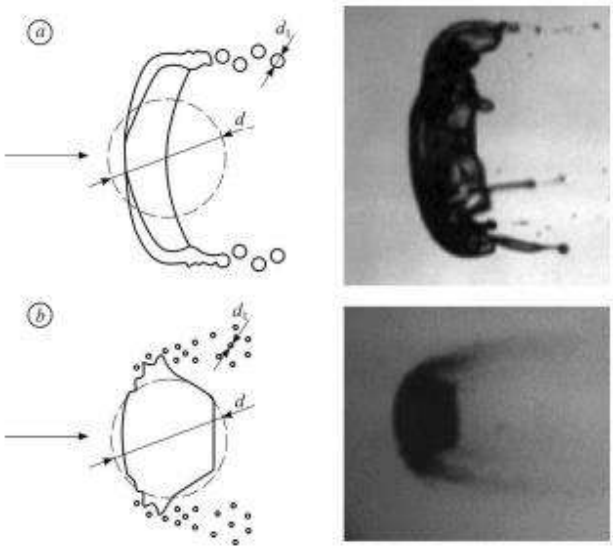

Figure – 1 Diagrams of deformation and photos of droplets during gas-dynamic crushing. a) – poppet, b) – pyramidal

In this work, a mathematical model was described for the study of flow dynamics taking into account the crushing of droplets of the mixture. The calculations were carried out using the software package "Program code for modeling the dynamics of homogeneous and dispersed media by the explicit McCormack method in generalized curved coordinates (2D)" [3].

The initial radii of the droplets of the five fractions c were r10 = 1 μm, r20 = 10 μm, r30 = 20 μm, r40 = 50 μm, r50 = 100 μm. Calculations were carried out in three speed modes, in which different values of the initial longitudinal component of the carrier medium velocity in Mach numbers were set [4].

$$d = 2{,}4\frac{d_i}{\sqrt{Re_{i0}}}\left(\frac{\mu_{ж}}{\mu}\right)^{0{,}5}\left(\frac{\rho}{\rho_{ж}}\right)^{0{,}25},$$

this d — drop diameter; d_i – size of the detached particles, $\mu_{ж}$ – dynamic viscosity coefficient; ρ — gas density; $\rho_{ж}$ — liquid density; Re = $\rho \cdot |u_{отн}|\, d\, /\mu$ – The Reynolds criterion, m_I — mass of a single particle.

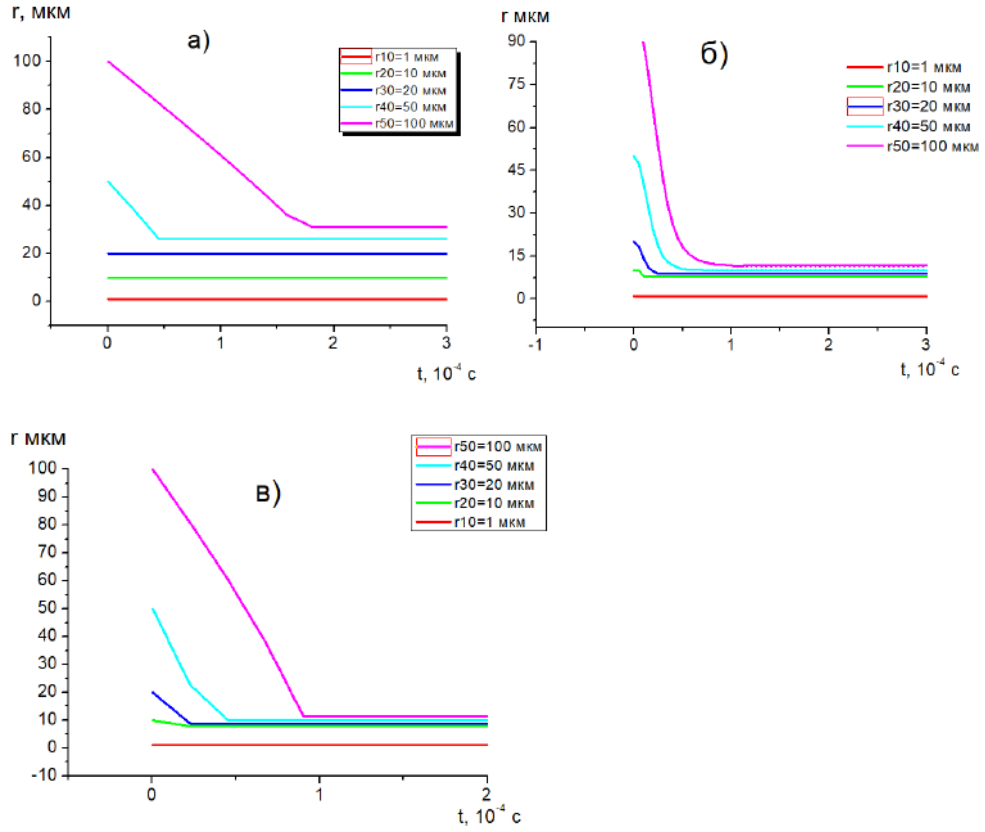

Figure 2 – Change of radii of five fractions from time at Mach numbers: а) M_1 = 0,15; б) M_2 = 0,25; в) M_3 = 0,40

As a result, through the crushing process the moving polydisperse vapor droplet stream was transformed into a bidisperse vapor droplet stream with droplet sizes of 1 microns and 12 microns. Hydro- and thermodynamic parameters and characteristics of the liquefied natural gas – methane vapor and dispersed droplet fractions were obtained. The main hydro- and thermodynamic parameters of the flow are Weber numbers, velocities, droplet sizes, average densities of dispersed fractions, pressure, temperature, density, and methane vapor velocities.

During the regasification of liquefied natural gas, it is required to disperse the liquid flow to the vapor drop to increase the evaporation intensity. For this purpose, a mathematical model was considered for the study of dispersed liquid in a regasifier. Several flow modes were also calculated for the purpose of crushing the pellets.

The study showed that with an increase in the initial velocity of the non-existent medium, the Weber number also increases, which leads to an increase in the intensity of crushing of the particles of fractions. The degree of dispersion of the liquid depends on the process of its evaporation. The smaller the size of the droplet fractions, the larger the area of contact of the droplet surface with the non-existent medium becomes, and the heat exchange process improves, which facilitates the evaporation of droplets. In calculations given above, at the speed of movement of the carrier medium M2 and M3, large fractions were fragmented to a size of about 12 microns. As a result, through the crushing process the moving polydisperse vapor-droplet flow was transformed into a bidisperse vapor-droplet flow with droplet sizes of 1 microns and about 12 microns.

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УДК 81`322.4

NEURAL MACHINE TRANSLATION

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Before the advent of neural networks, translation was carried out word by word — the system translated individual words and phrases, taking into account grammar. Therefore, with complex turns or long sentences, the quality of the translation left much to be desired.

Neural machine translation, on the other hand, has learned to translate the entire sentence, given the context. The system does not remember hundreds of translation options for phrases - it operates on the semantics of the text.

The process itself is divided into two phases. In the first, each word of the original sentence is passed through an "encoder" that generates what we call "source context" based on the current word and the context created by all previous words [1].

The sequence of original contexts is an internal interpretation of the original sentence, as mentioned above, is a sequence of floating-point numbers (usually 1000 floating point numbers associated with each original word).

This is actually a technical block, as in the case of a rule-based translation system, where each word is first compared with a dictionary, the first step of the encoder is to look up each source word inside a table or some multidimensional space [2].

Let's say you want to imagine different objects with variations in shape and color in 2D space. In this case, objects that are closest to each other should be similar. Figures are presented on the abscissa axis, and there we try to place objects of a different shape that are closest in this parameter. On the y-axis is the color - green between yellow and blue. If our figures had different sizes, we could add this third parameter by increasing the number of dimensions so that any point can represent different objects and the distance between them, which reflects the degree of their similarity.

The main idea is that this also works in the case of word placement. Instead of shapes, there are words, the space is much larger - for example, we use 800 dimensions, but the idea is that words can be represented in these spaces with the same properties as shapes [3].

Consequently, words that have common properties and features will be located close to each other. For example, one can imagine that words of a certain part of speech are one dimension, words based on gender (if any) are another, there may be a sign of positive or negative meaning, and so on.

The second step looks like this:

At this stage, a complete sequence is formed, focusing on the "source context", after which, one by one, the target words are generated using:

• "Target context", formed in conjunction with the previous word and providing some information about the state of the translation process.

• The significance of the "context source", which is a mixture of different "source contexts" based on a specific model called the "Attention Model". In short, Attention Models select a meaningful word to use in translation at any stage of the process (phrase, sentence).

• The previously given word using word embedding to convert it into a vector to be processed by the decoder.

The translation is completed when the decoder reaches the stage of generating the actual last word in the sentence.

At the moment, neural network translation is the most popular model for translation and is used in all major online translators. This is no coincidence, because the neural model learns new languages much faster, makes fewer mistakes, this is especially noticeable when processing large texts and makes it possible to translate even those concepts that are not in generally accepted dictionaries - slang, jargon or neologisms.

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УДК 621.317.791

COMPARATIVE ANALYSIS OF FUNCTIONAL CHARACTERISTICS OF ELECTRIC ENERGY QUALITY METERS

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Abstract: The article deals with the Russian-made electric energy quality meters and a comparative analysis of their functional characteristics.

Key words: PKE meter, electrical energy quality.

Electrical energy quality analyzers are devices that contain devices for processing measurement results of electrical quantities for qualitative and quantitative analysis of their compliance with the requirements of GOST 32144-2013[1]. These devices also contain devices for recording and storing events about violations of regulatory requirements. Analyzers are used mainly to determine the compliance of the quality of EE with norms, standards and terms of contracts. They are necessary and useful in troubleshooting power supply systems, in particular in electric power distribution systems.

Modern EE quality analyzers work on the principle of strobing or sampling[2]. The electric current and voltage in the network are measured over a certain time interval many times over the period of the network frequency. As a result, the input of the device receives data on the instantaneous values of current and voltage and their time dependence. This allows you to mathematically calculate different parameters of EE quality.

This article provides a comparative analysis of the following domestic devices for measuring PCE: Energomonitor-3.3T1, Proryv T-A-KT250, AKE-824 (AKIP series) and Resource-UF2MB.

Energy monitor-3.3T1 is a reference counter, a PCE analyzer according to GOST 32144-2013, a meter, a recorder and an oscilloscope in one device[6].

AKE-824 (AKIP series) is a microprocessor-based power quality recorder - analyzer designed for measurements in 1-phase and 3-phase networks, measurement of alternating voltage and AC power, frequency, power (active, reactive, total), power factor, active and reactive energy, as well as for recording and measuring anomalies from 10 ms (overvoltage pulses and voltage dips)[3].

Proryv T-A-KT250 is a device for measuring and registering PCE, established by GOST 13109-97 and GOST 30804.4.30-2013, current and power indicators for the purpose of assessing compliance and state control of electricity quality indicators in single-phase and three-phase electric networks and power supply systems with a nominal frequency of 50 Hz[5].

Resource - UF2MB is designed to measure the main indicators of the quality of electrical energy (PCE) according to GOST 32144-2013, current characteristics, power and energy of alternating three-phase and single-phase current [4].

The analysis of the functional characteristics of these devices is presented in Table 1.

Table 1. Comparison of functional characteristics of PCE analyzers.

№	Manufacturer	Model	Average cost (thousand rubles)	Advantages	Disadvantages
1	2	3	4	5	6
1	LLC "NPP Mars-Energo", Russian Federation	Energomonitor- 3.3T1	186 - 240	- mass-dimensional indicators; - scope of delivery; -availability of primary verification; -built-in battery; - the verification interval is 4 years; - UTC time synchronization; - compliance with class "A".	- the ability to connect only three current ticks; - 512 MB internal memory; - there is no possibility of memory expansion using SD memory cards.
2	JSC "Priest", Russian Federation	AKIP AKE-824	210	- scope of delivery; - mass-dimensional indicators; - internal Li-ION battery;	- lack of primary verification; - the interval between verifications is 1 year; - no UTC time synchronization; - compliance with class "B"; - lack of Russification of the menu.
3	LLC "NPP "Proryv", Russian Federation	Proryv T-A- KT250	107-165	- cost; - availability of primary verification; - operating temperature range; - compliance with class "A"; - UTC time synchronization; - the verification interval is 4 years.	- no display; - simplified software interface; - the need for a laptop to set the measurement configuration; - there is no possibility of memory expansion using SD memory cards. - metal case.
4	NPP "Energotechnika", Russian Federation	Resource-UF2MB	180	- scope of delivery; - ability to work with a USB flash drive; - UTC time synchronization; - operating temperature range; - a wide selection of standard software; - compliance with class "A".	- mass-dimensional indicators; - lack of a full-fledged display; - the interval between verifications is 2 years;

Summing up, it should be said that the quality of electric energy plays an increasing role in the electric power industry every year. Over the past decade, the development of a modern electronic database has made it possible to create highly efficient and reliable PCE analyzers that have a fairly productive element base for performing calculations and primary analysis of the measurements obtained right at the EE quality control site. Comparing analyzers of domestic manufacturers, it can

be concluded that before purchasing them, personnel will need to solve the task of determining the goals, degree, environment, and nature (i.e. certification, monitoring or periodic testing) of the use of these devices. This is necessary in order to eventually get an analyzer with the best price–consumer properties – quality ratio.

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УДК 629.7.054.44

PRINTED CIRCUIT BOARD DESIGN STEPS FOR AN ION LABEL VELOCITY METER IN THE MULTISIM&ULTIBOARD APPS

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Introduction

Modeling of digital components and systems often depends on the approach and method of compiling models, which in turn reflects its purpose, the complexity and accuracy of describing the electrical properties and the logic of operation. When developing the design of printed circuit boards, the following interrelated tasks are solved [1]:

1) circuitry - tracing of printed conductors, minimization of layers, etc.;

2) radio engineering - calculation of parasitic pickups, parameters of communication lines, etc.;

3) heat engineering - temperature regime of operation, heat sinks;

4) constructive - placement of elements on a printed circuit board;

5) technological - the choice of manufacturing method, protection, etc.

Circuit board design

The design of the printed circuit board (PCB) of the ion-label speed meter in the Ultiboard application will be carried out according to the following algorithm:

1) We base on the electrical circuit of the device being developed. Before integrating the circuit into Ultiboard, instead of virtual elements, it is necessary to select real electrical elements from the program base[2][3].

We see the electrical circuit assembled and prepared for the following actions in Figure 1.

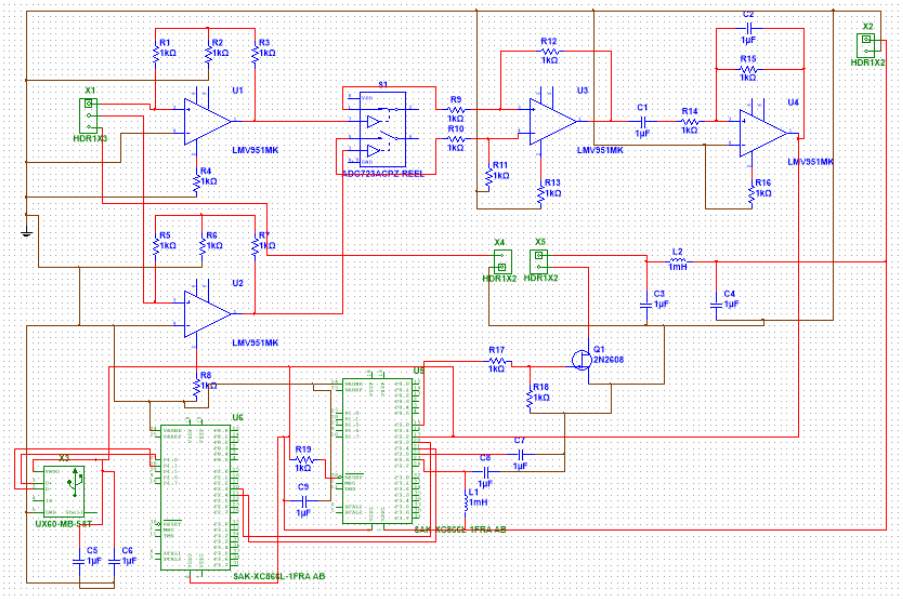

Fig.1 - Electrical circuit of the ion-label speed meter

2) We integrate the circuit into the Ultiboard.

3) We place the components within the printed circuit board.

4) We perform auto-layout of elements on the printed circuit board. To do this, use the menu command "Autorouting", Autolayout. Next, use the Install autorouter/installer command. Next, we perform "Autorouting selected components".

We can see the printed circuit board after tracing in Figure 2.

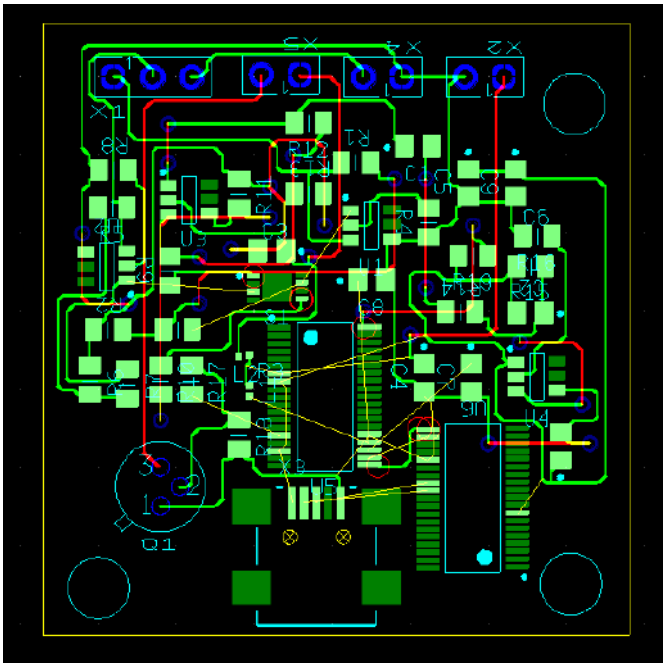

Fig. 2 - Printed circuit board of the ion-label speed meter

5) We manually change the size of the PCB

6) We can see the final view of the resulting circuit can be viewed in 3D in Figure 3.

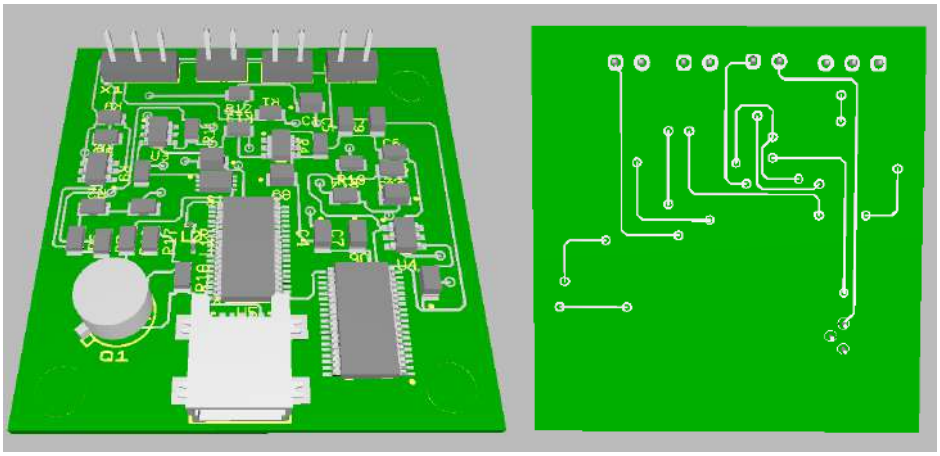

Fig. 3 - 3D model of the printed circuit board of the ion-label speed meter

Now we have an idea of how our printed circuit board will look like, and we also know its exact dimensions, which are equal to 38 by 40 mm, and the location of the elements for soldering.

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SIMULATION OF THE CONVERSION CHANNEL OF ION-LABEL AIRVELOCITY METER IN LABVIEW

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Introduction

Modeling the conversion channel makes it possible to analyze the behavior of the information-measuring channel under various influences, which makes it possible to create a model for determining the accuracy without operation and to ensure the prediction of metrological characteristics[1].

The differential label registrar must generate a signal with each arrival of the label.

Let's simulate this signal in the LabVIEW program. This program allows you to simulate a signal of almost any complexity.

Simulation of the conversion channel

Let's build each part of this block diagram in the LabVIEW program.

The white noise shaping block is shown in Fig. 1

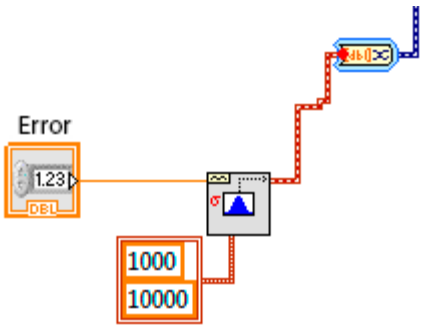

Fig.1 White noise shaping block

This block is designed to form and superimpose white noise on the output signal. This white noise simulates all possible interference that is superimposed on the useful signal. In this case, white noise can be adjusted with a slider.

The block for generating the output signal is shown in Fig.2

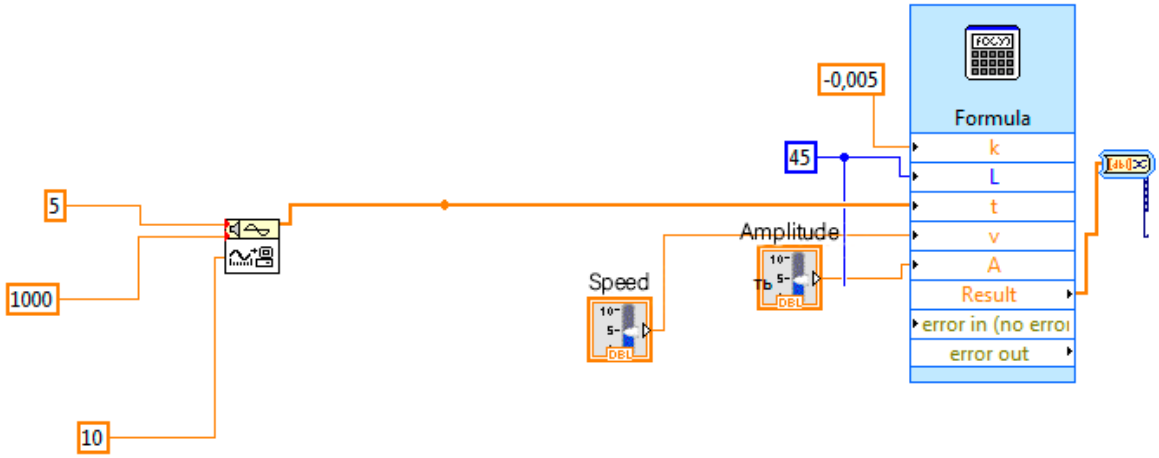

Fig.2 Output signal generation block.

This block generates a useful output signal from the differential ion label recorder. The "Formula" node generates a bell-shaped output signal due to the formula[2]:

$$A \cdot (2 \cdot k \cdot V \cdot (t \cdot V - L)) \cdot e^{k \cdot (t \cdot V - L)^2}, \quad (5.1)$$

where A is the amplitude of the signal;

K-constant equal to -0.005;

V is the given speed of the ion mark;

L-base distance;

The block for calculating the time and speed of flight of the ion mark is shown in Fig. 3

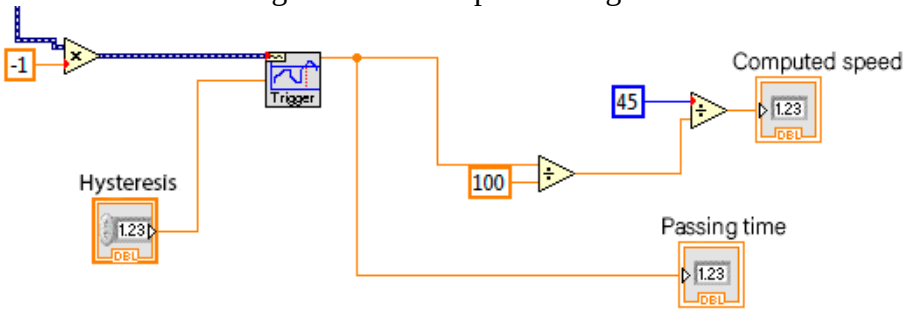

Fig.3 Block for calculating the time and speed of flight of the ion mark.

This block calculates the speed and time of flight of the ion mark, both without error and with error. The trigger captures the intersection of the graph with the time axis, then the base distance is divided by the time and the calculated speed of flight of the ion mark is displayed. Setting the

hysteresis in the trigger is necessary to prevent false triggering under the influence of white noise[3].

The front panel is shown in Fig.4

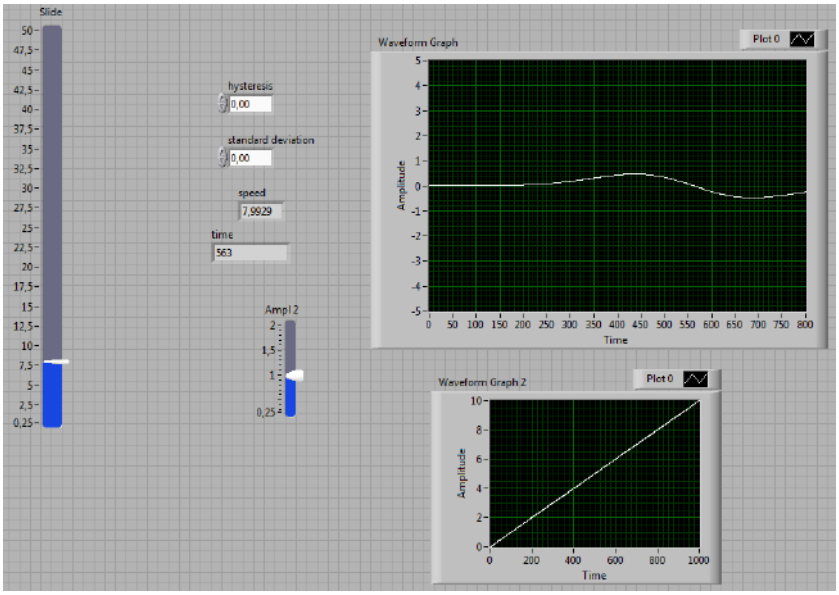

Fig.4 Front panel of the circuit for modeling the signal from the output of the differential label recorder.

Using this panel, we can change the speed of flight of the ion mark, change the signal amplitude, introduce an error, and adjust the trigger hysteresis. Also on this panel there are windows displaying the calculated speed of flight of the ion mark and the time of flight.

Thus, by adjusting the trigger hysteresis, you can get values of speed and time close to real ones. However, as the error increases, it is necessary to introduce a filter, since the trigger setting does not replace signal filtering.

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УДК 502.13

SANITARY PROTECTION ZONE AS A MEANS OF ENSURING THE SAFETY OF THE POPULATION

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With the increase in the cities of the motor transport complex, there is a need for the design of gas stations. In this regard, an increase in the contribution to the level of air pollution is accompanied. Air pollutant emissions are characterized by volume, emission intensity, temperature,

hazard class, concentration of pollutants. Their negative impact is usually considered in the zone of influence of the object. For safety reasons, zones of special conditions – a sanitary protection zone are established around objects of negative impact on the environment that potentially affect human health.

The purpose of this study is to define and justify a sanitary protection zone for a gas station. To achieve the goal, we are faced with the following tasks: to study environmental legislation; determine whether the petrol station is a source of chemical and physical effects on humans; calculate the boundaries of the sanitary protection zone in compliance with sanitary and epidemiological requirements; propose environmental protection measures.

The main activity of the gas station is the reception, storage and sale of petroleum products. On the territory of the facility there are: a boiler room, a welding section, boxes for storing vehicles, a generator room, an open parking lot for special equipment, movement of vehicles, refueling of an air conditioner, a car wash for its own passenger vehicles. Sources of pollutant emissions in the territory are: welding equipment, boiler room, diesel generators, engines of vehicles moving around the territory of the facility. The main pollutants released during the operation of the gas station are CO, C_xH_y, NO_x, SO_2, benzo(a)pyrene, $PM_{2,5}$ [1-2].

According to SanPiN 2.2.1/2.1.1.1200-03 [3], a gas station belongs to facilities of hazard class IV with an approximate sanitary protection zone of 100 m from the boundaries of the territory. It is not allowed to place: residential buildings, medical and educational institutions, sports facilities, recreation centers, etc. [4] within the boundaries of the sanitary protection zone.

The nearest residential area, according to the topographic map of Rosreestr, is located at a distance of 42 m from the border of the object in the west direction - a land plot intended for multi-storey residential buildings. The nearest security zone borders on the territory of the gas station from the north, northeast, east, southeast, south – a land plot intended for agricultural production. This fact violates the requirements of the Decree of the Government of the Russian Federation of March 3, 2018 № 222.

This work contains the results of calculations of concentrations and dispersion of pollutants in the atmospheric air, as well as permissible noise levels to justify the size of the sanitary protection zone from the sources of the gas station site. As a result of the calculations, it was established that the maximum surface concentrations at the boundary of the facility contour amounted to more than 0,1MPC (maximum allowable concentration) for the following pollutants: benzene, methylbenzene, ethylbenzene. The data are presented in Table 1.

Table 1 – Fractions of ground-level concentrations in atmospheric air

The pollutant	MPC shares at the boundary of the estimated SPZ	MPC shares at the boundary of the industrial zone
benzene	0,198	0,331
methylbenzene	0,093	0,156
ethylbenzene	0,077	0,13

Thus, the gas station, according to the factor of chemical impact on the habitat and human health, is a source of impact on the habitat and human health, since there is an excess of 0,1 MPC behind the contour of the facility. If an excess of 0,1 MPC in the atmospheric air is observed on the contour of the industrial site, it is necessary to take into account background air pollution, that is, pollution created by emissions of sources that are not related to the enterprise under consideration.

The calculation of dispersion at the border of the residential and protected zone, taking into account the background concentrations for benzene, methylbenzene, ethylbenzene, was not carried out due to the lack of observation of atmospheric air quality for these pollutants.

The following boundaries are proposed for the establishment of a sanitary protection zone:

– in the north direction – at a distance of 100 m from the boundary of the land plot of the object;

– in the north-east direction – at a distance of 0 m from the boundary of the land plot of the object;

– on the eastern side – at a distance of 0 m from the boundary of the land plot of the object;

– on the southeast side – at a distance of 0 m from the boundary of the land plot of the object;

– on the south side – at a distance of 0 m from the boundary of the land plot of the object;

– on the south-west side – at a distance from 0-100 m from the boundary of the land plot of the object;

– on the western side – at a distance of 26 m from the boundary of the land plot;

– on the northwest side – at a distance of 0-100 m from the boundary of the land plot of the object.

Table 2 shows the proportions of concentrations at the proposed boundaries of the sanitary protection zone.

Table 2 – fractions of concentrations at the proposed boundaries of the sanitary protection zone

The pollutant	MPC shares at the proposed SPZ boundary
benzene	0,331
methylbenzene	0,156
ethylbenzene	0,130

In accordance with the requirements of the Rules for the Establishment of Sanitary Protection Zones and the Use of Land Plots Located within the Boundaries of Sanitary Protection Zones, approved by Decree of the Government of the Russian Federation dated 03.03.2018 № 222, a calculation was made, as a result of which it was revealed that the gas station, by the factor of physical impact, is not a source of impact on the habitat and human health – there is no excess of 1MPL (maximum permissible levels), by noise impact, beyond the contour of the facility.

To confirm the calculated data of pollutant dispersion in the atmospheric air and the level of noise impact and substantiation of the boundaries of the sanitary protection zone, laboratory and instrumental studies (measurements) were carried out on the state of atmospheric air pollution and the level of noise impact. According to the study protocols, the content of pollutants in the atmospheric air and measurements, the noise level at the control points meets the requirements of hygienic standards.

Taking into account the above, the results of calculations of atmospheric air and the level of physical impact give reason to argue that the size of the sanitary protection zone by the combination of factors (chemical and physical impact on the environment and human health) is sufficient to establish the boundaries of the proposed sanitary protection zone. The sanitary protection zone should have a consistent study of its territorial organization, landscaping and improvement at all stages of the development of all types of urban planning documentation, projects for the construction, reconstruction and operation of a separate enterprise. It is recommended to:

1. Prevent trampling of lawns and storage of construction materials, sand, debris, snow, ice chips, etc.;

2. Green areas are prohibited: store any materials; burn leaves, sweep leaves into trays during the period of mass deciduous fall, fill them with trunks of trees and shrubs; discharge cost estimates and other pollution onto lawns; lighting fires and violating fire protection rules; tear flowers and break branches of trees and shrubs; carry out openings for laying utilities without approval according to the established rules; arrange parking of cars and cars on lawns, as well as at a distance closer than 2.5 m from the tree and 1,5 m from shrubs.

Measures to preserve and protect green spaces on the territory of the sanitary protection zone are advisory in nature.

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УДК 629.735.33

THE RELEVANCE OF THE AWACS TYPE AIRCRAFT. STATUS OF THE RUSSIAN AIRPLANE PARK OF AWACS AIRCRAFT

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(Kazan National Research Technical University named after A.N. Tupolev)

Early detection of enemy aircraft and large missiles (SAMs or ballistic missiles) is essential, and sometimes is a key, in the conduct of hostilities. Such tasks are performed by air defense systems, but their low coverage range makes engineers look for other options that have a longer coverage range. One solution to this problem is the long-range radar detection and control aircraft. Today, AWACS aircraft are in operation in 17 countries around the world.

The largest fleets are in countries such as: Russia, China, the USA. High power and efficiency of radio reconnaissance detection equipment allows partial and sometimes full control of the radio band in the working space. Due to large radius of action the airborne radar and radio reconnaissance could be carried out outside the zone of action of ground air defense and anti-aircraft missiles of the supposed enemy. However, AWACS aircraft is a powerful source of radio-wave radiation, which makes them a priority target for enemy air defense and fighter aviation. As a consequence, long-range radar reconnaissance aircraft require escort by a fighter aircraft as well as air defense system. Two other important advantages of this type of aircraft are worth mentioning: their ability to detect ground and air targets, which is impossible for ground-based air defense systems, and radio jamming.

Evaluating the nature of modern armed conflicts, we can assume that the use of airborne early warning systems is justified by achieving the goals set in the field of radio-technical reconnaissance. It is not difficult to find information from open sources about the use of AWACS aircraft in 1991 during the military operation in the Persian Gulf. At that time two A-50s of the Soviet Armed Forces flew into the sky for the purpose of radar monitoring of airspace over the Black Sea waters.

Today, the Russian Aviation Forces have a fleet of airborne and airborne missile defense equipment, which includes:

- 25 Kamov KA-31 helicopters;
- Promising aircraft A-100 (deep modification of A-50, estimated date of beginning of serial production - 2024);
- 20 aircrafts A-50 and its modified variant A-50U.

A few words should be said about the state of the air fleet of airborne early warning and control aircraft of the Russian air forces. The prototype for the A-50 aircraft was the Soviet military transport aircraft Ilyushin IL-76. The serial production started in 1985. Its main means of radio detection is a complex "Bumblebee". The radar station operates in the range of 1 centimeter and can detect a fighter aircraft at a low altitude at the distance of 200- 400 km, at a high altitude at the

distance of 300- 600 km. Surface targets can be detected at the distance of up to 400 km. When the aircraft is retrofitted with an infrared system, it becomes possible to detect a torch or ballistic missile at the distance of up to 1000 km. About 30 A-50s were handed over to the customer. The current number of A-50s has not been disclosed at the moment, but the IISS's military balance says that no more than 9 aircraft are currently in service.

The other part of the fleet consists of the modified A-50, which has been produced starting from 2009 up to the present day. As stated earlier, the modified A-50 are the A-50U. It was decided to produce a new version of this aircraft due to its obsolescence, as well as the reduced visibility in the radio range of aircraft of the alleged enemy. The first A-50U was handed over to the customer in 2011, after which about 7 aircraft were delivered from 2012 to 2022. It is know that the detection range of the new radio complex of the A-50U has been improved. An in-depth upgrade of the radio system positively distinguishes this aircraft from its basic model. The improvements were possible thanks to the introduction of more advanced algorithms for the functioning of the complex, computing facilities of increased productivity, as well as the end-to-end digital signal processing. The last feature made it possible to significantly reduce the mass and dimensional characteristics of the radio complex.

These days, the production and development of the latest A-100 aircraft with the "Premier" radio system is underway. The prototype of this aircraft has radio equipment with enhanced characteristics, compared to previous models. It is said that A-100 will be able to detect surface targets at up to 500 km distance and air ones - up to 1000 km. At the same time, the aircraft will be able to monitor more than one hundred air, surface and ground targets and to select the priority targets that need to be hit immediately without an operator.

To sum it up, AWACS aircrafts are still in demand and remain promising development targets for the troops of many countries in the world due to their effectiveness and the operation characteristics. The existing models are carefully preserved and actively enhanced.

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УДК 666.655

DEVELOPMENT OF A METHOD FOR IDENTIFICATION OF AN INTERGROWTH TYPE DEFECT IN NANOTUBES FOR NANOELECTRONICS ELEMENTS

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Research in the field of nanoelectronics is actually carried out only on the basis of carbon nanotubes (CNTs). Therefore, I consider such studies to be very relevant, since it is necessary to expand the base of nanoelectronics elements, it is necessary to consider various options for their application, thereby providing a wider field of materials for designers and developers. One of the most common types of defects in nanotubes is a "growth". We can observe it when the number of layers is not the same along the length of the nanotube. Since we know about the possibility of the presence of such a defect in nanostructures and about its significant effect on the band gap of semiconductor CNTs, we need to be able to identify and reject nanotubes containing "intergrowths". To do this, I propose to apply the quantitative theory of diffraction.

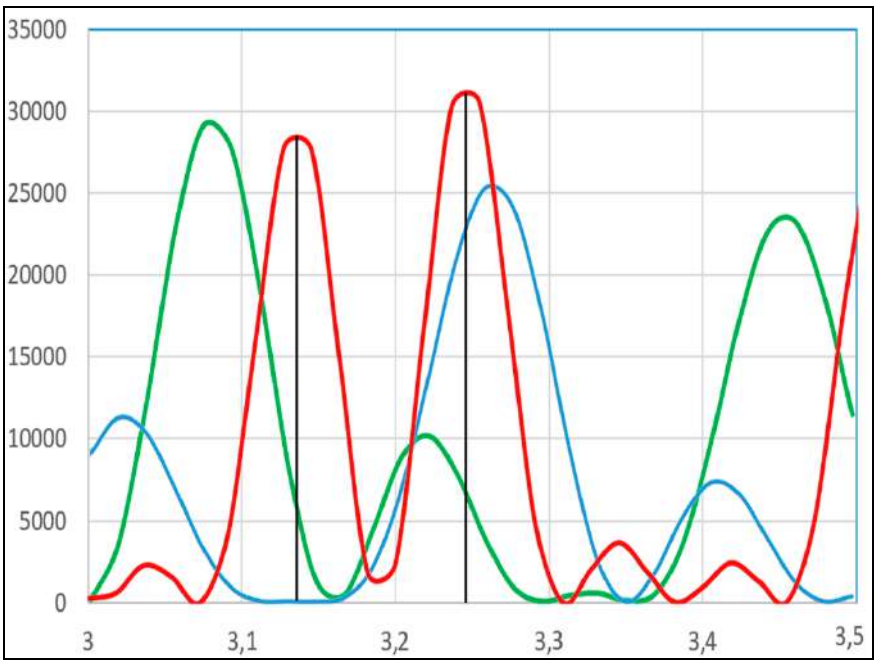

Figure 1. Comparison of diffraction patterns: nanotubes without splices (red), nanotubes with internal splice (green) and nanotubes with external splice (blue).

I analyzed the experimental material and compared it with the calculated data, and studied the structural parameters of internal and external "intergrowths" in nanostructures. Numerical values of the WS2 nanotube diameter became obtained.

Conclusions are drawn about changes in the diffraction pattern in the presence of "external" and "internal splices" in the nanotube structure.

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УДК 534.324

IMPROVEMENT OF AUTOMATIC COLOR MUSIC DEVICE

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Abstract: The article deals with the possible ways to improve the circuit and the principle of operation of an automatic light and music device.

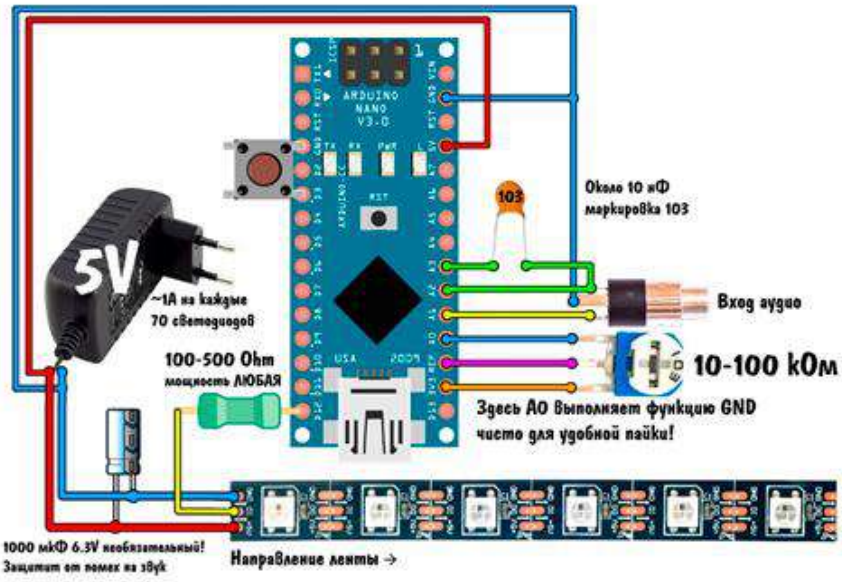
Key words: color music, light music, arduino.

The simultaneous use of visual and auditory sensations leads to a certain impact on the psyche and mental state of a person, which prompts him to do certain actions [2]. Studies of the influence of color and music on the psycho-emotional state of a person, his mood, feelings, thoughts and health in general are actively continuing to this day. They are aimed at finding forms, principles, algorithms, approaches designed to understand the principle of creating devices.

Modern light music is improving every year, it also has a number of disadvantages: inconvenient interface, high cost, the ability to buy only in specialized stores, the complexity of setting for a non-professional user.

We have assembled an automatic light and music device (ASMU) based on the programmable microcontroller ARDUINO NANO [3], which is designed for lighting a piece

of music, according to the following scheme [1]:



Scheme of connection of elements of light music on the addressable LED strip

However, a number of shortcomings can be identified in the assembled circuit: the lack of remote adjustment of operating modes, the absence of a protective case, low power, the ability to connect only through the audio input, and low mobility.

In the future, it is planned to eliminate the above disadvantages in the following ways: adjusting the operating modes through the remote control by installing an IR receiver in the circuit [5]; additional audio input device; installation of an operational amplifier to increase power [4].

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УДК 621.316.925

LOCATING A SINGLE-PHASE EARTH FAULTS IN NETWORKS WITH ISOLATED NEUTRAL

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Abstract
In networks with insulated neutral points, the single-phase earth-fault current is low. This allows the network to be operated without immediately disconnecting this type of fault. But in such a case the insulation of the equipment will age much faster and this can lead to a short circuit, which requires immediate disconnection of the damaged section of the network. The main task of the relay protection in this case is to determine the moment of occurrence of the fault and to determine the damaged phase. The paper proposed a method for determining the location of a single-phase earth fault.
Keywords: fault, current, location, network, neutral.

The most frequent type of fault on transmission lines is the single-phase earth fault. Single-phase earth faults account for about 70-90% of all faults in power systems. The course of various physical processes caused by earth faults significantly depends on the mode of operation of the network neutral [1].

6-35 kV networks operate on isolated neutral or neutral earthed through a considerable additional resistance. The earth fault current will be small as there's no closed circuit for current flow due to the insulation of the neutral. A single-phase ground fault is through the capacitances of the undamaged phases. This current is about 10-30 A, which is insignificant, and is determined by the capacitance of the undamaged phases [2].

In networks with insulated neutral points, a short-circuit fault can have such dangerous consequences as:

1. Depending on the branching of the network, the capacitive current ranges from 0.1 to 500 A. This magnitude of current poses a danger to people who are near the fault, for which reason these faults must be identified and disconnected.
2. A single-phase ground fault causes an arc fault. During an arc fault, overvoltages occur that are 2-4 times the phase voltage. The insulation can not withstand these overvoltages, so there is a risk of an insulation breakdown at any point in the network and an occurrence of double earth fault.
3. During the process of development and liquidation of the phase-to-ground fault occurs a ferroresonance effect in voltage transformers, which leads to their premature failure [3].

It becomes clear that it is necessary to quickly determine the location of a single-phase earth fault and to disconnect the faulted element – this is the purpose of our research.

One way to do this is to determine the location of a single-phase earth fault by identifying the pole with an insulation fault.

How does it work? The device contains a pointer mounted on each pole with a transmitter. When the phase insulation of the pole is damaged, the pointer triggers the transmitter, which transmits the number of the damaged pole via the communication channel to the operating personnel at the receiver installed in the control room.

According to the proposed method, it is possible to determine the damaged line and pole, the distance to the fault location and to disconnect the damaged line with a time commensurate with several periods of the industrial frequency.

Thanks to this method, the time for determining the location of a single-phase earth fault is reduced and the material costs for fault location are reduced.

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УДК 536.2.022

EVALUATION OF THE THERMAL CONDUCTIVITY COEFFICIENT OF THIN-FILM THERMAL INSULATION WITH MICROSPHERES

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Abstract: The paper compares the thermal conductivity coefficients of a thin-film coating obtained by modeling the heat transfer process in a COMSOL Multiphysics medium and found experimentally. Thermal insulation in the form of energy-saving paint with hollow microspheres acted as a thin-film coating.

Keywords: energy saving, microspheres, COMSOL Multiphysics, thermal conductivity.

Currently, more and more attention is being paid to the problem of energy saving [1]. In the Russian Federation, the urgency of this problem is explained by the low average annual ambient temperature (-5.5 ° C), the long heating season, as well as a large proportion of physically and morally outdated equipment.

To date, there are a large number of various thermal insulation materials that differ in cost, composition, and scope of application. For example, styrofoam, mineral wool thermal insulation coatings have become very popular among them.

Simultaneously with traditional materials, a fundamentally new thermal insulation consisting of hollow microspheres and binding components is being introduced in the domestic market - the so-called energy-saving paint. The advantages of such paints are high adhesion, mechanical strength, moisture and vapor resistance, cheapness [2-4].

The authors calculated the specific heat flow through a plate coated with a thin-film thermal insulation material with microspheres by modeling a stationary heat transfer process in a COMSOL Multiphysics medium.

The aim of the work is to compare the thermal conductivity coefficients of the thermal insulation material with hollow microspheres obtained by modeling the heat transfer process in the COMSOL Multiphysics environment and experimentally.

Research methodology

The study of the thermophysical characteristics of porous materials was carried out on the basis of an analytical solution to the problem of heat propagation in a porous body. A step forward in this process is the Laue theory, according to which a porous body with uniformly distributed porosity is divided into elementary tubes in a direction parallel to the direction of the heat flow. Some of them contain pores, while the other does not [5].

Based on this theory, the authors of this work modeled the geometry of the arrangement of hollow microspheres inside a thin-film coating (Figure 1).

For modeling and calculations of the heat transfer process, the COMSOL Multiphysics interactive environment was used, in which it is possible to solve engineering problems of various profiles.

To solve this problem, in this work, the 3D geometry of a steel plate with dimensions of 10×10×7 mm, covered with 1 mm thermal insulation, was modeled. The spheres had diameters of 0.03-0.1 mm.

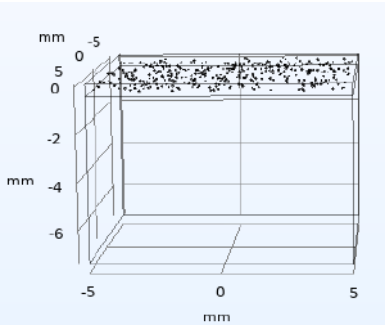

Figure 2. Geometry of a plate with randomized distribution of spheres and varying diameters

An energy-saving paint with microspheres located in the binder component in the form of acrylic was chosen as a thermal insulation material.

The following values of heat transfer coefficients and temperature were set for the heated medium under the plate (α=3000 W/(m^2·K), t=60 °C) and the air above it (α_a=18 W/(m^2·K), t=5 °C), the thermal conductivity coefficient of the plate material (λ_{pl} =80 W/(m·K)), the density of spheres (ρ_{sh} =230 kg/m^3) and acrylic (ρ_{ac}=1150 kg/m^3).

Research results

As a result of modeling and calculations, temperature field distributions were found over the geometry of the plate with insulation with microspheres in it (Figure 2).

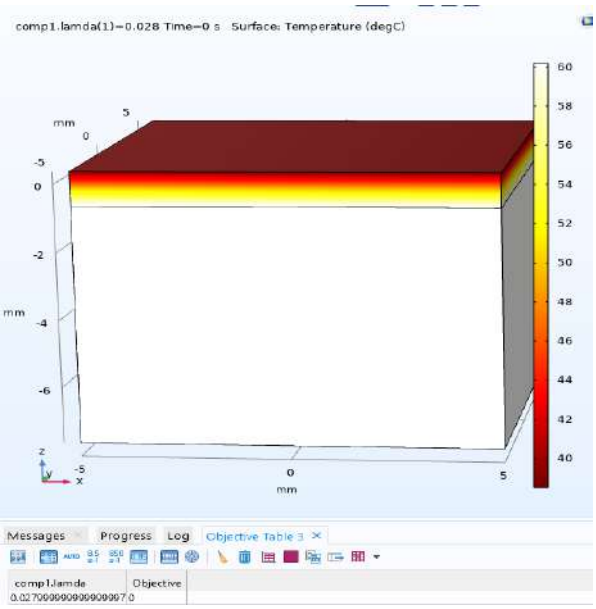

Figure 3. Display of temperature fields and calculation results of the thermal conductivity coefficient

The calculations resulted in finding the thermal conductivity coefficient, which was 0.0279 W / (m · K) at the temperature of the inner surface of the plate 60 ° C (Figure 2) and further comparing it with the data given in [9], equal to 0.028 W / (m · K) at the same temperature.

Conclusion

In the process of work, a model for generating the structure of thin-film thermal insulation in the COMSOL Multiphysics environment has been developed. The model structures correspond to experimental samples.

The values of the thermal conductivity coefficients of thin-film thermal insulation in the form of energy-saving paint with microspheres found during geometry modeling in the COMSOL Multiphysics environment and based on experimental studies are compared. It is established that the randomized method of distribution of microspheres in the thermal insulation coating, and the diameters of microspheres varying in a certain range, allow us to simulate the geometry closest to real samples of energy-saving paint.

As a result of the calculation, the value of the thermal conductivity coefficient was found, which was 0.0279 W / (m · K) at the temperature of the inner surface of the plate 60 ° C, which has minor discrepancies with the experimentally obtained data on real samples of energy-saving paint with microspheres.

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УДК 621.316.9

CALCULATION OF GAS PROTECTION SETTINGS FOR ON-LOAD TAP-CHANGERS AND POWER TRANSFORMERS

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Of great importance for the reliable operation of electrical installations is correct implementation and configuration of relay protection and automation devices and including the correct choice of operating parameters of operation (settings) RPA equipment. The correct choice of settings is doubly important for gas protection. The relay, as a standard device, must be individually configured for fulfillment of its main task, which is to quickly, selectively and reliably protect a specific electrical installation with occurrence of short circuit and other dangerous modes. Therefore, a competent calculation and the subsequent choice of gas protection settings is of paramount importance.

The aim of the work: development of guidelines for the calculation and selection of settings for gas protection of on-load tap-changers and power transformers, to consider and characterize the types of gas relays that are used in gas protection. This report used the materials of state standards, standards of organizations that establish a general methodology for selecting and calculating the settings for the operation of gas protection for transformers and on-load tap-changers.

Research methods to achieve the goal include:

- Research gas relay protection in general
- Research different types of gas relays
- Compare different types of gas shields
- Develop a methodology for calculating the gas protection settings of on-load tap-changers and power transformers for each type of gas protection

Calculation of gas protection settings for on-load tap-changers and power transformers:

Gas protection is installed on transformers, autotransformers, converter units and oil-cooled reactors with expanders.

Gas protection has been widely used as a sensitive one in the event of internal damage (inter-turn short circuits), accompanied by an electric arc or heating of parts, which leads to the decomposition of oil, insulating materials and the formation of volatile gases.

The characteristic damages of an oil—filled electrical apparatus — transformer, autotransformer, reactor (hereinafter referred to as transformer) include short circuits (short circuits) between windings, loop closures, "fire" of magnetic circuit steel, oil leakage from the tank, malfunctions of the oil-filled contactor of the switch of branches of the voltage regulation device under load (on-load tap-changers), etc.

Almost all damages inside the tank of an oil-filled electrical apparatus are accompanied by the release of gas as a result of oil decomposition or other insulating materials under the action of partial electrical discharges, increased heating, electric arc. When the short circuit occurs, the accelerated flow of oil or its mixture with gas from the tank of the apparatus into the expander. During operation, it is also possible to reduce the oil level or release gas for various reasons**.**

The protection that reacts to these damages is called "gas". This protection is carried out with the help of so-called gas and jet relays.

Gas relays are designed to protect transformers with an expander from damage inside the tank, in which gas is released, the oil level decreases or an accelerated oil flow occurs from the transformer tank into the expander.

Jet relays are designed to protect contactors of oil-filled switches of transformer branches from damage accompanied by the occurrence of accelerated oil flow from the contactor tank to the expander. They are most often used in on-load tap-changers.

In case of internal damage in the transformer, even the most insignificant, gaseous decomposition products of oil or organic insulation are released, which ensures the effect of gas protection in the the beginning of the occurrence of gradually developing damage. In some cases of dangerous internal damage to transformers ("fire" of steel, inter-turn circuits, etc.), only gas protection works, and the electrical protections of the transformer do not work due to insufficient sensitivity.

It can be concluded that the gas protection response settings, unlike most types of relay protection (for example: maximum current protection, current cut-off, differential protection, etc.), are selected based on strictly specified oil flow rates, exceeding the level of which leads to the operation of the gas relay. Therefore all of the calculations become unnecessary. This principle of selection of actuation settings is valid for all models of gas and jet relays, with minor adjustments in oil flow rate due to differences in design solutions and degrees of cooling.

Research results:

Based on the results of the practice, a methodology for choosing the settings used by gas protection was studied, developed and presented. Gas protection, due to its design and method of operation, uses the oil flow rate as the pickup setting.

Gas relays, due to their design, are used to protect transformers (including power ones), and jet relays, due to the lack of floats inherent in gas relays, are used to protect the on-load tap-changer, where such a design solution is due to the peculiarity of the tap-changer contactors.

The gas protection has a set oil flow rate equal to the selected pickup setting. This speed increases with internal damage to the gas shield caused by damage and malfunctions of the protected object.

Each model of the gas and jet relays has its own setpoints, indicating the oil flow rates during normal operation of the gas protection, exceeding which by a factor of 1.25 leads to the operation of the gas protection within 0.1 - 0.2 s for gas relays, and for jet relays overshoot leads to the formation of pressure on the reacting element, which will lead to the operation of the gas protection within 0.1 - 0.2 s

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УДК 614.89

ANALYSIS OF HAZARDS OF ELECTROPLATING PRODUCTION

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In the conditions of scientific and technological progress, the development of electroplating production is accompanied by an increase in production capacity, intensification of technological processes, the use of more highly parametric physical and chemical processes, an increase in the variety of chemical reagents, which complicates the solution of the problem of occupational safety.

All the various dangerous and harmful factors of galvanic production by the nature of human exposure can be reduced into three main groups: physical (moving parts and equipment, microclimate parameters, noise, ultrasound, vibration, fire and explosion safety); chemical (harmful toxic substances in various aggregate state); psychophysiological (physical and neuropsychiatric loads, working posture, pace and rhythm of work) [1]. Each factor, depending on the intensity and conditions of exposure, can be dangerous or harmful, leading, respectively, to injury or occupational disease. The state of working conditions is characterized by the amount of deviation of the quantitative characteristics of each factor from the regulatory requirements.

To determine harmful and (or) dangerous factors of the production environment and the labor process, as well as to assess the level of their impact on employees, a special assessment of working conditions is carried out [2].

Table 1 shows the approaches to labor protection of the employee of the galvanic site.

Table 1 – Approaches to the protection of the employee of the galvanic site.

Harmful factor	Harmful effect on the employee's body	Protection from harmful factor
Microclimate	Significant temperature differences in the height of the working area (2 m) in the cold season, increased to 75-80% relative humidity, increased to 1.5 m / s air velocity in case of violations of the ventilation systems.	The most common ways to protect against adverse microclimatic conditions are ventilation, heating or air conditioning, the use of personal protective equipment against high or low temperatures, regulation of periods of work in an unfavorable microclimate and rest in a room with a microclimate normalizing the thermal state, reduction of work shifts.
Harmful substances	Many chemicals have adverse effects on the human body, causing violations of its normal functions of varying severity. The consequences are dangerous for health, and in some cases for life.	1. Replacement of harmful substances in production with the least harmful ones; 2. Restriction of the content of impurities of harmful substances in the initial and final products; 3. The use of advanced production technology that excludes human contact with harmful substances; 4. Selection of appropriate production equipment and communications that do not allow the release of harmful substances into the air of the working area, in quantities exceeding the maximum permissible concentration during the normal conduct of the technological process; 5. Control over the content of harmful substances in the air of the working area; 6. The use of personal protective equipment for workers; 7. Conducting preliminary and periodic medical examinations of persons who have contact with harmful substances.
Noise	The impact of noise on the human body is characterized by a variety of manifestations of adverse effects on the central nervous, cardiovascular and digestive systems. Noise, as a general biological irritant, quickly tires workers, reduces efficiency, labor productivity, slows down reactions to dangerous situations. With systematic exposure, it causes irreversible organic lesions of the auditory nerve - hearing loss.	1. Weakening of these factors in the source of occurrence (replacement of shock interactions with non-shock; reciprocating movements with rotational ones; damping and using less sonorous moving parts; improvement of aerohydrodynamic flow, etc.); 2. Reduction of factors along the distribution path (construction-acoustic, space-planning measures for the placement of vibroacoustic equipment in separate, remote, isolated rooms; use of sound- and vibration-absorbing and insulating materials and screens, etc.); automation and remote control; 3. Personal protection in cases where technical means do not allow to reduce noise and vibration levels to the maximum permissible level.
Vibration	General vibration causes deformation of human organs and tissues, is accompanied by a change in the functional state	

	of the body, leads to pathological changes in the neuromuscular, musculoskeletal system, vascular disorders - vibration disease. Local vibration leads to painful changes in the hands (a symptom of a "dead finger")	
Ultrasound	The general effect of ultrasound has a lot in common with the effect of high-frequency noise. The peculiarity manifests itself in an excessive increase in fatigue, irritability, dizziness. Local exposure to ultrasound (similar to vibration) leads to damage to the peripheral nervous and vascular apparatus of the fingers, hands and forearms.	

Thus, many harmful factors act on a person in a galvanic enterprise. It is necessary to create comprehensive protection against harmful factors for employees at the enterprise, thereby reducing the degree of development of occupational diseases.

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УДК 62-621.2

EFFICIENT GAS FLOW DRYER TECHNOLOGY FOR INLINE USE

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Currently, there is an increased interest in natural gas as the most environmentally friendly and safe fuel, as well as as a raw material for industrial and domestic needs. For the efficient use of natural gas, it is necessary to improve the technology of its production and processing, as well as transportation, which can be considered as the most important thing in this system, since the greatest capital and capital intensity are invested in this process. Dehydration of gas is an important part in the process of its preparation for transportation through the main gas-pipelines and is intended to prevent the formation of hydrocarbon gas hydrates and water plugs in pipelines, which can cause delays in gas transportation, equipment failure and accidents at stations [1].

The purpose of this work is to develop an effective technology for dehydration of natural gas, suitable for in-flow application. To achieve the goal it is necessary to solve the following tasks:

- to identify disadvantages of existing methods of drying;
- to determine directions for improving the efficiency of the methods and simplifying the equipment;

- to choose modern technical solutions for the main elements of the equipment.

Quality requirements for dehydration are developed and fixed in the corresponding all-Russian standards [2]. In developing the quality requirements for marketable gas it is essential:

1. to ensure that the trunk gas is transported in a single-phase condition;

2. the gas does not cause the corrosion of pipelines, valves and measuring instruments;

3. to provide certain consumer qualities of gas as fuel or hydrocarbon raw materials, while ensuring safe operation [2].

Analysis of existing drying methods showed that there is no universal method suitable for the use in all conditions. Therefore, it is advisable to use combined methods. In this paper we will consider a combined method of gas drying for its transportation, namely low-temperature separation with further drying by absorption method using diethylene glycol.

When using the absorption method drying is performed with the use of liquid absorbents [3].

Glycols - of the general formula CnH2n(OH)2 - are used as absorbents at the plants [3].

The advantages of the absorption method are: drying of gases containing substances that poison solid sorbents; continuity of the drying process; simplicity of the automatic control system [3].

The gas at the exit from the well has a pressure of about 100-150 atm. and higher, which can be converted into cheap cold by throttling the flow. Consequently, the easiest and most common option for gas treatment under such conditions is low-temperature gas separation. The advantages of the low-temperature separation design include:

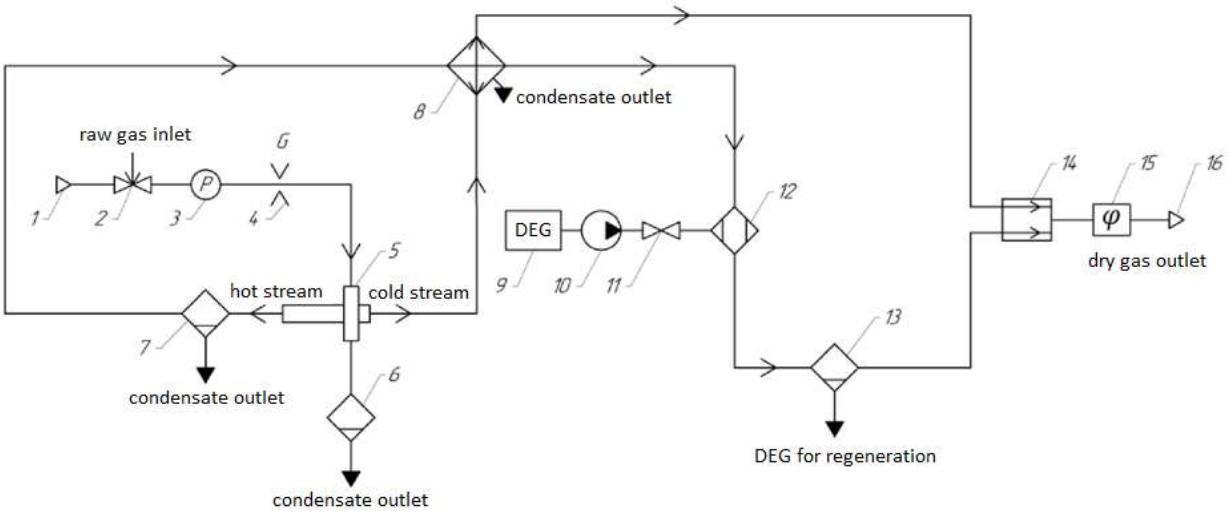
- low capital and operating costs with free differential pressure;
- gas drying to dew points occurs simultaneously with separation.

The cooling of the gas stream can be done in different ways. But when choosing a method, it is necessary to evaluate efficiency, structural simplicity and many other important factors that affect further work on preparing gas for transportation.

One of the most advantageous and suitable methods for cooling a gas stream is a vortex tube. Installations based on a vortex tube have a number of advantages: the absence of any refrigerants and heat carriers; simple design of the vortex tube, which leads to a reduction in the complexity of manufacturing, operation and maintenance; reliability of the system as a whole, due to the absence of moving parts in the design; layout convenience [4].

Considering all the advantages and minimizing the disadvantages of the methods, the following scheme of the gas stream dryer was developed:

Scheme 1 - Gas stream dryer



The device works as follows: raw gas through inlet 1 and shut-off valve 2 enters the dryer. Pressure of incoming gas is measured by manometer 3 and flow rate by flow meter 4. The gas is supplied to the inlet of vortex tube 5. In the vortex tube nozzle adiabatic expansion with pressure and temperature drop takes place. This creates conditions for condensate formation. The condensate

that precipitates impairs the efficiency of the temperature separation. Therefore, the condensate is removed before the gas enters the separation chamber, in the volute of vortex tube 6. In the separation chamber of the vortex tube, the flow is separated into cold and heated parts. Condensate formed in the central cold part is thrown to the periphery in the hot flow and partially evaporates. In the separation chamber of the vortex tube a means is provided for removal of unevaporated particles 7. Practically dry cold stream acts as a cooler for the hot stream in the heat exchanger 8 with condensate separator. The cold stream has the same moisture content. 8 the cold stream enters the mixer 12. In the heat exchanger 8 when cooling the hot stream condensate is formed, which is removed in the separator of the heat exchanger 8. The cooled hot stream enters the dryer by chemical method 11. The absorbent diethylene glycol is injected into the cooled hot stream from tank 9 through shut-off valve 11. Gas and diethylene glycol mixture enters separator 13 where separation of diethylene glycol from dried gas flow takes place. Then diethylene glycol is sent for regeneration and dried gas stream to the mixer 14. In the mixer 14 the two previously dried gas flows are combined, then after controlling the moisture content in the meter 15 are supplied to the consumer through the outlet 16.

The developed scheme will allow, firstly, to increase dehydration depth due to combination of physical and chemical methods; to increase efficiency of energy separation in the vortex tube during condensate withdrawal from the vortex tube volute, which allows to reduce cold flow temperature; condensate withdrawal from hot flow in the vortex tube. Secondly, to reduce diethylene glycol consumption by separating as much condensate as possible before contact with the absorbent. Thirdly, organize continuous drying in the flow by cooling in a vortex tube and using the absorption method. Fourthly, to simplify the equipment by eliminating the use of separate cooling sources.

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УДК 625.768.5

BLOCK DIAGRAM OF A MOBILE SNOW MELTING PLANT

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Nowadays, environmental pollution has become a serious problem. One of the reasons for this environmental problem is the untimely disposal of snow.

Because of this problem, many harmful substances get into the snow. Through meltwater, these substances enter the soil and reservoirs. This affects the quality of life and adversely affects people's health. It is proved that in the snow of Kazan the content of suspended solids, nitrites, phosphates, phenols, fluorides, petroleum products, iron, copper, zinc, aluminum, manganese, mercury, nickel, cobalt exceeds the maximum permissible concentration by several times.

Currently, in Russia, snow removal methods do not have any methods of cleaning snow and melt water from external pollutants.

This indicates the need to introduce a device that combines the capabilities of snow removal and its cleaning. Patent No. RU 2695676 [1] describes a mobile snow melting plant. This device is designed for mechanical and chemical cleaning of melted snow collected from the streets of the city. Figure 1 shows a diagram of the mobile snow melting plant.

To create a prototype of the plant, it is necessary to develop a block diagram of the control channel.

Structural schemes are widely used in the system analysis of information-measuring and measuring-computing systems, description of the principles of construction, functional composition, purpose of elements and their interrelation in the system. By type, the block diagrams of information-measuring systems are divided into several main groups. (Figure 2) [2].

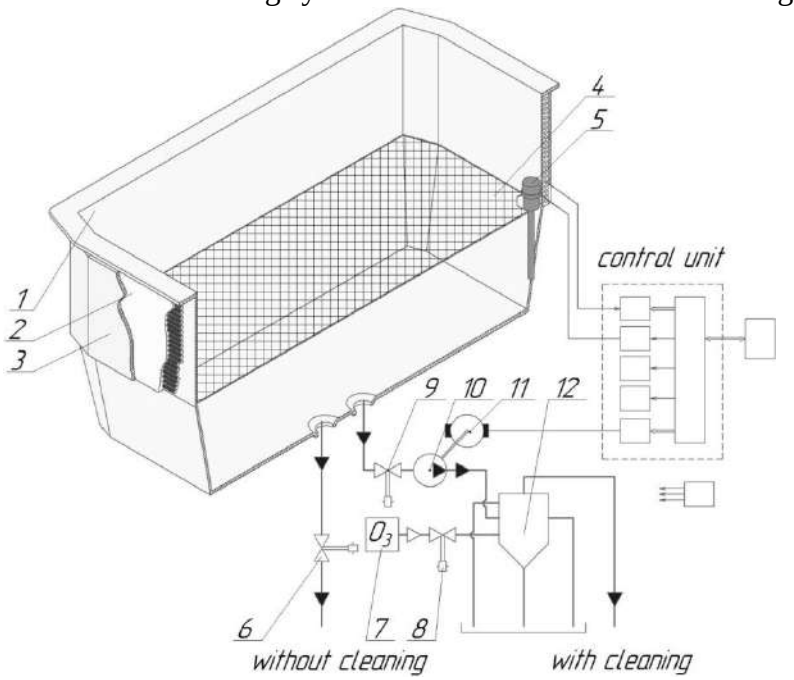

Figure 1. Diagram of a mobile snow melting plant

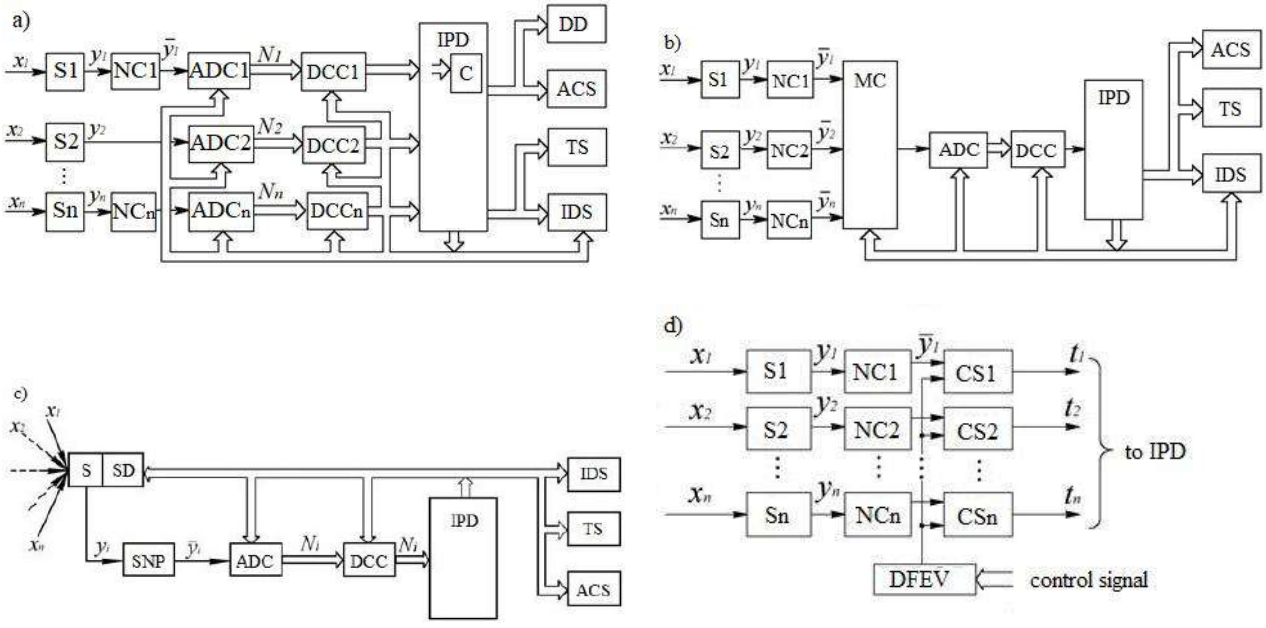

Figure 2. Typical block diagrams of information-measuring systems:

a – with parallel measuring channels; b – with parallel-sequential channels; c – with sequential channels; d – multiplicated deployment systems

S – sensor (primary transducer); NC – normalizing converter; ADC – analog-to-digital converter; DCC – digital communication channel (input ports); IPD – information processing device; C – calculator; DD – display device; ACS – automatic control system; TS – technical systems; IDS – information display system; MC – microcontroller; SD – scanning device; CS – comparison scheme; DFEV – the device for forming an exemplary value.

The distinguishing factor of the existing construction schemes is that the primary information is perceived by the corresponding sensors (primary converters), which are located relative to each other in parallel, sequential or mixed type of construction. These methods of constructing schemes differ in information processing time, that is, speed, hardware costs, cost and complexity of control.

Thus, based on the information obtained and a comparative analysis of the existing structural schemes of information-measuring systems (Figure 2), for the develop of the control channel of the mobile snow melting plant, we will use the structural scheme of parallel action shown in Figure 3.

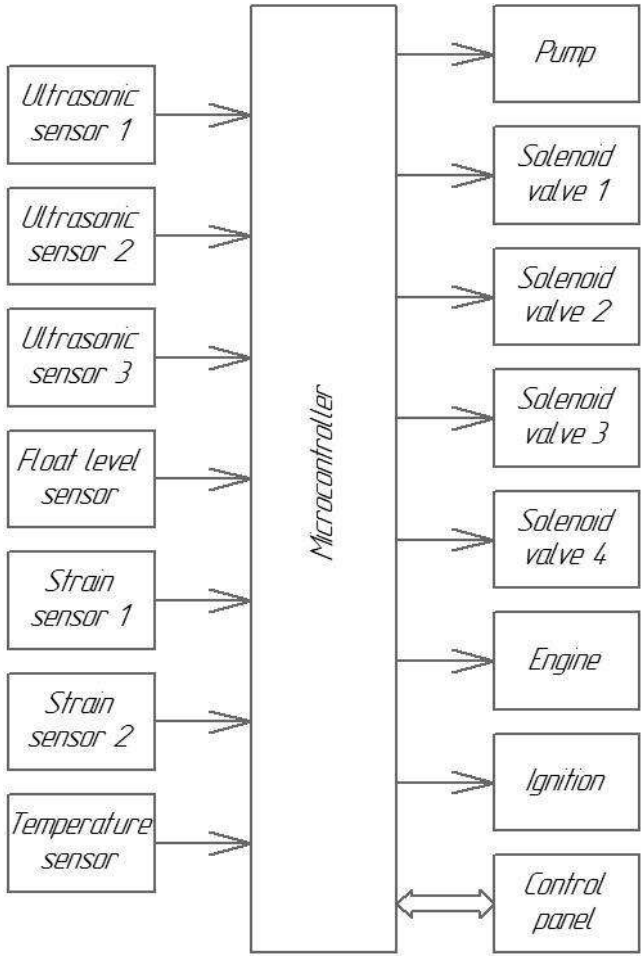

Figure 3. Block diagram of the control channel of a mobile snow melting plant

The main information processing device of the control channel of the mobile snow melting plant is the microcontroller. The microcontroller receives information from sensors and the control panel, the data is processed and control signals are generated.

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УДК 625.768.5

SIMULATION OF THE CONTROL CHANNEL OF A MOBILE SNOW MELTING PLANT

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Mobile snow melting plant (patent № 2695676) [1] performs melting and carrying out mechanical and chemical cleaning of snow masses. The plant will help improve the environmental situation.

Figure 1 shows the electrical circuit diagram of the control channel of the mobile snow melting plant.

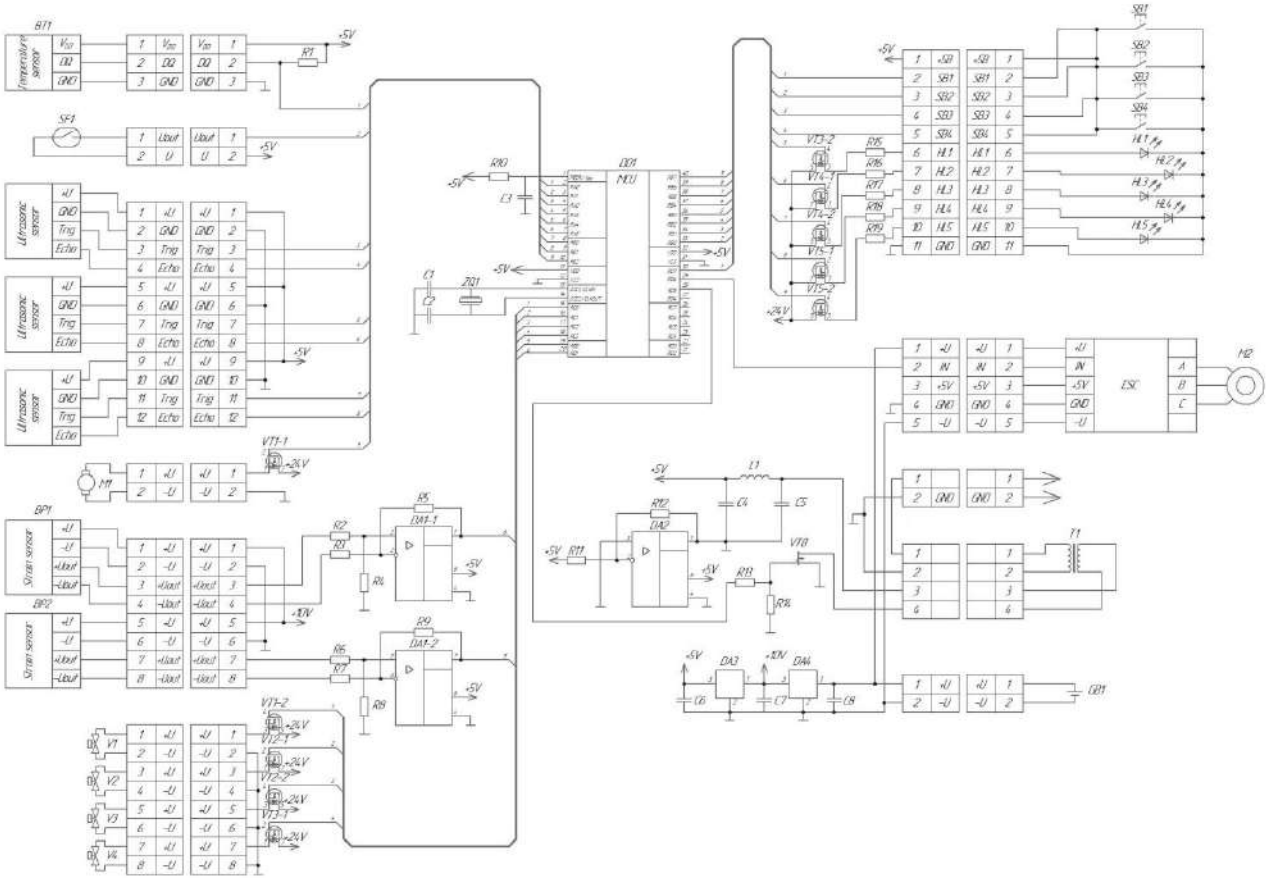

Figure 1. Electrical circuit diagram of the control channel of the mobile snow melting plant

The main information processing device of the control channel of the mobile snow melting plant is the DD1 microcontroller. The microcontroller receives information from sensors and the control panel, the data is processed and control signals are generated.

Ultrasonic sensors 1 and 2 are used to measure the level of liquid and snow in the snow melting box of a mobile snow melting plant. An additional ultrasonic sensor is introduced to measure the speed of sound, to minimize the measurement error caused by a change in the speed of propagation of an ultrasonic wave in the air.

A float level sensor SF1 was selected to signal the maximum liquid level in the sludge box of the mobile snow melting plant. The principle of operation of the sensor is based on signaling the movement of the float. The choice is due to the simplicity of the design, the low price, the possibility of operation of the sensor in the presence of foam in the sludge box.

The temperature sensor is installed in the snow melting box to measure the air temperature and regulate the gas supply depending on the information received.

Strain sensors 1 and 2 are necessary to control the amount of gas and oxidizer in the cylinders.

M1 – a pump, which is needed to supply the contaminated liquid for cleaning to the two-stage hydrocyclone-oxidizer.

V1-V4 – solenoid valves that open when voltage is applied.

There are four solenoid valves used in total in the plant:

- valve for draining liquids without cleaning;
- valve required to supply the liquid to the two-stage hydrocyclone-oxidizer;
- valve required to supply the oxidizer to the two-stage hydrocyclone-oxidizer.
- valve required to supply the gas.

The power supply unit consists of two voltage stabilizer KIA7805API-U /PF (DA3) and KIA7810API-U/ PF (DA4), at the output of which we get a voltage of +5V and + 10V.

The mobile snow melting plant is controlled using the control panel, which consists of four buttons and five lamps. The buttons are designed to turn on/off the plant and select the program "with cleaning" or "without cleaning". The lamps are designed to signal the operation of a float level sensor, strain sensors and ultrasonic sensors.

Mathematical modeling of the developed control channel of the mobile snow melting plant in the Multisim and Ultiboard programs has been performed.

Figure 2 shows a diagram of the control channel of the mobile snow melting plant assembled in the Multisim program. In this scheme we used foreign analogues of the selected elements of the circuit, because in the program Multisim there are no elements of domestic manufacturers.

We assembled the circuit in Multisim and transferred it to Ultiboard to create a 3D model of the printed circuit board. Placed the elements on the board and traced the wires. Figure 3 shows a 3D view of the printed circuit board.

The resulting printed circuit board of the information-measuring control channel of the mobile snow melting plant has dimensions of 96x104 mm.

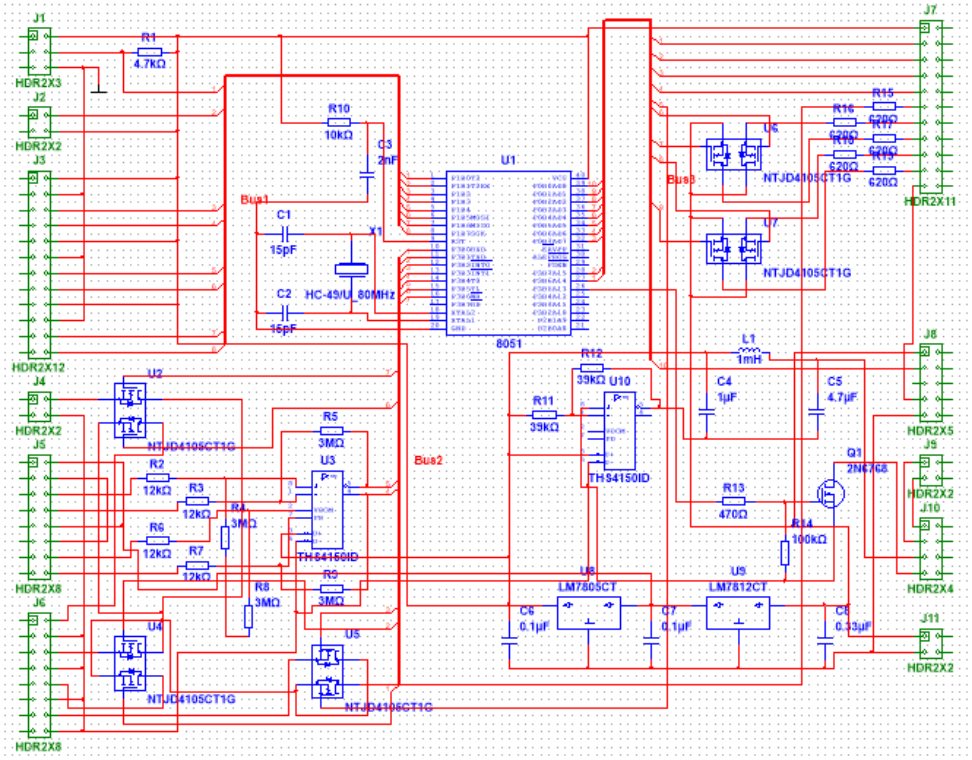

Figure 2. The scheme in the Multisim program

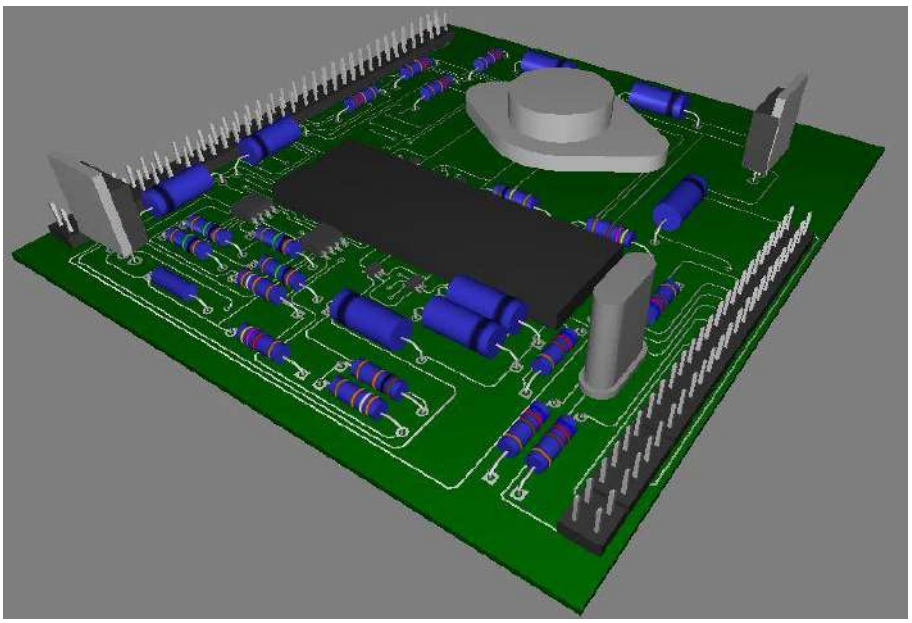

Figure 3. 3D view of the printed circuit board

Thus, this paper presents the developed electrical circuit diagram, as well as the mathematical modeling of the information-measuring control channel of the mobile snow melting plant in the programs Multisim and Ultiboard.

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1. Patent for an invention RU №2695676, 09.01.2018. Smirnova S.V., Potapov K.A., Musharapov R.N., Mingazetdinov I.H. Mobile snow melting plant // 25.07. 2019. Bul. № 21.

УДК 621.31

PROBLEMS AND ADVANTAGES OF IMPLEMENTING DIGITAL SUBSTATIONS

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In this paper, the topic of the introduction of digital substations into the power system is considered. The advantages of their use are substantiated. A description of the concept of a digital substation is given. In addition, the problems that arise at the stages of implementation and operation of substations of this type are presented.

Keywords: digital substation, new technologies, efficiency, reliability, security, cybersecurity.

Any country faces an important task of developing, improving the efficiency of the energy industry, and minimizing costs. To do this, it is necessary to improve the old and introduce new technologies. Currently, the idea of creating an intelligent energy system is becoming relevant in the world. The development of such a system means the use of smart equipment based on digital information exchange. A digital substation is considered as an object of a new generation electric power system that allows to implement this idea. Currently, the mass introduction of digital substations has begun in the world. Their use should allow to reduce the costs of design, maintenance, operation, etc. Digital substations have a huge potential to make secondary substation systems more reliable, more efficient, and the substations themselves safer. Digital technologies can increase the level of uninterrupted operation, provide higher safety for humans and the environment as a whole. The direction of introducing digital substations, according to many scientists and specialists, is promising from an economic point of view.

A digital substation is an automated substation equipped with digital information and control systems interacting in a single time mode and functioning without the presence of permanent staff on duty. [1]

The main essence of digital substations, based on the definition, is the complete automation of control and diagnostics. For this purpose, a high-tech software and hardware complex is used, which includes three structural levels: processes, connections and substations.

A digital substation has a number of advantages:

The transition to a DPS allows you to reduce the amount of cables used to transmit an electrical analog signal, to control relay protection and measurements. A traditional substation requires a lot of different construction and installation work to lay cables. When using fiber-optic cables, the complexity and volume of work is reduced.

The transition to digital data transmission makes it possible to implement the project in digital form — "digital design". Digital data transmission is also an opportunity to add new functions to an existing system without the need to recycle it.

The objectives of the creation of the digital substation are:

-transition to "maintenance-free" substations, i.e. to substations without permanent duty of operational personnel;

-to increase the noise immunity of secondary circuits due to the transition to digital communication using copper cables for transmission, and at long distances, high speeds and unfavorable electromagnetic conditions - fiber–optic environment;

-improving reliability by reducing the number of personnel errors during operational switching.

The introduction of digital substation technologies provides advantages over traditional substations at all stages of the implementation and operation of the facility, namely:

Design stage:

1) simplification of the design of cable connections and systems;

2) data transmission without distortion;

3) unlimited number of data recipients.

The distribution of information is carried out by means of Ethernet networks, which allows data to be transmitted from one source to any device at the substation or beyond.

Operation stage:

1) comprehensive diagnostic system, allows you to establish the place and cause of failures in a shorter time, as well as to identify pre-failure conditions;

2) monitoring the integrity of secondary circuits (continuous monitoring of the state of secondary connections: breakage, data loss);

3) protection against electromagnetic interference. The use of fiber-optic cables provides complete protection against electromagnetic interference in data transmission channels;

4) easy maintenance and operation.

5) the re-switching of digital circuits is much easier than analog circuits;

6) reduction of repair time due to the wide supply of devices from different manufacturers compatible with each other on the market.[2]

With all the advantages, it is necessary to note the fact that the development of digital technologies leads to an acute problem of cybersecurity. Various cyber threats can lead to the deterioration of the digital substation's performance. The damage caused by a cyberattack can lead to consequences of various scales. Therefore, finding ways to increase cyber resilience is necessary and inevitable. Cyber-resilience can mean a kind of immunity of an energy facility for self-defense against partial or complete destruction, that is, the acquisition of the ability to exist and maintain its operability in the face of cyber attacks.

One of the main obstacles to the introduction of measuring complexes of digital substations is the imperfection of the existing metrological support and the almost complete absence of a regulatory and methodological framework for metrological support of digital substations.

Some problems hindering the introduction of digital substations:

-technical issues requiring additional standardization;

-professional development of commissioning, operating and design organizations;

-lack of regulatory documentation regarding the organization of maintenance, which could be accepted by operating organizations at the moment;

-the problem of cybersecurity is the lack of adequate proposals to address the issue.[3]

Thus, a digital substation is understood as a substation with a high level of control automation, in which almost all the processes of information exchange between substation elements are carried out digitally.

The main task of the introduction of digital substations is to increase the efficiency of power grids. This new technical solution is able to provide relative ease of operation, as well as improve the safety and reliability of the network. It is worth noting that digitalization has a number of advantages and disadvantages. It can solve a lot of existing problems at the moment: reduce the volume of preventive maintenance, speed up troubleshooting and reduce the time of repair due to a significant reduction in the number of cable connections, reduce the frequency of preventive maintenance, due to the constant receipt of information about the condition of equipment, simplification of equipment management.

At the same time, the introduction of high-tech equipment puts forward new requirements for personnel. In addition, with the development of digital technologies, the problem of cybersecurity becomes critical.

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УДК 004.89

PROSPECTS FOR THE USE OF ARTIFICIAL INTELLIGENCE TECHNOLOGIES IN FINDING DAMAGE SITES IN DISTRIBUTED GENERATION SYSTEMS

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Abstract: In the work, a simulation of a power supply system with distributed generation consisting of 12 wind farms of 5 MW each, two parallel overhead lines, a backup power supply system based on a synchronous generator, a battery of static capacitors (BSC) and a generalized load of consumers (R) was performed in PSCAD. BSC is used to compensate for reactive power in the power supply system, which in turn leads to a voltage drop and uncertainty of the impedance of a system with distributed generation, which in turn makes it difficult to find damage sites, including those associated with single-phase earth faults. The paper considers methods for improving the accuracy of finding damage sites based on the use of artificial neural networks.

Keywords: Artificial neural networks LSTM, distributed generation, PSCAD

Currently, trends are beginning to manifest themselves based on the use of artificial neural networks, in particular for finding fault sites in distributed generation systems, when traditional relay protection and automation algorithms (RPA) do not work due to the uncertainty of the parameters of the power supply system.

Determining the locations of damage in power systems is of great importance, requiring serious consideration. Accurate calculation of the distance to the place of damage contributes to a significant reduction in the cost and time of repair. The proposed algorithm uses artificial neural networks with short-term and long-term memory (LSTM) to evaluate network parameters that change over time. The simulation was performed using the PSCAD software on the example of a two-circuit network.

In [1] describes a method for determining the distance to the damage site based on so-called synchronous vector measurements. However, this work was carried out only in a single-chain power supply system. Work [2] reveals the scheme of synchronous vector measurements of the values of the impedance matrix using the voltage coefficient at the two ends of the power line. The advantages of synchronous vector measurements are their low cost and independence from the communication channel, but they have a significant disadvantage associated with very high required measurement accuracy, which is usually impossible to perform in practice.

In [3], an algorithm for error estimation using sensitivity analysis at each measurement stage is proposed. In order to reduce measurement errors in [4], the so-called most optimal method is used.

Algorithms based on impedance determination are very effective in determining the location of damage in a single-chain power line. However, due to the complexity of RG systems with parallel overhead lines, the errors of existing sensors, these algorithms face serious problems, therefore, artificial neural networks are increasingly being used to find damage sites in systems with RG, and of various configurations to increase the accuracy of finding damage sites associated primarily with OZZ.

The most common damages in power lines are OPC, as a result of which we have different values of the short-circuit impedance. This creates a new problem for known algorithms, since determining the exact impedance of the fault has a significant impact on determining the exact location of the damage. Similarly, the calculation of the short-circuit impedance in two-chain lines also presents another serious problem for algorithms for determining the location of damage due to the presence of mutual induction between the lines.

A system with two-way power supply, including a wind farm and a synchronous generator, was chosen as the calculation model. The wind power plant includes 12 wind generators of 5 MW each, which makes it possible to talk about a system with a RG. Due to the strong dependence of the power generated by the wind power plant on the wind speed, the voltage and impedance of the source change.

An actual trend for RZA systems with RG is the use of neural networks due to the possibility of their training and adaptation to changing computational parameters. The authors [5] propose in their work an algorithm for detecting damage using networks with long-term and short-term memory (LSTM). LSTM refers to a recurrent type of neural networks used for training and problem solving in conditions of uncertainty of initial parameters. The Vanilla LSTM neural network model, which is the most common LSTM model, is also used in research [6]. This model is discussed in more detail in [7]. After applying the LSTM network, various parameters necessary to determine the location of the damage are accurately evaluated, namely: source impedance, compensation coefficient and other parameters, after that the location of the damage is calculated. It is shown that this method is much superior to some other available methods of finding the site of damage in terms of accuracy, which is very important for RPA.

In the presented work, the circuit was modeled in the PSCAD software package, the OZZ and various types of short circuits were modeled, the data necessary for LSTM training and refinement of the parameters of the RPA algorithms were obtained in order to increase the accuracy of determining the damage sites.

An actual example for Russia of a small-generation network and RG will be a system based on gas turbine units (GTU) of small and medium capacity. In the state farm "Maysky", located near the city of Kazan, such power plants are used as the main source of power. The neural networks described above can be used for them as well. The advantage of GTU in comparison with wind power plants can be attributed primarily to the absence of drawdown in capacity due to the stable

flow of gas through the pipe. Thus, it can be concluded that the use of neural networks at stations with GTU is a very promising technological solution and deserves attention as a promising development in case of pressure drop of incoming pipeline gas.

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УДК 621.391.82

ASPECTS OF SHORT-TERM FAILURE IN WIRELESS WEARABLE DEVICES

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(Kazan National Research Technical University named after A.N. Tupolev)

The development of wireless wearable devices (WWD) has changed the daily living of every person and influenced the appearance of these devices, their ergonomics and features. A vast number of people use WWD simultaneously, without thinking of the potential problems. Approximately half of such problems arise due to improper operation of devices, less than half of them - as a result of technical imperfections of devices [5].

The most recent stages in the development of electronic technology show that the requirement for miniaturization of devices has the greatest influence. To meet this requirement, developers have to accept a number of compromises. A device must meet a huge number of requirements provided by interstate GOST standards, such as: design requirements; technical requirements; software requirements; reliability requirements; safety requirements; performance requirements; requirements for means and communication lines; requirements for electromagnetic compatibility; technical and economic requirements; requirements for device patent clearance and certification.

With proper operation of the device, its service life may increase, however, there are cases when a user is not able to predict and prevent the external negative effect in time. Thanks to modern developments in electronic devices manufacturing technique, the protection against many external factors is provided and is mandatory for all new manufactured devices.

Practical experience shows that at the moment, there are several minor issues in the operation of WWD, such as:

- Difficulty in simultaneous operation of Wi-Fi and Bluetooth in close proximity;
- Electromagnetic interference (EMI) observed in certain areas of a community;
- EMI that occurs under certain weather conditions;

- Aspects of simultaneous operation of multiple devices (3 and more) via Bluetooth;
- Malfunction of a user activity recording mechanism;
- Imperfection of device software.

The difficulty in device simultaneous operation via Wi-Fi and Bluetooth lies in the fact that these two technologies use the same radio frequency (2.4 GHz) [5]. For example an attempt to use a smartphone connected to a Wi-Fi router and wireless Bluetooth headphones at the same time can interfere with the connection of wireless headphones and the smartphone. To solve this problem, a 5 GHz Wi-Fi router can be used instead [1].

EMI observed in certain areas of a community can occur both intentionally and unintentionally. It will be difficult to find the source of interference without special equipment, but almost everyone can localize the area of its influence. As a rule, such cases occur when a person with a working wearable device passes the area affected by interference. Some experts argue that there are additive (that is, accumulated) factors, when interference sources collectively can become an issue, but each separate source is harmless.

EMI occurring under certain weather conditions is one of the unpredictable factors. For example, significant interference can be observed, when a lightning discharge occurs at a certain radial distance from a car radio.

Aspects of simultaneous operation of multiple devices via Bluetooth are similar to the first problem described above. Devices operating simultaneously in the same radio frequency create mutual interference with each other, which causes problems [2]. A good example is an attempt to connect a smart bracelet and wireless headphones to one smartphone. As a result, information is not shared between the bracelet and the smartphone, and the sound in the headphones is lost from time to time. To solve this problem, the latest smartwatches support the function of disabling their internal Bluetooth module, thus avoid causing interference.

Some smart devices with the function of monitoring human vital signals, such as a step-counter, pulse oximeter or blood pressure monitor, can have a serious measurement error associated with a malfunctioning recording mechanism or its absence [3]. Due to this problem, it can be difficult to determine the validity of the received data.

The imperfection of device software is one of the common issues when a WWD, for some reason, cannot be connected to another device [4]. The main cause of such problems is bad software created by a device developer.

In conclusion, the influence of mutual interference, software imperfection and ill-conceived mechanisms of device operation, in some cases, can be significant if developers stop taking these factors into account.

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УДК 666.655

STUDY OF NONLINEAR EXPANSION OF PIEZOCERAMICS

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The paper considers the determination of the nonlinear dependence of piezoceramics on a linearly increasing voltage. Today, piezoceramics is a promising material for ultra-precise movement. This material tends to increase its linear dimension under the action of stress applied to its opposite walls [1]. However, the main disadvantage of piezoceramics is the non-linear dependence of the increase in size.

The following technique was used to determine the nonlinear dependence. Piezoceramics were placed in an electron microscope, in which special wires were built to transmit voltage. The resulting expansion values were recorded and entered into a table.

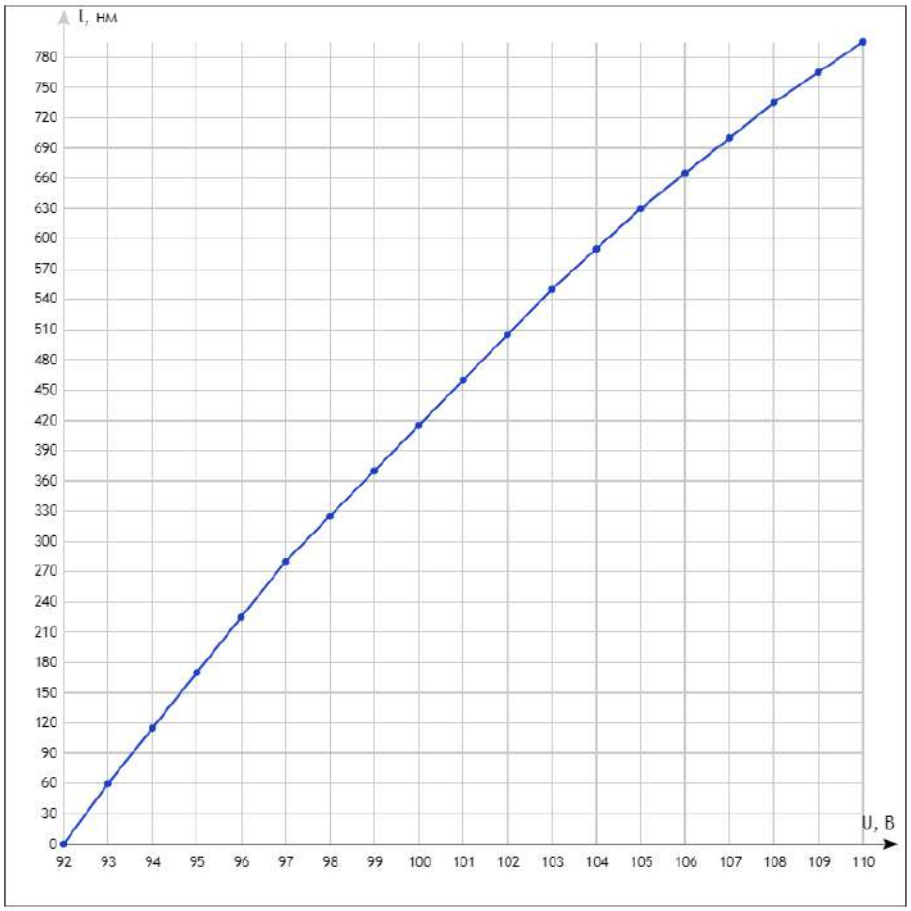

Figure 1. Obtained values of the voltage dependence of the magnification of the piezoceramic.

Based on the data obtained, it can be concluded that the piezoceramics are non-linear in the high-voltage region. As the voltage increases, the non-linearity increases.

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УДК 620.179.16

ACOUSTIC CONTROL OF PIPELINES

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Abstract: the article provides general information about the acoustic method of pipeline control.

Key words: acoustic method, pipeline, acoustic control.

Piping systems required for public consumption, industry and increased consumption, increased consumption: gas, oil products, heat carriers (hot water and steam), air, drinking and process water, etc. In the Russian Federation alone, the length of pipeline networks exceeds 5 million km [1].

The large length of pipeline networks and their high degree of wear resistance lead to the original leakage chain. For example, in Hong Kong, the share of water due to leaks is about 15%, in Europe about 20% of the total volume of transported water, and in cities such as Dublin (Ireland), Lusaka (Zambia) and Calcutta (India) can reach 40–60%.

A big problem associated with the loss of lost networks. Hidden losses - absorption of water (or other product), which are not manifested by knocking out liquid to the surface or flooding of various underground utilities. This decision is about the difficulty of their receipt and detection of cases of energy loss [2].

Failures of pipeline systems, as well as illegal tie-ins with theft of the transported product, not only lead to significant economic damage, but also create the possibility of landslides, fires, explosions or environmental losses.

In this regard, the problem of improving the quality and reliability of pipeline systems is relevant. Today, there are many methods for finding places of depressurization of pipelines. Among them, one can distinguish such as visual-optical method, electromagnetic control, acoustic control, ultrasonic control, radiographic examination, thermographic tests, hydro- or pneumatic tests with pressure measurement before and after a leak, etc. However, with all the variety of control methods, it is impossible to single out among them effective in any conditions.

From the study of the authors, it can be concluded that acoustic methods are the most balanced in comparison with others. This is due to the fact that the acoustic signal has sufficiently capacious information about the state of the pipeline. As a method for assessing the state of pipelines, acoustic methods have been used for a long time. The main problem of the effective application of acoustic control is the need for high-quality information extraction from the signal[3].

Initially, scientists used the Fourier transform to process acoustic signals . Surely this is not enough. The Fourier transform inherently cannot distinguish a stationary signal from a non-stationary one, which is a big problem for its applicability. This problem can be partially solved by the windowed Fourier transform. It allows you to get a characteristic of the signal frequency distribution (with amplitude) in time. The main problem of its use is the Heisenberg uncertainty principle, which arises for the time and frequency parameters of the signal. The uncertainty principle is based on the fact that it is impossible to say exactly what frequency is present in the signal at a given time (we can only talk about the frequency range) and it is not possible to say at what exact moment in time the frequency is present in the signal (we can only talk about a period of time). This raises the problem of the resolution of the windowed Fourier transform [4].

With the development of science and technology, more advanced processing methods began to be used to analyze the acoustic signal.

One of the relatively new methods of mathematical processing of vibration signals are such transformations as: wavelet and Hilbert-Huang, which have recently been widely used in practice [3]. These transformations make it possible to solve the Heisenberg uncertainty problem. The main disadvantage of wavelet analysis is associated with the need to choose a basic wavelet depending on

the nature of the original time series. In the process of analyzing non-stationary signals, information about the main basis, as a rule, is not available, for this reason it becomes necessary to select possible options to obtain optimal results.

The Hilbert-Huang transform does not require the choice of a basis function. However, this method does not have a strict theoretical basis. It requires additional research to confirm the legitimacy of its use in each specific case. In addition, one can note the problems associated with the choice of splines for decomposition, the choice of a stopping criterion when weeding out the residual, the choice of significant modes, mode mixing, and edge effects. These shortcomings increase the complexity and complicate the interpretation of the results [5].

Signal analysis methods are carried out in various ways, one of these methods is the theory of artificial neural networks. The mathematical apparatus of neural networks improves the accuracy of the diagnostic process due to the existing knowledge base about the operation of analogues. The disadvantages include the complexity of implementing and training the neural network, in addition, it is worth highlighting the low degree of unification (for each new object, it is necessary to create a new network and then train it) [6].

Currently, there is an active testing of non-traditional approaches in the processing and analysis of information. The theory of fractals is one of the promising areas of mathematical data processing. The concept of a fractal is associated with geometric objects that satisfy such a criterion as self-similarity. Fractals have a rough or fragmented geometric shape that can be divided into parts, each of which is a smaller version of the whole. To describe fractal structures based on a quantitative assessment of their complexity, a coefficient called the fractal dimension is used. One of the most accurate methods for determining the fractal dimension of time series is R/S analysis using the Hurst exponent [7].

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УДК 621.316.925.1

VOLTAGE REGULATION OF POWER TRANSFORMERS AND AUTOTRANSFORMERS

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Abstract: Quality requirements for electric energies demand that variations of voltage's properties stay within a certain range. This is managed by voltage regulation. Voltage can be regulated on power transformers and autotransformers using various methods.

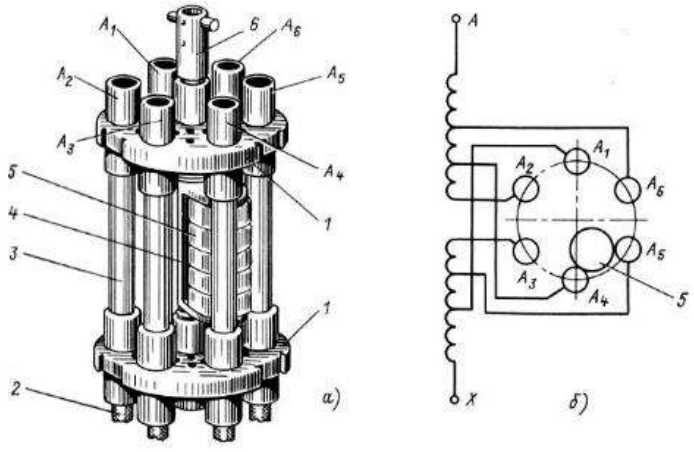
Key words: voltage, power, current, electric energy, transformers.

There are certain quality requirements for electric energy among which there are ones for continuous variations of voltage's properties. There are different methods to get rid of said variations or to reduce their influence on electric energy's quality and voltage regulation of power transformers and autotransformers is one of them.

Voltage regulation of power transformers and autotransformers is a process of transformation ratio alteration which is done by variating the number of its windings. Transformers have special branches and switches for regulation which are responsible for transformation ratio alteration.

There are several types of regulations. For example, it can be divided by criteria of the unit being regulated into longitudinal regulation, transverse regulation and longitudinal-transverse regulation. It also can be divided into neutral regulation and line regulation depending on where voltage regulation takes place.

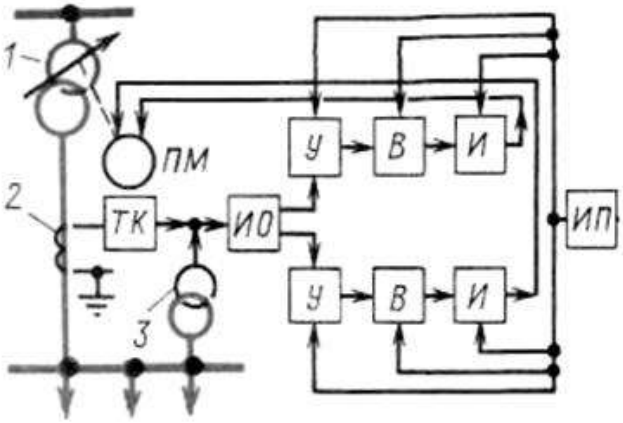
First of the methods of voltage regulation of power transformers is regulation with off-circuit tap-changer. This way regulation can only be done when transformers are turned off. Transformers with high rated power can have up to five branches which provides four additional voltage steps equal to 2.5% of rated voltage. Tap-changers can be single-phase or three-phase depending on transformer's rated voltage and number of voltage steps. Operating of off-circuit tap-changers has some specificities. Usually voltage regulation with off-circuit tap-changers is done from one to two times year and that's why this type of regulation is called seasonal. [1]



Picture 1 – A drum (barrel) switch

The second and most common method of voltage regulation is load tap change. It's done using the load ratio control device which is needed for voltage regulation on still operating transformers. In other words, transformers stay turned on for the whole process of regulation. In comparison to

transformers with off-circuit tap-changers transformers with load tap changers have a wider regulation range and a bigger number of voltage steps. [2] Load tap changers can be operated remotely or using an automatic voltage regulation device. One switching cycle can usually take from three to ten seconds to be finished. Special units of automatic transformation ratio regulation are to be considered if load tap changers need to be operated automatically.



Picture 2 – A structure of automatic transformation ratio regulation unit

Regulated voltage goes from voltage transformer to automatic transformation ratio regulation unit. Current compensation device is needed to cope with a voltage drop caused by load current. Load tap changers have to be operated automatically. Load tap changers are to be operated remotely in some cases. Those cases are when automatic regulators are broken or when switching wasn't finished properly. Load tap changers are blocked when currents are higher than two hundred percent of the rated current.

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УДК 621.316.925

REACTIVE POWER COMPENSATION

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Abstract: Magnetizing current is necessary for the formation of an alternating magnetic field in asynchronous machines, transformers and overhead lines.

Therefore, in AC electrical circuits, along with the production, transmission and consumption of active electrical energy, it is necessary to distinguish between the production, transmission and consumption of reactive electrical energy.

The demand for reactive energy is covered primarily by generating it by generators of power plants along with the generation of active energy.

From the technical and economic side, it is important to reduce the transfer of reactive energy through electrical networks, which is achieved by installing additional reactive energy generators.

Keywords: current, reactive, inductive.

Electricity generated at power stations passes through a large number of devices on the way to the consumer, their purpose is to provide a safe, economical and convenient way of transmitting and distributing this electricity [1].

In alternating current circuits, there is a phase shift between voltage and current, the reason for this is the current, which is called reactive or magnetizing. This current is necessary for the formation of an alternating magnetic field in transformers, asynchronous machines, as well as overhead lines.

It is because of this that in AC electrical circuits, along with the production, transmission and consumption of active electrical energy, it is necessary to note the production, transmission and consumption of reactive electrical energy.

The main dimensionless quantity characterizing the predominance of the reactive component in the equipment is the power factor, which is numerically equal to the cosine of the ratio of the active power consumed by the equipment to the total.

It is necessary to strive to increase the power factor, since the low power factor causes such problems as large power losses in the lines, significant voltage drops in the lines, the need to increase the overall power of generators, cable cross-section, power transformers.

The following means of reactive power compensation can be used in 110 kV electrical networks [1]:

1. Controlled shunt reactor is a device that uses the principle of a magnetic amplifier. As the magnetic core rods become saturated, the inductance of the network winding located on them decreases, and its inductive resistance also decreases proportionally.

As the inductive resistance of the reactor's mains winding decreases or increases back, its current increases or decreases proportionally, and hence the power consumption of the controlled shunt reactor.

2. Capacitor banks are a simple and reliable static device. They are assembled from separate capacitors. A capacitor is a device that consists of two conductors separated by a dielectric material. The power generated by a capacitor bank at its given capacity is proportional to the square of the applied voltage and frequency [2].

3. Synchronous compensator is a synchronous machine operating in a motor mode without a load on the shaft with a varying excitation current [3].

Static thyristor compensators are static compensators where the reactor is regulated using a thyristor key. These devices can work both for the output and for the consumption of reactive power.

Thus, the power factor decreases with increasing reactive power consumption by the load. This leads to the conclusion that it is necessary to strive to increase the power factor.

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УДК 620.9

MEASURE THAT INCREASE THE EFFICIENCY OF OPERATION OF THE SUPPLY SYSTEM

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Abstract: The topic of energy efficiency is considered at the level of international and state policy. The issues of limited natural resources, climate change and other issues are discussed daily. The rational use of energy resources can be achieved only through the integrated use of advanced energy-saving technologies and the introduction of organizational measures aimed at energy saving. The constant rise in prices and tariffs for energy resources is directly reflected in the production process of any enterprise.

Keywords: Heat supply, energy efficiency, energy saving, optimization.

Heat supply is vital for human life and production activities.

One of the main tasks in the thermal power industry is to improve the quality of heat supply and the reliability of heat supply systems. The quality of heat supply can be understood as a set of indicators, which include the provision of microclimate parameters in a single room, a group of rooms in a building, a group of buildings (consumers of thermal energy). The complexity of solving the problem of heat supply quality is deepened by the heterogeneity of thermal energy consumers, both in terms of thermal power and types of thermal load. The main loads are heating load, ventilation and hot water supply, less often technological load [1].

The solution to this problem is seen in one thing – the need to save energy and carry out activities that contribute to this. An integrated approach is required, taking into account that the level of energy efficiency of a building depends on architectural and planning solutions, the layout of the building, the characteristics of natural and climatic influences, the mode of operation of heating and air conditioning systems, and the level of automation of microclimate maintenance systems. Currently, heat engineering standards require a significant increase in the level of thermal protection of designed and reconstructed buildings. Optimization of the use of fuel and energy resources is ensured by the introduction of a set of interrelated legislative acts and regulatory and technical documents aimed at achieving economic efficiency in the use of energy resources at the current level of development of technology and technology and compliance with environmental protection requirements [2].

When developing energy saving measures, it is necessary to:

1. identify the most significant energy losses of the building;
2. determine the technical essence of the proposed improvement in the principles of obtaining savings;
3. calculate the potential annual savings in physical and monetary terms;
4. determine the composition and cost of the equipment necessary to implement the recommendations;
5. evaluate the overall economic effect of the proposed recommendations, taking into account the above points.

List of measures to improve energy efficiency:

1. Process automation
2. Reducing the cost of own needs

- Use of modern equipment such as condensing boilers and heat pumps;
- Use of cogeneration and trigeneration technologies.

3. Increasing the thermal resistance of enclosing structures
4. Increasing the energy efficiency of the heating system

- Replacement of cast-iron radiators with more efficient aluminum ones;
- Installation of thermostats and temperature controllers on radiators;
- Implementation of measures for the calculation of heat according to the number of installed sections and the location of the heaters.

5. Saving water
- Installation of common house meters for hot and cold water;
- Installation of water meters in rooms with separate consumption;
- Installation of pressure stabilizers (pressure reduction and pressure equalization by floors);
- Thermal insulation of DHW pipelines (supply and circulation);
- Heating of the cold water supply (from the heat pump, from the return network water, etc.).

6. Saving electrical energy

7. Gas saving
- The use of energy-efficient gas burners in the furnace devices of the boiler room;
- Application of climate control systems to control gas burners in the boiler block.

The main disadvantages of the existing heat supply systems are the low efficiency of transport and distribution of thermal energy to numerous subscribers in the absence of a system for high-quality control of air temperature in heated rooms. The production of thermal energy exceeds the required demand by 2-3 times, and part of the residential buildings receives an excess amount of heat, i.e., reheated, which leads to a proportional overrun of consumed fuel resources [4].

In conclusion, I would like to note that the overall result of the implementation of projects to improve the efficiency of operation of the heat supply system is the organization of such a scheme for supplying consumers with various types of energy resources, in which the production plan is carried out as efficiently as possible. Best of all, the effect of measures to improve the efficiency of operation of the heat supply system is noticeable in industries where energy resources make up a significant share in the costs of the enterprise [3].

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УДК 621.398

ANALYSIS OF HEART SIGNALS BY Z LEAD TO DETECT HIGH-FREQUENCY COMPONENTS

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Nowadays, there are many environmental factors that negatively affect human health. This fact is confirmed by appearance of heart problems in people. In according to statistics of Chekhov Vascular Center, 46% of population in Russian Federation have cardiovascular diseases [1].

Ventricular late potentials (VLPs) help to identify problems with cardiovascular system.

VLPs are low amplitude high-frequency signals that are recorded in terminal part of QRS complex (the beginning of the ST segment). The area of VLPs is shown at Fig. 1.

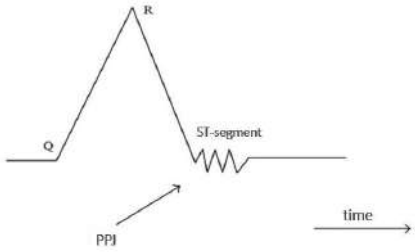

Fig. 1. VLPs at heart's signal.

In this work 100 signals of patients with myocardial infarction were analysed. Signals were exported from PTB Diagnostic ECG Database, which is provided by free Internet resource Physionet in form of .mat files containing signals' records by 12 standard leads and 3 orthogonal Frank leads - X, Y and Z. Duration of all signals is approximately 2 minutes, sampling frequency is 1 kHz, resolution is 16 bits and noise level is less than 0.5 μV [2].

Simson's method was used to analyse signals. This method is based on averaging signals from leads X,Y,Z [3]. In this paper we analysed signals only by Z lead. There are known studies in which it is possible to analyse signals by single lead, for example, [4].

The analysis performed in several stages:

First stage is extraction from original .mat file of signal's record by Z lead;

Second stage is signal preprocessing: filtering of extracted signals using a bandpass filter in 2-400 Hz range in order to eliminate drift of isoline, to cut off low-frequency component of spectrum near 0 Hz and high-frequency noise. Filtering of network interference at a frequency of 50 Hz is also performed. Example of analysed signal by Z lead is presented at Fig. 2.

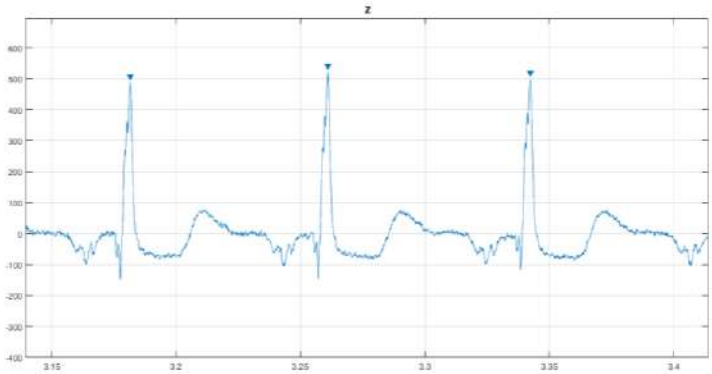

Fig. 2. Fragment of analysed signal.

Third stage is extraction of cardiocycles (CC). Fig. 3 shows extracted and accumulated CC before averaging, Fig. 4 – after averaging.

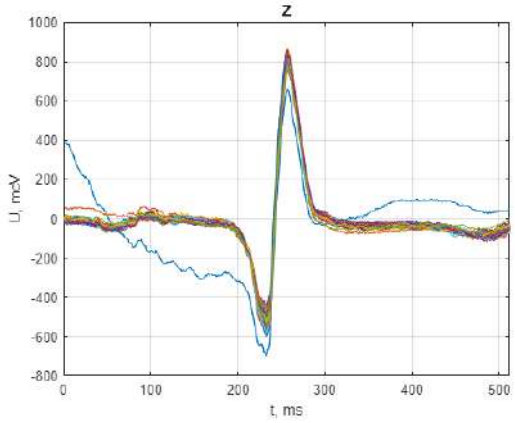

Fig. 3. Accumulated signals by orthogonal lead Z.

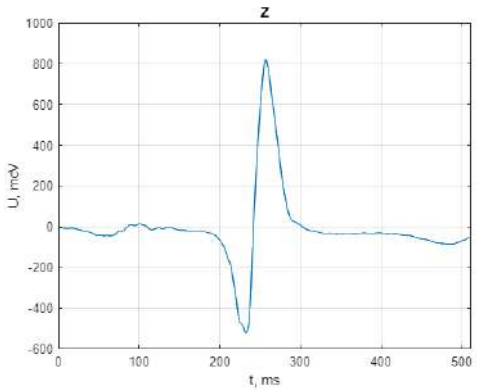

Fig.4. Averaged KC by orthogonal lead Z.

Averaged signals are filtered by a bidirectional filter in range of 40-250 Hz.

Following inclusion criteria are considered to make a decision about presence/absence of VLPs:

- Duration of filtered QRS complex D_{fqrs} > 114 ms;
- Signals with an amplitude less than 40 ms in the late part of fqrs LAS40 > 39 ms;
- Root mean square amplitude of the last 40 ms in fqrs RMS40 < 20 μV.

If at least two conditions are fulfilled, then it is confirmed that VLPs are present.

Previously signals were analysed by standard Simson method [5]. 15 signals have VLPs.

As a result of analysis only by orthogonal Z lead VLPs presence is registered in 32 cases. Case of VLPs presence is shown in Figure 5.

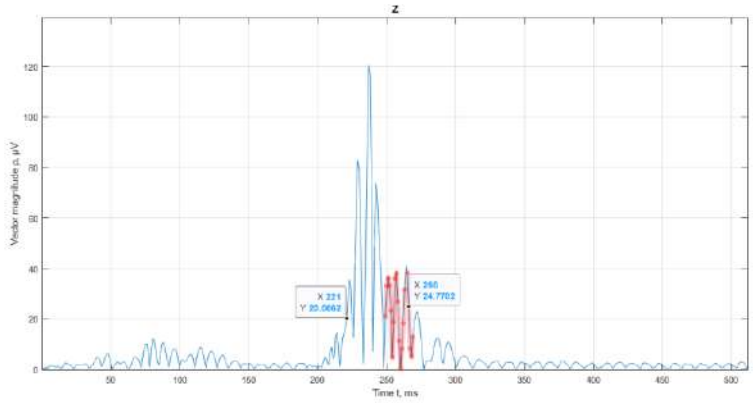

Fig. 5. Example of VLPs presence.

In according to description of signals in [2], all signals have features of myocardial infarction, therefore, presence of VLPs is rather an advantage. The accuracy of designed algorithm is 70%.

As a result of the study, we can confirm that it is possible to register VLPs by Z lead. We are planning to increase number of analysed signals to refine the results.

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УДК 621.31

ACTUAL ELECTRIC VEHICLE FAST-CHARGING STATIONS ANALYSIS

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The main purpose of the work is to carry out an analysis of the actual electric vehicle (EV) fast-charging stations and point out vital parameters of this technology. The received information may be used in broad based charging station design. The main feature of the station is its adaptability for various operation places: public parking lots, petrol stations, highways, etc. It is necessary to take into account the existing experience in EV fast-charging stations infrastructure design for developing the outlined EV charging station. In the present paper, an analysis of one of the most widespread fast-charging networks Tesla Supercharger will be proposed. As a second example, a network of charging stations installed in St. Petersburg is given. St. Petersburg is considered to have one of the most developed charging infrastructures in Russia.

Currently, the Tesla Supercharger network is the most widespread and well-known in North America. This charging station system is designed for charging the Tesla vehicles line-up. The Supercharger network was introduced in 2012; at the moment the company operates about 4200 charging stations worldwide (more than 1300 stations in North America, 1100 stations in European countries and more than 1800 stations in Asian countries are among them). Figure 1 shows the location of Tesla Supercharger stations in North America. [1].

Picture 1. The US Tesla Supercharger network location map.

Fast charging stations offer the possibility of using charging interfaces with peak powers of 72, 150, 250 kW. The nominal voltage of such charging stations is 480V. Among the features of the Tesla Supercharger charging station network, the following should be pointed out:

1. Special focus on the design of stations on intercity routes. Thus, owners of electric vehicles are able to travel long distances within the coverage of the charging stations network;

2. Location of a sufficiently large number of charging stations in the city areas;

3. Ability to charge several electric vehicles simultaneously at one station;

4. Lack of charging stations outside the countries of North America, Europe and certain countries of the Asian region;

5. Inability to use these stations for charging electric vehicles of other models.

As of now, 45 public charging stations from PJSC Rosseti Lenenergo and 49 stations from other organizations have been installed in St. Petersburg. The vast majority of charging stations from PJSC Rosseti Lenenergo are fast charging stations. There are 5 EVs for 1 station, on average, in the city. For the sustainable development of the charging stations infrastructure, the availability of 2-4 charging stations for each electric vehicle is a necessary condition. However, in terms of charging infrastructure development in Russia, St. Petersburg occupies a leading position. The location of charging stations on the territory of St. Petersburg is shown in Figure 2. [2].

Picture 2. St. Petersburg charging stations location map.

Among the features of the PJSC Rosseti Lenenergo charging stations network, the following are the most important:

1. Relatively high number available in the central part of the city;

2. Relatively high percentage of fast charging stations;

3. Versatility of charging stations, which allows charging cars of different models;

4. Inaccessibility of the charging stations network for residents of other cities.

The following recommendations can be given based on the analysis results. First of all, it is necessary to take into account distribution of certain EV models. In Russia, cars with a Charge-de-move (CHAdeMO) charging connector are the most popular. In addition, it is necessary to take into account the places of greatest demand for EV fast charging stations. As a rule, these are the central parts of cities, as well as public spaces, such as shopping centers, business centers, and public parking lots. To form a trend of sustainable development of the electric vehicle market, it is necessary to comply with the strategy of the charging stations network advanced development. In this case, the use of electric vehicles will become possible on a daily basis.

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УДК 001.11

FUNDAMENTAL AND APPLIED RESEARCH IN SCIENCE

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Fundamental research is the acquisition of fundamentally new knowledge and the further development of the already accumulated knowledge system. The purpose of fundamental research is the discovery of new laws of nature, the disclosure of connections between phenomena and the creation of new theories. On its basis, many practical tasks are solved in connection with the needs of specific branches of science, technology and production.

Applied research is the search and solution of practical tasks for the development of individual industries based on the results of fundamental research. They are associated with the creation of new technologies or the improvement of existing ones, for example, means of production, consumer goods.

Fundamental research has a cognitive function. Cognitive function is a complex phenomenon, not fully studied and not understood. Currently, various studies are being conducted to assess cognitive functions such as memory, mental acuity, ability to concentrate, ability to learn and mobilize, and speed of thinking.

Modern society needs specialists capable of initiative, creative, independent and dynamic activity, easily adapting to new types of situations, quickly ensuring the full functioning of complex information, finding new ways to solve production problems, using communicative and creative abilities at the enterprise. Activity in modern production conditions requires professional training from an engineer, the use of the widest range of human abilities, the development of unique individual physical and intellectual qualities in order to stand out among the masses of other people.

Applied research has a transformative function. The essence of the transformative function of sociology is that the conclusions, recommendations and suggestions of a sociologist, his assessment of the state of a social subject serve as the basis for the development and adoption of certain decisions.

It is clear to everyone that when implementing large engineering projects, not only a feasibility study is required, but also a socio-economic justification. Operations are remembered here. But sociology is just a science whose task is to develop practical recommendations. As for its implementation, it is the prerogative of management bodies, namely managers. Thus, many valuable and very useful recommendations on changing modern society developed by sociologists have not been implemented in practice. In addition, governing bodies often act contrary to the recommendations of scientists, which has serious consequences for the development of society.

The connection of theory with practice in fundamental research occurs indirectly, i.e. the execution of an action not directly, but through an intermediary, obtaining a result by transferring a function from one object to another. It can be anything: an object, a job, knowledge, a person, etc. The object receives a result without having a direct action on it.

Indirect cognition is based on the perception that we receive with the help of certain sensory organs and receptors. You can find out the temperature of the water by touching it or throwing a thermometer into it. And we don't need precise knowledge about the physical laws that govern the rise or fall of a column of mercury. There are enough general ideas about this phenomenon. This is how people learn about the formation of distant stars and planets, without using their materials directly in laboratory experiments, about the height of various objects, without climbing on them. We get this data by knowing the necessary laws, phenomena and facts. Our thinking allows us to mediate this knowledge with another being. That is, according to the theory of planetary motion, we can find the mass of Uranium without weighing it down.

At present, fundamental and applied research, fundamental and applied aspects are inherent in all sufficiently developed branches of social and natural sciences. At the same time, the main branches of science can be connected with practice not only through applied research in their field, but also through groups of special sciences closely related to the requirements of production, economics and other branches of the national economy and culture. These disciplines include, first of all, technical sciences. Therefore, the function of science as a productive force is most fully and vividly manifested in the technical sciences. This indicates the increased social role of technical sciences and their importance in the life of society.

Thus, it can be concluded that fundamental and applied aspects are very important for the development of science, they cannot benefit without each other, there will also be no progress if they exist separately.

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УДК: 621.3

ADVANTAGES OF THE CHROMATOGRAPHIC METHOD IN THE DIAGNOSIS OF OIL-FILLED ELECTRICAL EQUIPMENT IN ELECTRIC POWER SYSTEMS

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The purpose of our work is to consider instrumental methods of diagnostics of oil-filled equipment, to identify the most optimal of them.

As you know, power transformer equipment is one of the weakest links in the field of electric power, since their technical malfunction leads to a long downtime of power units. Therefore, the main direction of uninterrupted operation of power transformers is the transition from scheduled preventive repairs to maintenance of malfunctions at an early stage of their occurrence at a time when they do not pose a threat to the operation of oil-filled electrical equipment. For this purpose, an examination of transformer electrical equipment is usually carried out, which includes analysis of the results of technical archives, experimental measurement and test data, operational documentation, examination using televisions, determination of vibration characteristics and the

degree of discharges, diagnostics of switching devices and oil pumps. To fully characterize the transformer oil, its physico-chemical analysis is carried out using various instrumental methods.

During the operation of oil-filled electrical equipment, under the influence of high temperature, vibration, electromagnetic fields and other negative phenomena, various gaseous compounds are formed in it, which worsen the operating conditions of power transformers [1-3].

Transformer oil has a complex multicomponent composition, which contains a significant amount of naphthenic hydrocarbons, as well as aromatic compounds that are oxidized under the influence of temperature and oxygen.

The electrical strength of transformer oil is also reduced in the presence of moisture, which can be in the form of an emulsion and excess water, which is deposited at the bottom of the tank. Moisture impurities in transformer oil also significantly reduce its electrical strength and in many cases lead to failure of electrical equipment.

Also, during the use of power transformers in transformer oil, acid is formed as a result of oxidizing processes, which has a negative effect on metal parts of technological equipment, as well as on solid inorganic insulation.

Various instrumental control methods are currently used to diagnose oil-filled electrical equipment. Spectral and chromatographic methods are most widely used, which have a fairly good sensitivity and a low threshold for determining impurity components in transformer oil.

Having analyzed the results of practical research and comparing the characteristics of currently used instrumental methods of transformer oil control, such as spectrophotometry, photocolorimetry, paper chromatography, thin-layer chromatography, high-performance liquid chromatography, gas chromatography, chromato-mass spectrometry, infrared, ultraviolet and optical spectroscopy, we can conclude, that the main advantage of chromatographic methods for monitoring the content of impurities in transformer oil is a large number of detectable components in the process of a single sample entry into the chromatographic column, as well as high sensitivity and low error of analysis. In this regard, chromatographic methods are widely used in power plants to control the content of markers and key parameters of the technical condition of the main components of oil-filled electrical equipment.

Recently, to determine the degree of degradation of paper–oil insulation in power transformers, it has become necessary to use second–generation markers, which include, in addition to furan derivatives, also methanol and ethanol, which are formed as a result of the rupture of one 1,4 - β - glycoside bond of a cellulose molecule. At the same time, the concentration of methanol in transformer oil strongly depends on temperature, and exceeding its concentration is diagnosed as the presence of defects affecting paper insulation.

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УДК 21474

DESIGN OF ON-BOARD ELECTRICAL STRUCTURES WITH REGARD TO ELECTROMAGNETIC COMPATIBILITY

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Abstract: The article deals with the problems of electromagnetic compatibility in the design of power supply system of moving vehicles. The paper also presents a way of designing on-board optoelectronic electrical structures with regard to electromagnetic compatibility.

The process of designing the power supply system for vehicles involves a multi-iteration work that takes into account changes in both the input parameters and constraints on the elements of the power supply systems and the design process itself.

With the development of automobiles, the complex of electrical and electronic equipment has become much more complex, which has led to an increase in the length of electrical harnesses, as well as the complexity of their layout and routing. As electronic onboard equipment has evolved, it has become clear that various factors can interfere with sensitive parts of the electrical supply system. One such factor is voltage induction in electrical circuits from electromagnetic waves. [1] The most common way to induce high-density electromagnetic fields on a modern vehicle is electrical harnesses. A way to solve this problem can be universal CAD tool systems that take into account electromagnetic compatibility. [2]

Engineering methods for designing on-board wired electric structures taking into account electromagnetic compatibility in automobiles can reduce design time and increase the reliability of the electrical power distribution system on-board automobiles by accounting for electromagnetic interference [3] in the design of harness connections due to algorithms for taking into account electromagnetic compatibility as a means of accounting for the optimization parameter. Figure 1 shows a structural diagram of the on-board optoelectronic design process.

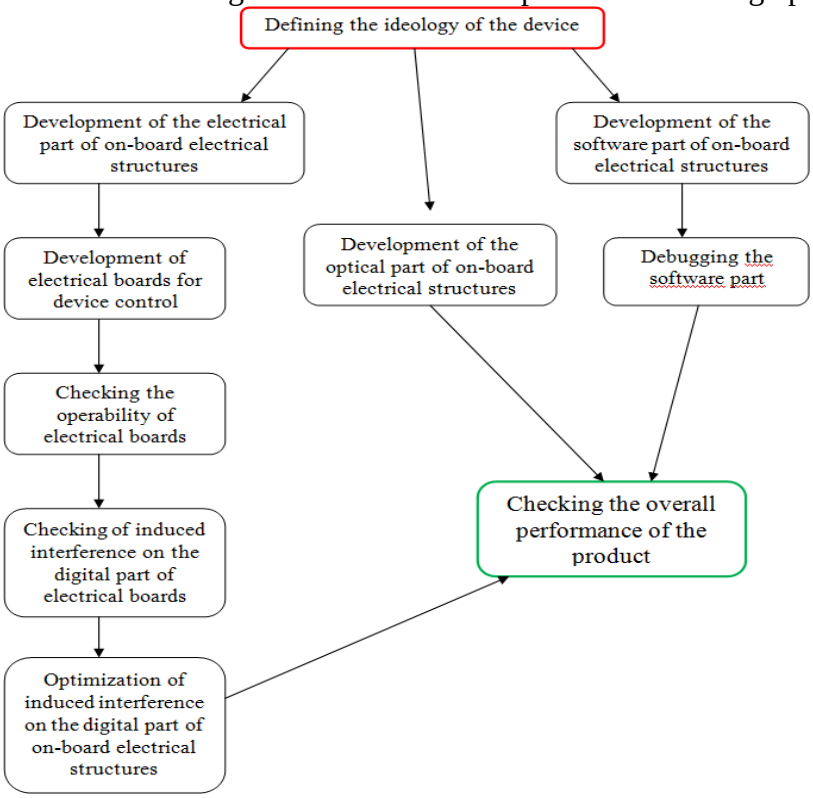

Figure 1 - Design of on-board optoelectronic structures

Existing installation and mounting instructions are related only to functional requirements and often do not take into account the mutual interaction of electromagnetic interference created by on-board electronic devices [4]; methods and algorithms of automated design of cable harness traces do not consider the conditions of electromagnetic compatibility between cables and conductors in harnesses. Therefore, solving electromagnetic compatibility problems is rare not only for engineers installing systems, but also for specialists responsible for the development of equipment of manufacturers.

In connection with the above, the study of the electromagnetic environment within the system and the development of models and algorithms for laying cable routes of mobile objects, taking into account electromagnetic compatibility, are relevant scientific and technical tasks of great importance in the design of onboard systems of mobile objects. [5]

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УДК: 681.5

AUTOMATION OF ELECTRICITY CONSUMPTION ACCOUNTING IN RESIDENTIAL MULTI-APARTMENT BUILDINGS

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The purpose of our work is to consider a way to automate resource accounting in multi-apartment residential facilities.

The consumption of energy resources is increasing every day, which negatively affects both the economy of the state and the citizens themselves.

Most modern urban buildings are connected to resource supply networks and are most often equipped with five main channels: hot water supply, water supply, electricity, gas and heating, which have a special priority in terms of energy saving.

Accounting for consumption through the described channels is quite simple. An entrance node is created at the entrance node of the corresponding room in the building, measuring devices are installed in this node to obtain data on the consumption of the consumed resource (counters). They, in turn, are connected to a controller that processes meter readings and sends this data to a communication node, most often GSM, and then the information is transmitted to a remote server

on which the accounting system is installed. According to this scheme, most automated accounting and control systems for heating and electricity are built.

The advantages of such systems are the already existing experience of their installation and use. However, there are much more disadvantages. Firstly, these systems are not adapted to the integrated accounting of resources of all channels. Secondly, the price. If the cost of one unit of accounting and control of the resources of an entire apartment building can be justified, then for each individual apartment the price should be lower. Thirdly, a short period of the verification interval (the time of operation within a given error), which is relative to the general house system of meters, can suit, but not for apartment-by-apartment.

Also among the disadvantages is the lack of standardization of data transfer protocols to accounting servers. Since additional funds will be required to support each of the various protocols, and this is an additional expense. In addition, there is no software that would allow you to take into account all the channels of resources, analyze this data, predict and warn in the range from one house to an entire city.

Such software should help solve tasks such as recommendations of measures to save electricity during peak hours, assistance in restoring the system in the event of an accident. In addition, software with a common database should enable residents to independently access personal pages for monitoring and accounting of resources remotely. On the basis of these data, residents want to receive a bill for the resources consumed by them.

Let's consider one of the most optimal options for creating an automated resource management system that takes into account both the tasks of current energy efficiency and security issues: both wireless and wired meters can be used separately for the operation of the accounting system in each apartment. This will not change the overall picture of the system. But it should be borne in mind that when using wired sensors, there will be a need to lay additional cables and work, that is, to increase the cost of the system.

The main requirement for wireless meters and sensors is the ability to provide power elements with the need for replacement no more than once every 3-4 years.

Such meters can create a network that, with a small power of each of the transmitters, forms a reliable control system and information collection, regardless of the frequency of data transmission. The controller receives all the collected information from all sensors in the apartment. According to the standard, the power reserve of such a controller should be at least 10% of the total load.

To ensure the reliability of the system (controllers in particular), uninterruptible power supplies should be used. Further, the information from the controllers goes to a common server, which, in turn, is designed to archive all the information received and manage the modem for subsequent sending to the resource accounting server or receiving information from it. To reduce the cost of the system, you can use one server for several entrances.

Actually, it is difficult to create such an information collection system that would be subordinate to an independent organization, on the one hand, providing information to consumers so that they could analyze and reduce resource consumption, and on the other hand, would send data to the supplier of the corresponding resources for calculation its with consumers. With this approach, there are no questions about how the consumer learns the amount of resources used by him with subsequent payment. Since all calculations take place in one transaction from the data received from the archives of the central server [1-2].

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УДК 681.518

PROJECT FOR THE PLANNING OF A MVSAT SATELLITE COMMUNICATIONS DATA NETWORK BETWEEN SHIP -TO-GROUND STATIONS.

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1. Problem statement.

With each satellite launch, the interest in the development of space technologies grows in all sectors of each country due to the great importance they have for the development of each nation, since the use of the various applications it offers allows to improve most of the industries that require it. Satellite communications have been widely used to meet the communication needs of different organizations, as they can reach any inhospitable place where terrestrial networks do not exist. The maritime sector only has few options to transmit its communications services, therefore, the most appropriate method is through satellite communications links. It is noted that, despite the availability of the latest satellite technologies in orbit, there is a need for data network planning that allows users to receive services through satellite platforms managed by various organizations. Based on the needs of the requirements of the maritime sector, the research question arose: "Is it possible to develop an MVSAT data network plan for satellite communication between ships and earth stations?" The purpose of the study is "To propose a project for the planning of an MVSAT data network for satellite communication between ships and ground stations".

2. Purpose and objectives of the study

Propose the planning of an MVSAT data network for spacecraft-to-ground satellite communications.

2.1 Objectives:

- Explore the different methodologies of satellite services in the maritime sector.
- Diagnose the current situation of the organization where the satellite data network will be implemented with respect to the required communications services.
- Develop planning for an MVSAT data network for spacecraft satellite communications.

3. Current situation

The organization where the data network will be implemented proposes a challenge related to a change in the technological paradigm. Taking into account that the services to be proposed are unpublished, so new equipment will be used to implement a series of services that allow you to exchange information quickly. The network infrastructure that could exist in the organization would allow interconnection between computers on the network.

4. Justification for the use of a data network based on MVSAT technology

According to business intelligence and market research firm Verified Market Research (VMR) in its Marine VSAT Market Size and Forecast Report [1], the maritime market was valued at $2780 million in 2019 and is expected to reach $7040 million. by 2027 with a compound annual growth of 13.3% between 2020 and 2027. The high demand for services for military and civil maritime operations has grown enormously generating growth in the market. According to the report offered by this company [1], it shows a comprehensive analysis of the key segments, trends, driving forces, restraints, competitive environment, and factors that play an important role in the market.

Maritime communication has existed since maritime activities began by means of signaling with flags and light signals. Then with the invention of radio, this application has been enhanced, setting the tone in historical events [2].

MVSAT technology is widely used for rural areas and harsh environments, which is perfectly suited for maritime environments [3]. MVSAT is a technology that uses very small and low-cost satellite earth stations that connect directly with users to exchange point-to-point, point-to-multipoint or interactive information [5], so it would easily adapt to the proposal.

5. Research methodology.

Methodologically, the research corresponds to the case study, since the object of the study is a specific institution, with a field design, since the data collection is carried out directly in the institution under study based on the requirements that it has. The theories to be used are theories of VSAT networks that can serve as a starting point to interpret and refine everything related to the final work.

6. Definition of requirements

Services should be implemented to enable the sharing of e-mail, internet, voice, videoconferencing and positioning services between ships and earth stations. Then you must define the hardware that will be used in the network. Subsequently, a series of service, configuration, technical and regulatory parameters must be determined [3].

7. Advantages of MVSAT technology

- Private networks designed with the needs of businesses in mind.
- The antennas installed in the necessary terminals are small.
- Available speeds are usually on the order of 56-64 Kbps.
- It allows you to transfer data, voice and video.
- The network can have a high density and is controlled by a central station (HUB), which organizes traffic between terminals and optimizes access to satellite bandwidth.
- Asymmetric connections.
- R narrow frequency in band C, Ku and Ka. But, Ka-band will meet the growing demand for broadband in several markets, especially in Europe and Africa [4].

8. Typical configurations for a VSAT network.

The typical topology of a VSAT network is an interactive star. The disadvantage of this technical solution is that when geostationary satellites are used in each transition from the satellite, large attenuations of the order of 200 dB [6] occur, and the radiation power of the satellite is limited to a few watts. In addition, the terminals use small antennas and receivers of limited sensitivity. VSAT antennas have a diameter of 0.75 to 3.8 meters. While the diameters of the antennas d the hub can vary from 0.3 to 30 meters depending on the application used [7,8].

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УДК 621.314

THE DIGITAL TWIN IS THE FUTURE OF THE AVIATION INDUSTRY

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The digital twin (DT) is a precise mapping of physical entities in the information space and the existence of an identical physical entity. The digital twin reflects the change of state of the physical entity in real-time which is an inversion and mapping of the current state of the physical entity. Simulation is based on the existing entity to build a model and to simulate the possible state of the physical entity in advance and analyze the possible state change of the physical entity based on the simulation result [5].

The composition of modern aircraft is becoming more and more complex. The number of components that make up an aircraft is extensive, and each component has its individual characteristics. Periodic maintenance when facing a complex system has a lack of accurate estimation of the current state of the system, which is prone to too frequent inspection and maintenance or premature failure of the system due to untimely maintenance costs and insufficient reliability of the aircraft.

Recently, the interaction of a physical and digital machines termed as digital twin with connectivity and data flow in both directions (as shown in Fig. 1) is being actively pursued to increase the safety and reliability of aircraft and its systems through near-realistic predictive analysis.

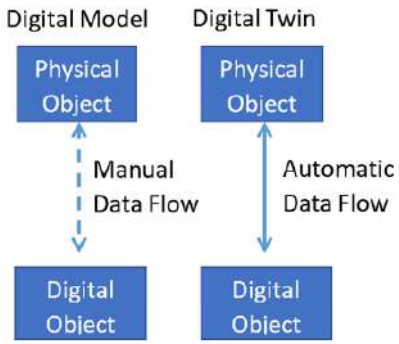

Fig 1. The interaction between physical and digital objects depicting the difference between a digital model and a digital twin.

The digital twin consists of three components: the physical entity of the aircraft, the digital twin, and communication between the physical entity and the digital twin. The digital twin is continuously modified by data collected from sensors present in the physical entity, and the digital twin controls the physical entity through inversion and prediction. This allows the simulation of the entire life cycle of the aircraft from design electrical power supply system to maintenance. The use of digital twin technology will make it possible to effectively analyze non-standard and emergency modes of operation in the onboard power supply system of an aircraft (short circuits, open circuits, overvoltage and voltage dips) and make timely decisions to eliminate the consequences in future [2].

Aircraft manufacturing includes the comprehensive control of products which must be controlled beginning with mechanical processing workshop, welding workshop, electrical assembly workshop, etc. These links determine the manufacturing quality and efficiency of the aircraft and affect its safe operation in the future [4].

Moreover, due to the unique nature of the aircraft industry, there are some drawbacks in conducting digital twin research, mainly in two aspects. The first is a complete reliance on artificial intelligence and the second is an ignoring the importance and priority of human decision making will affect the operational safety of the aircraft. To bring the digital twin closer to physical entities, the number of sensors needs to be increased, which will increase the weight of the aircraft [1].

Thus, for the full implementation of digital twin technology in the aviation industry, many problems must be solved. To accurately describe such an advanced apparatus, the simulation environment would most likely need to include several hundred or even thousands of multiphysics and multiscale models [3]. The digital twin of an aircraft consists of many different subspaces containing models, calculated and empirical (experimental) data, as well as reports for each of the aircraft subsystems. This system can be called a set of digital twins. An illustrative example of the system can be seen in Fig. 2.

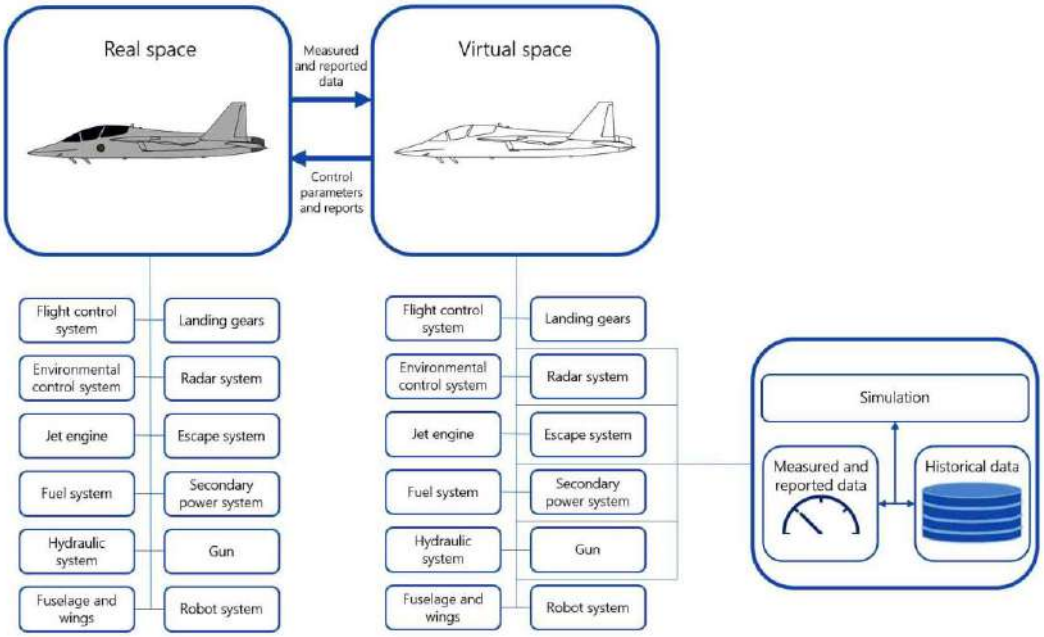

Fig 2. Some of the most important aircraft subsystems

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УДК 621.317+611.127

THE RESEACRH OF FILTER ORDER'S INFLUENCE ON MODIFIED SIGNAL-AVERAGED APPROACH IN HEART SIGNALS' ANALYSIS

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Signal-averaged approach (SAA) is the main method to detect ventricular late potentials (VLPs) - low amplitude signals which are located at the end of QRS-complex in heart signal. SAA consists of: Registration of heart's signals from X, Y, Z leads; Signals' preprocessing; Synchronization point's selection: usually it is peak voltage value; Coherent accumulation; Accumulated signals' averaging; Bidirectional filtering and Comparison analysis with threshold parameters [1].

Zacharia D. et al. in study [2] are pointed that VLPs are correlated with ventricular tachycardia – arrhythmia which can result to sudden cardiac death (SCD). Brito J. et al. in study [3] are also pointed on a correlation between VLPs and SCD: authors are formed the conclusion that SAA is useful to detect Brugada Syndrome.

Mentioned authors are used standard SAA in which segments before and after synchronization point are analyzed. However, VLPs are located at late part of QRS-complex. That is why in study [4] we are formed the hypothesis that it is necessary to analyze only segment after synchronization point. In study [4] we are filtered both segments with following analysis of late part. Bidirectional filtering of 40÷250 Hz for 512 ms signal is performed by filter with finite impulse response, 150 order and Blackman-Harris window function. That filtering is performed due to filtfilt function in MATLAB program complex. In according to function's specifications, length of filtered signal must be at least three times higher than filter order. So, it is impossible to use bidirectional filtering to 256 ms segment after synchronization point with designed filter. That is why in this study we analyze how filter order's decrease will be impact on results of analysis and, as a consequence, efficiency as well.

Preliminary 100 signals from PTB Diagnostic ECG Database [5] are analyzed for this research. Most of analyzed signals were about 2 minutes from the point of time domain. 17 signals have VLPs in according to standard SAA approach. MATLAB program complex is used for this research. Example of analyzed signal is presented at Fig. 1.

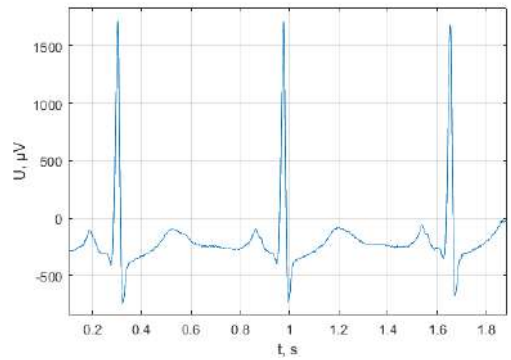

Fig. 1. Fragment of analyzed signal.

Signals were preprocessed with bandpass filtering within 2÷400 Hz to eliminate baseline drift and high-frequency oscillations. Peak voltage value in signal registered by X orthogonal lead was selected as synchronization point. 256 ms segment after synchronization point is selected for this research: these signals were accumulated as presented at Fig. 2.

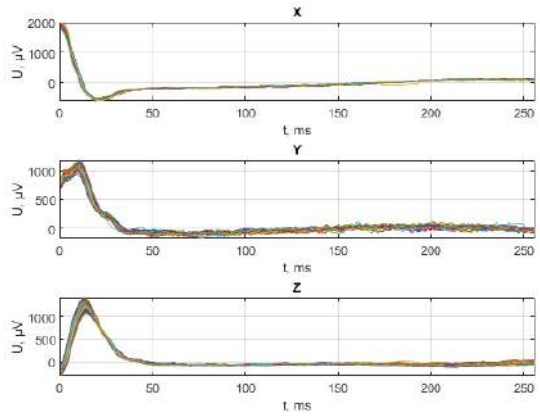

Fig. 2. Accumulated signals.

Then signals were averaged with the purpose to increase signal-to-noise ratio in according to equation (1):

$$SNR_{INCREASE} = \sqrt{n}, \quad (1)$$

where n is the amount of averaged 256 ms segments.

After that averaged signals were filtered within 40÷250 Hz frequency range with bidirectional filter with finite impulse response, 85 order and Chebyshev window function which is selected due more rectangular form of filter's amplitude-frequency characteristics.

Then vector magnitude is determined in according to equation (2):

$$\rho = \sqrt{U_x{}^2 + U_y{}^2 + U_z{}^2}, \quad (2)$$

where Ux, Uy, Uz – voltage values in averaged signals by X, Y, Z leads.

At least two of conditions should be fulfilled to make a decision about VLPs presence in signal:

a) Duration from the beginning of vector magnitude to signal's offset point D_{RxJ} > 69 ms in according to study [4];

b) Elements less than 40 μV at terminal part of signal LAS40 > 39 ms;

c) Root mean square at terminal 40 ms of signal RMS40 < 25 μV. If D_{RxJ} < 40 ms then the root mean square of entire signal is analyzed.

VLPs are registered in 11 out of 17 signals (65%). In other group VLPs absence is registered in 83 out of 83 cases (100%). Example of VLPs in standard and modified SAA is presented at Fig. 3.

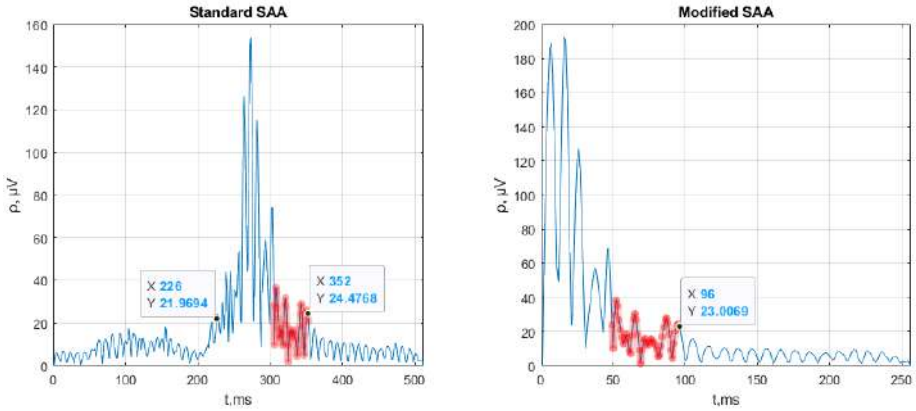

Fig. 3. Example of VLPs presence.

Overall efficiency of designed algorithm is 94%. Opportunity to detect VLPs using modified SAA is confirmed.

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УДК 621.317

THE RESEARCH OF POWERLINE INTERFRENCE'S IMPACT ON LATE POTENTIALS' EVALUATION IN ELECTROCARDIOSIGNALS

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Ventricular late potentials (VLPs) – high-frequency low amplitude elements of electrocardiosignals (ECS). Their presence is related with development of cardiovascular diseases [1].

Main problem in VLPs' registration is related with high-amplitude interferences. They can cover VLPs, thus, it becomes harder to detect them. That is why it is very relevant to design efficient and robust algorithm to detect VLPs.

In our opinion, powerline interference deserves special attention. That interference lies in m*50 Hz frequencies, where m is constant. Main harmonic is located at 50 Hz frequency, its spectral power is significant. That is why it is necessary to filter powerline interference in signal preprocessing.

Main approach to detect VLPs is signal-averaged electrocardiography. It is based on coherent accumulation and time averaging of cardiac cycles. It helps to increase signal-to-noise ratio.

It is necessary to filter powerline interference in order to perform efficient procedure of VLPs detection. However, it is not concrete which harmonic is needed to filter: main harmonic or all of harmonics.

This study is continuation of our previous works [2, 3]. We significantly increase the amount of analyzed ECS for more robust evaluation of our hypothesizes:

1. Main factor of decision's change about VLPs presence/absence is filtering of powerline interference's additional harmonics.
2. It is enough to filter only main harmonic of powerline interference for more efficient VLPs detection.

This research was realized in MATLAB program environment with use of Signal Analyzer app from DSP System Toolbox utility. Analysis of ECS from PTB Diagnostic ECG Database [4] was performed. In this study 537 signals were analyzed.

Simson's method is realized for ECS by three orthogonal leads X, Y, Z. An example of analyzed signals is presented at Fig. 1.

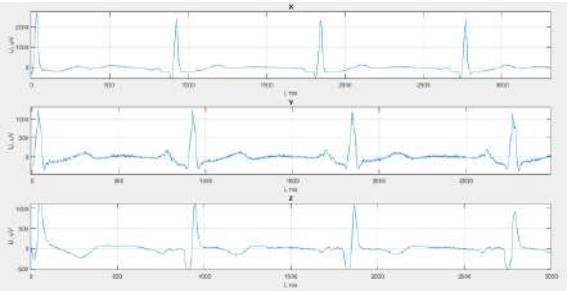

Fig. 1. Signals by X, Y, Z leads.

Following operations were performed with these signals:

1. Filtering within 2-400 Hz frequency range with bandpass filter to eliminate baseline noise;
2. Filtering 49-51 Hz with notch filter to eliminate main harmonic of powerline interference;
3. Cardiac cycles' extraction, accumulation and time averaging. R-peak of ECS by X lead was used as synchronization point. Duration of analyzed signals – 512 ms;
4. Filtering of averaged signals within 40-250 Hz frequency range with bidirectional filter to increase signal-to-noise ratio;
5. Vector magnitude evaluation: $\rho = \sqrt{x^2 + y^2 + z^2}$, where x, y, z – filtered averaged signals by X, Y, Z orthogonal leads;
6. Analysis of conditions: duration of filtered qrs-complex (D_{fqrs}) > 114 ms, duration of low amplitude (less than 40 μV) components at the terminal part of qrs-complex (LAS40) > 39 ms; root mean square of last 40 ms in qrs-complex (RMS40) < 20 μV. If at least two conditions are fulfilled then decision about VLPs presence is made.

Then algorithm is repeated to original signals but we filtered not only main harmonic of powerline interference but all of its harmonics to 400 Hz: 50 Hz, 100 Hz, …, 350 Hz, 400 Hz.

In case of only main harmonic's filtering VLPs are registered in 188 signals;

In case of every harmonic's filtering VLPs are registered in 153 signals;

In 47 signals decision about VLPs presence/absence was changed. Example of this scenario is presented at Fig. 2.

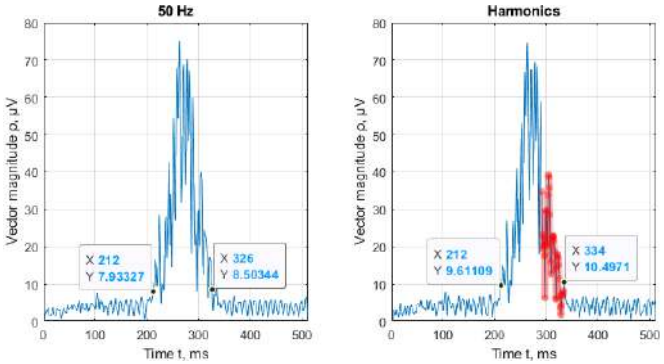

Fig. 2. VLPs detection: from absence to presence.

In 41 signals VLPs were presented when main harmonic of powerline interference was filtered but were absent when all of harmonics are filtered. In 6 signals – vice versa.

VLPs presence is rather the advantage of designed algorithm because their detection will help to prepare person for operative actions in the terms of health control. Thus, we can form the conclusion that it is enough to filter powerline interference within only main harmonic.

We also concern the opportunity to design algorithm for complex powerline interference's filtering: if at least at one of analyzed cases will result to VLPs detection then decision about their presence is made. Future studies will be related to decrease the amount of analyzed data in this algorithm.

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УДК 621.3.04

METHOD OF EVALUATION OF THE MOST EFFICIENT DESIGN OF ELECTRIC MOTOR ROTOR

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At present, the exceptional need for modern civilization is manifested in the satisfaction of energy needs. In this regard, the question arises as to its expedient and, as a result, economical application. In large-scale production, the urgent need for energy efficiency is expressed in the ratio of the costs of enterprises for electrical energy and the net profit from products [1].

To date, it has been established that 25% of the territory of the Republic of Tatarstan is enriched with oil fields, the development of which results in almost 35 million tons of production per year. However, it should be noted that, according to modern energy research, the main cost of electricity for oil companies is approximately 50% of the selling price of the produced products. Thus, after assessing the energy saving potential, it was found that the task of increasing the energy efficiency of the electrical complex of the oil production complex is relevant and requires a rational solution.

As practice shows, the main part of the supply electricity falls on the drive of oil pumps. These pumps are usually equipped with three-phase asynchronous electric motors, but recently there has been a tendency to install synchronous electric motors with permanent magnets, which have several advantages, such as: the absence of an excitation winding on the rotor, which reduces electrical losses, increases efficiency and improves conditions engine cooling; high ratio of the maximum allowable torque to the moment of inertia of the motor - which is preferable in a high-speed electric drive; better weight and size indicators, which is characterized by a high ratio of rated power to the mass of the engine [2]. In electric drive systems, various types of PMSM are used, which differ in the design of the rotor. All diversity can be combined by two features: with the location of permanent magnets on the surface of the rotor and with an internal location.

In connection with the above advantages, the introduction of synchronous electric motors with permanent magnets in the electrical complexes of oil producing enterprises will reduce losses in the electric machine compared to asynchronous motors, i.e. improve energy efficiency[3]. However, consumers do not want to make changes to the dimensions of existing installations and manufacturers only support them in this. Therefore, a solution was found that was already used in DC machines: to use the housing and stator core of the existing IM for the PMSM.

To evaluate the most energy-efficient solution for machine states in various conditions, it is proposed to introduce a stepwise methodology, including the main stages of designing an electric machine: determining the main dimensions of an electric motor, calculating stator winding data, calculating rotor geometry, calculating losses and efficiency. For the most capacious and accurate analysis, as a rule, the manual calculation of the electric motor is replaced by the use of a simulation program. In the proposed method, the calculation of the magnetic induction in the teeth and yoke of the stator by the method of magnetic induction tubes is replaced by the compilation of a simulation model in the ELCUT program. This replacement allows you to significantly simplify, speed up and improve the calculations, making them more accurate.

Thus, the problem of evaluating the most efficient design of an electric motor with different dimensions using a capacious and accurate analysis can be solved using simulation in the ELCUT program.

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УДК 62-621.2

RESEARCH ON FLOW AND HEAT EXCHANGE IN CORRIDOR-TYPE TUBE BUNDLES WITH VORTEX GENERATORS

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At present, research on increasing the thermal efficiency and reducing the resistance of tube bundles in their transverse flow is relevant due to the widespread use of tube bundles in air coolers for process liquids, oils, natural gas, in waste heat boilers and energy economizers, in industrial boilers and shell-and-tube cross-flow heat exchangers (accounting for 80% of all heat exchangers in the world), in coolers of refrigeration, air conditioning and ventilation systems, etc.

The number of literature sources on tube bundles as well as on the use of vortex generators reducing aerodynamic drag and increasing heat transfer in a transverse flow around tube bundles is quite limited. There is an optimal arrangement of vortex generators on the pipe surface, in which the thermal-hydraulic efficiency of the pipe with generators exceeds the efficiency of a smooth pipe. According to the previous studies, an in-line arrangement of pipes in a bundle with their transverse flow causes the decrease of the resistance of the bundle by 25% (with the geometric parameters of the applied recesses d = 0.002 m, h = 0.00025 m). Heat transfer intensity for the first row was not more than 10%; and for the deep rows it was not observed [1,2].

The purpose of this work is to study the flow around tube bundles with surface vortex generators in order to assess the reduction in resistance and increase in thermal-hydraulic efficiency.

Tasks:

1. Design a working section and select equipment for conducting research on the structure of the flow around single and bundles of heat exchange tubes with vortex regenerators.

2. Based on the visualization of the flow around pipes with different density of application of vortex generators, determine the angle of separation of the flow (the size of the separation zone) and the effect on it of the density of application of vortex generators.

3. Conduct an experimental study of the heat transfer resistance in the corridor heat exchange tubes with different density of application of vortex generators in the form of spherical recesses using the existing experimental stand.

To conduct the experiment, an installation was assembled, which is an open-type wind tunnel, which consists of an air preparation and supply system, a working section and a measurement system. For visualization, a Hurricane 1200 steam generator is installed on the unit. The working fluid for steam production is D-98 glycerin. The steam, together with air, is supplied through the air intake.

Prototypes were placed in the working area, representing a corridor row of cylinder bundles with spherical recesses applied to them. The area of filling the recesses of the surface of the cylinders was 50%, 75% and 100%. To assess their effect on heat transfer, the samples were uniformly heated due to the serial connection to an electric current source.

The PIV method was used to study the aerodynamic drag of tube bundles. The air flow with glycerol particles is illuminated by a laser at least twice, and a high-speed camera takes pictures of this area synchronously with it. Further, the images from the camera are compared and processed using a cross-correlation algorithm on a computer. As a result, we obtain the values of the velocity field in a given flow region.

The results of the study showed that the highest thermal and aerodynamic efficiency for in-line tube bundles with a vortex generator application area of 100% was 0.98 - 1.0. The lowest efficiency for the tube bundle with the application area of vortex generators of 50% and 75% was 0.89 on average. The results of this study can be used to intensify heat transfer in tubular heat exchangers, to improve their heat and hydraulic efficiency.

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УДК 621.355

BATTERY CHARGING PROCESS

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Abstract: The article discusses the main processes and methods for charging batteries of various types.

Each battery requires a charge during operation, both for energy recovery and as a preventive measure. Its return directly depends on the charge of the battery.

The correct charging process depends largely on the charger. The cheapest chargers are just a power supply and, accordingly, charge the battery very mediocrely [1]. More expensive ones have so-called charge algorithms that help achieve the most correct battery charge. The main characteristics that distinguish chargers are the power and charging currents. By design, chargers are divided into:

1. Starter chargers are those chargers that can instantly give a large short-term impulse of high power.

2. Transformer - an outdated model that has ceased to be produced.

3. Pulse - the current flows gradually, i.e. comes in proportion to the charge level.

The correct charging of the battery depends on the type of battery, as each battery has its own signs of "charge". Let's consider them in more detail:

Lead-acid batteries: This type of battery is unpretentious in the process of charging [2]. Their only drawback is the long charge time and the release of explosive substances during charging.

Nickel-cadmium batteries: the most important feature is that this type does not like overcharging. When recharging this type of battery, the cadmium electrode forms oxygen - this leads to a decrease in current use. For a more correct battery charge, it is necessary to catch the moment when the voltage drop begins - the more accurately this moment is tracked, the sooner the charging process will be stopped, and thus the battery will be charged better and overcharging will not be allowed [3]. If it is necessary to obtain full power from the battery, then it should be charged with high currents, and if it is necessary to obtain maximum capacity, then with small currents.

Lithium-ion batteries: just like nickel-cadmium batteries, they cannot be recharged. When overcharging, an active release of metallic lithium occurs at the cathode, and oxygen begins to be released at the anode - this leads to an increase in temperature and pressure inside the case, which can lead to depressurization of the battery. This type of battery should be charged with a voltage of 4 - 4.2 V. If the voltage goes beyond these limits, then the potential properties of the battery are reduced.

In addition, there are various types of battery charging: automatic, manual, regeneration, buffer mode [4]. Automatic mode is a mode where the charger automatically detects voltage and current and changes them to avoid various problems (undercharging, electrolyte boiling, overcharging). Manual mode - in this charging mode, the user must independently check the voltage and current values. Regeneration is a charge mode in which the battery capacity is restored by removing deposits from the plates. For this, special charges are used - machines with a desulfation mode [5]. Buffer mode - chargers with this function are able to detect battery leakage currents and maintain capacity for a long time. This mode is great for storing the battery for long periods of time during the winter or when the battery is used infrequently.

The method of charging the battery is divided into 2 main types: charging at constant current or at constant voltage. Each of the methods has its own advantages and disadvantages. Charging with constant voltage - using this method, you can fully charge the battery, which is an advantage, but there may be a problem with overheating of the electrolyte and, as a result, its boiling away. Charging the battery with direct current - using this method, it is possible to avoid the problem of overheating of the electrolyte, but it will not work to fully charge the battery. In addition, this method significantly reduces the capacity of the battery, and emits a significant amount of gases. Also, in addition to the main charging methods, there is a combined charging method. The combined method involves 2 stages: Stage 1 - charging at a constant current, then, after the battery voltage has reached its nominal value, the charging mode at a constant voltage is switched on. The use of the latter method eliminates all the problems associated with the first two.

The correct approach to battery charging can greatly affect the safety of operation and extend the life cycle of the battery.

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УДК 629.78

PROSPECTS FOR THE DEVELOPMENT OF REUSABLE SPACECRAFT

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Introduction

For more than 60 years, humanity has been conquering space. This has allowed technology to advance far ahead, but today it is increasingly difficult to make space flights. The reason for this is space debris that remains in orbit after the launch of rockets. When launching rockets, it is necessary to take into account the trajectories of a huge number of satellites and rocket stages in order to avoid a catastrophe. I am going to analyze how humanity faced this problem and how this issue can be solved.

Actually, it is considered to be, that space discovering history by human divided in 4 stages.

The first stage characterizes the issue of space research as an occasion to demonstrate the strength and capabilities of states, space exploration is viewed from the standpoint of political rivalry and the conquest of primacy in everything.

The 2nd stage can be called the "hidden exploration" of space, marked by the launches of communication satellites, television, GPS, etc. This expansion allowed ordinary people to use the achievements of space science and other fields, opening up a lot of opportunities.

The 3rd stage of space exploration is underway right now. Large private companies have begun to develop this industry and have begun to create their own infrastructure. Projects are being developed to expand the launch capabilities of missiles. In the future, they plan to assemble ships directly in orbit.

The 4th stage will come when the near-Earth space will be filled with man-made space infrastructure. Then cosmonautics as a whole will become cheaper, which will attract even more companies to this area and give a powerful boost to the economies of all countries.

Well, now reasons are known, so let’s discuss what investments are needed for solving the problem of loaded low-Earth space. The issue of promising developments in the field of astronautics is a key indicator of the scientific and technological progress of any country.

Historically, funds for financing space research have been allocated mainly by state structures of countries with their own space program. In our country, the space industry receives significant contributions for development, and often the amount of funds allocated depends on the country's GDP. This pattern can be seen by comparing the graphs in Fig. 1 and 2.

So what can help solve this problem? one of the most understandable solutions is the use of reusable spacecraft. However, I will not talk about the achievements of the American private company Space X. I am going to discuss Russian and Soviet projects.

And the first project is orbit spacecraft “Spiral”. It was inventing since 1969 to 1974 and the main purpose was getting first knowledge about principles of the reusable system. As a result, technologies which scientist discovered during inventing this spacecraft were used in next stages of inventing new reusable spacecraft BURAN.

Actually, so many people hold the opinion that Buran is the top of Soviet and Russian cosmonautic. Why is it so? The main goal of this project was countering the activities of a potential enemy to expand the use of outer space for military purposes, solving tasks in the interests of defense, national economy and science, conducting military-applied research and experiments using weapons on known and new physical principles, as well as launching into orbit, servicing and returning to earth spacecraft, astronauts and cargo. The first and last flight of Buran was unmanned. Engineers and programmers invent unique system. The spacecraft had a computer which fully controlled all options. Also it could receive weather data from control center. Actually, this system landed the spacecraft better than it was expected. However, the economical and political situation in the Soviet Union wasn’t able to keep funding this project and it was closed.

Multipurpose spacecraft "Clipper" was the first project of reusable spacecraft in Russian Federation. This ship had to replace legendary spacecraft “Soyuz”, but project didn’t get foundation enough.

And last project in Russia is reusable spacecraft Federatsiya or Oryol. This spacecraft should replace soyuz and put astronauts in moon orbit. Unfortunately, because of world crisis the project still is not completed.

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УДК 66

THE ROLE OF COMPOSITE MATERIALS IN SHIPBUILDING

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At present, composite materials (CM) are being actively introduced in various spheres of production: aircraft building, mechanical engineering. Shipbuilding is no exception, where the volume of composite materials application increases every year, the intensive development process of new composites and manufacturing technologies is under way.

A composite material is an artificially created heterogeneous solid material consisting of two or more components with a clear interface between them. In most composites (with the exception of layered ones) the components can be divided into a matrix and reinforcing elements included in it [1].

There are a huge number of known composite materials nowadays, and their main advantage is that the material and structure are created simultaneously. Also its advantages include high specific strength, high rigidity, high wear resistance and high fatigue strength. It is worth noting that different classes of composites may have one or more advantages. Some qualities of composite materials cannot be achieved simultaneously. Modern composite structures of marine construction are usually half the weight of steel ones, resulting in reduction of fuel consumption by about 50% or increase in deadweight (displacement) of the vessel. According to experts, the cost of a 25-year life cycle of a vessel made of polymer composite materials (PCM) is €47.8 million lower than a vessel made of aluminum, and €149 million lower than a vessel made of steel. A comparison of the mechanical characteristics of individual CMs and metals is shown in Table 1.

Table 1. Comparison of mechanical characteristics of composite materials and metals

Properties	Metals			Fiber PCM		
	Al alloy	Ti alloy	Steel	Glass-plastics	Carbon-plastics	Organo-plastics
Specific gravity ρ, g/cm^3	2,8	4,5	7,8	1,6–2,2	1,3–1,9	1,2–1,35
Tensile strength σ′, MPa	450	1100	800-1200	340-1700	780-1700	780-1500
The modulus of elasticity E$^+$, GPa	70	115	200	50–60	120–220	60–80
Relative elongation ε, %	11–15	12	10	0,5–2,8	0,4–1	2–7

Polymer composites are the largest class of composites. The matrix of polymer composites are thermoplastics, which retain their properties when repeatedly heated and cooled, and thermosetting resins, which take on a certain structure when heated irreversibly. If we consider technologies of hull shell and hull structures manufacturing, closed molding technologies, which include infusion and RTM methods, have been used recently. For the first time, such technologies were applied at Sredne-Nevsky Shipbuilding Plant, OJSC, where the ship Pr. 12700 from CM is being built.

Polymer composites (PCM) can be conventionally divided into several groups [2]:

- fiberglass composites, containing up to 80% silicate glass fibers. They are characterized by optical and radio permeability, low thermal conductivity, high strength, good electrical insulating properties, and low cost.

- carbon plastics with artificial or natural carbon fibers based on cellulose, petroleum or coal derivatives. Carbon fiber-reinforced plastics (CFRP) are lighter and stronger than glass-reinforced plastics, they are not transparent, do not change their linear dimensions with temperature changes, and conduct current well. They can withstand high temperatures even in aggressive environments.

- boroplastics with boron fibers, threads and cords. Very hard and wear-resistant, not sensitive to aggressive substances. They do not withstand operation at high temperatures.

Metal composites are based on many non-ferrous metals, such as copper, aluminum, nickel. Fibers that are resistant to high temperatures and do not dissolve in the base are used for the filling. Metal fibres or single crystals of oxides, nitrides, ceramics, carbides and borides are used most frequently. This results in composites that are much more fire-resistant, durable, and wear-resistant than the original pure metal [2].

Ceramic composites are manufactured by pressure sintering an initial ceramic mass with the addition of fibers or particles. Metal fibers are most often used as fillers - cermets are obtained. They are resistant to thermal shock and high thermal conductivity. Cermets are used in the manufacture of wear-resistant and heat-resistant parts, such as gas turbines and electric furnaces. They are also in demand for the production of cutting tools, parts of braking systems, fuel rods for nuclear reactors [2].

The history of the use of CM in foreign submarine construction also extends back more than 50 years. Glass-fiber reinforced plastic was first used in submarine construction in the USA in 1954 as part of a program to increase the service life of submarines. As an experiment, the submarine USS Halfbeak (SS-352) (Balao type) had a fiberglass retractable device enclosure (OVU) installed. The material then spread to submarine construction in France, Great Britain, Germany, Sweden, Spain and Japan.

The main areas of application of composite materials in shipbuilding [3]:

- Surface ships (hulls and superstructures of corvettes and mine countermeasures ships with a displacement of up to 2000 tons, and superstructures of larger ships);
- Submarines (outer hulls, acoustic and vibration protection structures, stabilizers and rudder elements);
- Manned and unmanned underwater structures (outer hulls, buoyancy units);
- Propellers and vibration-isolating couplings, various vessels including compressed air tanks and hydraulic accumulators;
- Hovercraft, screen and speedboat components.
- Various tanks for transport and storage of petroleum products and liquefied natural gas;
- Fairings and protective covers for instrument (e.g. artillery turrets).

In the early 1960s, the object for which CM was first used in the USA was submarine acoustic antenna fairings and retractable device fairings. The main reason for the introducing this solution was the acoustic transparency of fiberglass. Since then, all foreign submarines, including nuclear-powered multi-purpose and strategic submarines, have used only CM for their acoustic antenna fairings. For example, Figure 1 shows a side view of the nose fairing of the Virginia nuclear submarine. It is a fiberglass nose fairing without stiffeners, 6m long, 8m support diameter and weighing about 25t. It should be noted that Seeman Composites Inc. is producing several large structural components in CM for Virginia submarines. The largest one is the LWWAA onboard antenna complex, which consists of three parts: two side fairings and a central part, a fairing and a foundation plate [7].

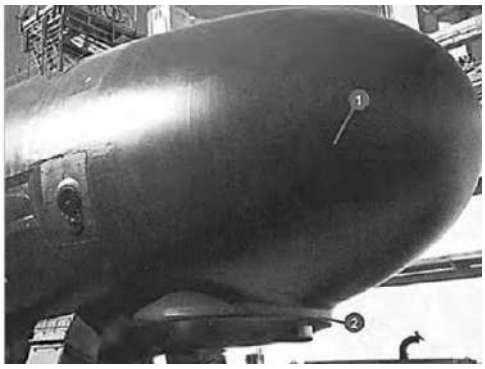

Fig. 1. The nose cone of the nuclear submarine Virginia

The first composite propeller (CP) was developed by HDW for the Type 206A submarine of the German Navy. Within a few years two composite propellers were successfully tested, demonstrating good acoustic performance. Following these tests, an improved, larger composite propeller was developed and successfully tested on a non-nuclear submarine type 212A of the German Navy [7].

New polymer and metal-polymer composite materials make it possible to create bulk-free or sparsely supported set hull structures of sandwich composites with high-strength layers of fiberglass or steel and an intermediate layer of low-density polymer composites. The use of such materials enables construction of modern high-speed vessels [1].

The superstructure units are three-layer honeycomb structures, the height of which can reach 20 m or more, and the weight of 300 kg or more. In Russia, the first ship superstructures started to

be installed on research vessels, for example, on the vessel Izumrud (displacement 300 tons, length 42.9 m, width 8.25 m) [5].

One of the promising directions of increasing the performance of ships and vessels is the use of carbon fiber reinforced plastics and hybrid PCMs based on carbon reinforcement systems in their structures. It is connected with the fact that carbon plastics have a number of advantages compared to other PCMs, which primarily include: significantly higher specific strength and stiffness characteristics; increased resistance to repeated-static and vibration loads [40]. As an example, it is possible to mention corvettes of the "Visby" type of the Swedish Navy of 640 t displacement and length 73 m which hull and superstructure have a three-layer structure with load-bearing layers made of carbon fiber on the basis of multiaxial carbon fabric with a reinforcement structure (0°/+45°/90° /–45) from fiber T800H of Japanese company "Toray Group" and a middle layer from foam Divinycell (company DIAB, Sweden) [6].

Despite the fact that composite materials have many positive aspects, CMs also have many major disadvantages that hinder their spread in usage. Significant disadvantages include high production cost, anisotropy of properties inconstancy of properties of composite materials from sample to sample), low impact toughness (causes high damageability of products made of composite materials), high specific volume, hygroscopicity, emission of toxic fumes at operation. Composite materials have low operational manufacturability, low maintainability and high operating costs.

The design solutions used abroad in submarine shipbuilding have a unified approach - they either have a sectional breakdown or represent a single product. Overall, it can be confidently stated that CMs are the materials of the future in submarine shipbuilding. According to Frost & Sullivan, the market for shipbuilding composites is expected to grow to 200,000 tons as early as 2018 (up from 135,000 tons in 2011), with an annual market growth of 5.6%. A Transparency Market Research report shows that global demand for shipbuilding composites is estimated at $954.6 million.

Thus, the issue of creating higher quality composite components and finding new technological solutions in their creation remains today one of the topical issues both in the field of shipbuilding and in other areas of mechanical engineering.

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УДК 621

MATERIALS AND TECHNOLOGIES FOR THE MANUFACTURE OF MODERN SPORTS VESSELS

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Scientific and technological advances have played an important role in the development and promotion of sporting life in society. Thanks to the introduction of new modern technologies, materials, it has been possible to improve the safety of the life of athletes, to improve many results and to increase public interest in physical education and sports. Today it is impossible to deny the fact that the final result of an athlete at competitions depends not only on his physical capabilities, but also on the equipment of modern high-tech tools and equipment. Nowadays composite materials are widely used in sports. Due to the lightness and durability of composite materials, their use has revolutionized results in many sports, such as pole vaulting, tennis, road and track cycling, the vast majority of winter sports and many others. Composites in sporting goods enable athletes to achieve their goals, improve their performance, "raise the bar" for human performance and records, and use equipment many times longer.

To confirm the above words, one should consider a sport that is quite popular today - rowing and canoeing. It originated as a sport back in the 1860s by a Scottish lawyer, John MacGregor. He designed and built a boat called Rob-Roy, which was 4.57 m long and 0.76 m wide. The clinker cladding on this model was of oak and the deck was made of cedar. MacGregor chronicled his travels in the book "1000 miles on the Rob-Roy canoe", which caused a great public outcry. Already in 1866 he founded the world's first rowing club, the Royal English Rowing and Canoeing Club [1].

By definition, a kayak is a boat in which the competitor sits facing forward and paddles on both sides with a two-bladed oar. The competitor sits on a special seat (slide), with his feet on a footrest inside the boat (footboard). A canoe is a boat in which the competitor stands on one knee facing forward and rows with a single-bladed oar on one side. The knee of the supporting leg of the athlete rests on a special support (cushion) [2].

Unlike the first kayaks, modern kayaks differ in both materials and manufacturing techniques. For example, kayaks made of composite materials are currently very popular. It is a constructional (metallic or non-metallic) material with some reinforcing elements in the form of threads, fibers or flakes of a more durable material. [3]. The main advantages of composite materials are:

– low weight;
– high rigidity (modulus of elasticity 140 - 240 GPa);
– high wear resistance;
– high specific strength (3500 MPa);
– high fatigue strength;
– CM can be used to produce dimensionally stable structures.

The following composite materials are now widely used in the construction of kayaks and canoes: fiberglass, carbon fiber, basalt or aramid.

Fiberglass has long been used in the construction of boats, launches, yachts and more. Fiberglass fabrics are used to give rigidity and volume to the finished product. Fiberglass fabric is glass stretched into very fine hair-like fibers. The individual fibers are combined into threads and then threads are woven into fabric. Fiberglass E-glass (E-glass), which is relatively cheap and quite strong, is used for making oars and boats. A fiberglass product is able to return to its original shape after an impact without destroying the element [4].

Carbon is a composite material and belongs to the carbon fiber class. Carbon fabrics are based on thin carbon filaments. It is easy to break the thread, but it is very difficult to tear it. Carbon fiber

reinforced plastic parts are lighter and stronger than fiberglass. In the manufacture of oars and boats, carbon fiber allows for maximum strength and stiffness with minimum weight. The disadvantages are worth mentioning, and unfortunately they exist. Carbon has a very low relative elongation (i.e. it does not stretch) and is sensitive to very hard impacts [4].

Basalt is a natural material, an igneous rock which is widespread all over the world. Basalt products and materials have high initial strength, resistance to aggressive environments, durability, electrical insulating properties, and are natural eco-friendly materials. The use of basalt fiber is associated with its unique properties, such as the specific strength of basalt fiber is 2.5 times higher than the strength of alloy steels and 1.5 times than strength of glass fiber [4].

Aramid is a para-aramid synthetic fiber. These fibers are made up of long molecular chains. The chains are rigidly connected by strong internal bonds and these bonds define the properties of the aramid [4].

If we consider the manufacturing technology of the case, then either the method of manual molding or vacuum molding is commonly used.

In manual molding, the reinforcing material is manually impregnated with epoxy resin by means of a roller. The impregnated reinforcing material is then placed in a mold (matrix) where it is rolled with rollers. Rolling is carried out in order to remove air inclusions from the laminate and to distribute the resin evenly over the entire volume. The laminate is cured for 24 hours, after which the product is removed from the mold and machined [4].

Vacuum infusion is a composite boat hull manufacturing technique in which resin is injected into a laminate using vacuum pressure force to remove excess resin, thereby increasing strength and reducing weight. The raw components of the composite material are placed dry in a tooling, at the next stage vacuum conditions are created, after which the resin is sucked through special tubes into the laminate. The laminate is cured for 24 hours, after which the product is removed from the mold and machined [4].

However, in spite of all the advantages of CM products over traditional products, composites have a significant disadvantage of being expensive. Currently, the cost of manufacturing inventory from PCM is much higher than that of other materials. This is due to the necessity of application of expensive technological tooling and equipment, and also because of high cost of the components of the composite material.

By far the key factors for the growth of the global sporting goods market are:

- an increase in the number of patents from leading manufacturers for sports goods made using composites;
- development of the manufacturing industry;
- reports of new product launches, agreements and increased of company activity.

However, despite the rapidly developing global CM industry, the Russian share in it is extremely small. For example, in 2018, the Russian share was about 1% of world production. Weak marketing, lack of interesting design solutions and many other factors put Russian products at a disadvantage compared to foreign competitors. But in terms of technology and innovative ideas, Russia is not lagging behind, and is even ahead of foreign manufacturers in some respects. The main task is to learn how to commercialize Russian developments and bring a quality product to the end consumer. At present due to the action of the State Program of the Russian Federation “Industry development and increase of its competitiveness”, and in particular, subprogram 14 “Development of production of composite materials (composites) and products from them” there is an increase in quantity of developments in the field of polymer composite materials [5].

Such an unfavorable situation in the Russian composite industry is due to many reasons, among which the key ones are:

– shortage of Russian raw materials for the production of composites;
– lack of domestic specialized equipment;
– limitation of financial resources, significant economic risks;
– a complex and lengthy process of certification of domestic developments (3 years and more);

– lack of regulatory documentation on the application of composite materials in a number of sectors of the economy;

- absence of a solution to the problem of recycling composite materials;

– limited repair capability;

– admission of imported materials to the Russian market in the strategic industries with the availability of domestic analogues;

- lack of qualified specialists.

Thus, modern materials and technologies are being actively introduced into our lives, particularly in sports. They help improve performance of athletes, "break" records, and also reduce the likelihood of injury.

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УДК 621.317+611.127

ANALYSIS OF HEART SIGNALS ON PRESENCE OF HIGH-FREQUENCY COMPONENTS USING THE POWER SPECTRUM

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The problem of mortality due to cardiovascular diseases is relevant in Russian Federation. Ventricular late potentials (VLPs) could be classified as their predictors.

VLPs are low-amplitude, high-frequency signals that are located in late part of QRS complex. VLPs area in electrocardiosignal (ECS) is shown at Fig. 1.

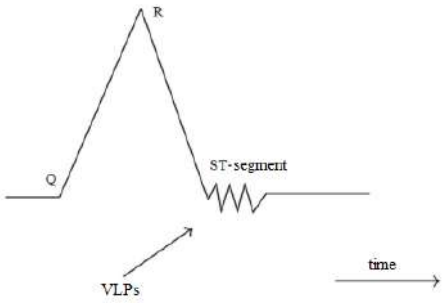

Fig. 1. Location of VLPs.

The generally accepted approach of VLPs registration is Simson method, which is based on time averaging. [1]

An alternative approach to determine presence or absence of VLPs on ECS is spectral analysis. Advantage of that approach is informativeness from point of frequency resource. Thus, use of spectral analysis in concerned problem will make it possible to track the dynamics of changes in frequency range. Spectral analysis is actively used in task of detecting VLPs [2].

There are also works in which the analysis of the ECS is performed by I standard lead [3]. The advantage of this approach is simplicity of signal registration. Therefore, in this work spectral analysis of signals is applied, which is based on obtaining a power spectrum.

We used PTB Diagnostic ECG Database (ptbdb) of the freely available electronic resource Physionet [5] for this study, as well as the resources of the MATLAB R2022a software environment.

Duration of most signals is about 2 minutes; the sampling frequency is 1 kHz. 67 signals were analyzed in this work: 5 with presence of VLPs and 62 without VLPs. In Fig. 2 you can see a fragment of researched signal.

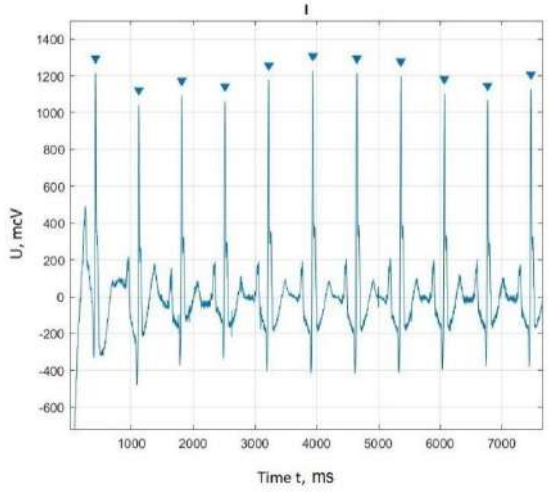

Fig. 2. Fragment of analyzed signal

Further, preliminary signal processing was performed in 2 stages. First of all, we filtered signals in range of 2-400 Hz, then we filtered powerline interference at 50 Hz using a notch filter. The next step was to obtain power spectrum. An example of this spectrum is shown in Fig. 3.

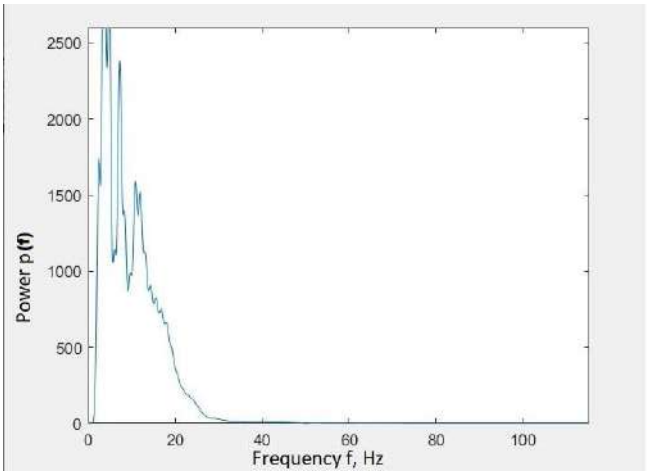

Fig. 3. A sample of power spectrum

As a criterion, we propose a coefficient K equal to ratio of high-frequency band to low-frequency band in power spectrum:

$$K = \frac{\sum_{f_{t+1}}^{f_{max}} P_i}{\sum_{i=0}^{f_t} P_i},$$

where f_{max} is upper frequency of signal spectrum, f_t is boundary frequency, P_i are components of power spectrum.

After analysis of 67 signals, following average values of parameter K were obtained:

- In presence of VLPs: K=0.085
- In absence of VLPs: K=0.209

After study, it can be concluded that average value of K coefficient in signals with VLPs is less than in their absence. In the future it is planned to continue study by increasing number of analyzed signals.

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УДК 62-3

INTELLIGENT FIRE ALARM SENSOR

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A significant change in the socio-political situation in the country, the growth of crime and, above all, its organized forms, required everyone to take a new approach to security issues. The complex of problems included in the concept of "security" covers all aspects of our daily life. Therefore, the topic of personal security, property is consistently among the highest priorities of society in all developed countries of the world.

There have been many fires lately and the current fire alarm system does not always cope with these problems. The main problem of a fire alarm system is the moment a fire is detected. The current system can detect the consequence of a fire, not the moment of its occurrence. To upgrade the fire alarm system, an intelligent sensor should be introduced that can detect a fire at the moment it occurs

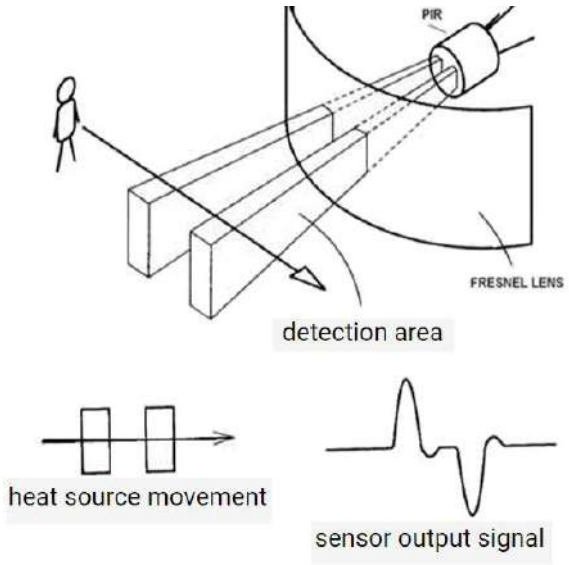

Figure 1. Working principle of infrared detection with lenses

The basis of an intelligent fire alarm sensor is infrared radiation. With this radiation, the probability of detecting a fire is much greater.

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УДК 544.6

FORMATION OF A MANGANESE-CONTAINING NANOSTRUCTURED GLASS-CARBON SURFACE

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Recently, electrocatalytic conversion of CO_2 has been considered as a promising way to utilize carbon resources and produce fuel [1]. We propose to use the complex of sodium pectate with manganese as a precursor to form a manganese-containing nanostructured glass-carbon surface exhibiting the properties of a heterogeneous carbon dioxide reduction catalyst.

Potential-controlled electrolysis of PG-NaMn aqueous solution for 60 seconds at -1.5 V leads to the formation of a manganese-containing nanostructured electrode surface, which was confirmed by electron microscopy. Figure 1 shows cyclic voltammetry in the reduction region for the modified and unmodified glass-carbon electrodes in the presence of CO_2.

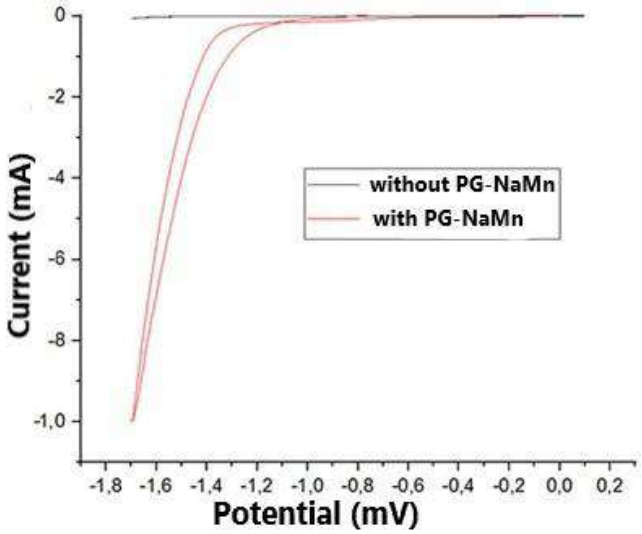

Figure 1. Cyclic voltammetry patterns on modified and unmodified glass-carbon electrodes in the presence of CO_2.

The manganese-containing nanostructured glass-carbon surface exhibits the properties of a heterogeneous carbon dioxide reduction catalyst with the achievement of a significant reduction of reaction overvoltage (580 mV) and high current density at operating potentials.

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УДК 532

LIFTING FORCE

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Since ancient times people have been watching birds and trying to figure out what magic was making them stay in the air. Times have passed and we no longer believe in magic, but even now most of us must have also wondered why an airplane can fly. The flight is due to the lifting force. The aim of this article is to study what the lifting force of an airplane wing is, how it works and what the science behind it actually is.Lifting force is a component of the total aerodynamic force perpendicular to the velocity vector of the body in the flow of liquid or gas, resulting from the asymmetry of the flow around the body. The total aerodynamic force is the integral of the pressure around the contour of the wing profile. Calculated by the formula

$$Y = Cy\frac{\rho V^2}{2}S,$$

where Y is the lifting force, S - wing area, V - flight speed, ρ is the density of air,Cy is the coefficient of lift.The lift coefficient is a dimensionless value depending on the angle of attack and the shape of the wing profile. It is used in calculating the lifting force of the wing at a known speed, air density and angle of attack. In order for the plane to take off, we need the lifting force to be equal to the weight of the aircraft.Approximately, the occurrence of lift can be explained by the fact that due to the presence of inertia and viscosity of the gas flowing around the wing at a non-zero angle of attack, the gas from the positive angle of attack must accelerate, overcoming inertia, in order to catch up with the "fleeing" surface of the wing, and on the other hand shrink under the influence of the oncoming surface. As a result , we have the following components of the lifting

force:For aircraft, lift is usually provided by the wings. A wing in aviation technology is a bearing surface having a profiled shape in the cross section in the direction of flow and designed to create aerodynamic lift. The wing of an aircraft can have a different shape in plan, and in scope — a different shape of sections in planes parallel to the plane of symmetry of the aircraft, as well as different angles of rotation of sections in these planes.The first theoretical studies and important results for the wing of infinite span were carried out at the turn of the XIX—XX centuries by Russian scientists. Zhukovsky, S. Chaplygin, German M. Kutta, English F. Lanchester.WE Theoretical work for the real wing was started by the German L. Prandtl.In conclusion, I would like to say that the lifting force a very interesting phenomenon, and I would like to study this topic in more detail in the future.

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УДК 517

ANALYSIS OF COOLING SYSTEMS OF POWER TRANSFORMERS

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Power transformers are the most common type of industrial transformers. They are widely used to increase and decrease voltage with a constant frequency. They are an integral part of the power supply network of enterprises, residential buildings.

During the operation of any transformer, the inevitable heating of the elements occurs: the windings and the magnetic circuit, which leads to a loss of energy in them and a subsequent loss of efficiency. The limiting heating of transformer elements is limited by insulation, the service life of which directly depends on the heating temperature of the equipment. The intensity of cooling depends on the power of the transformer, the higher it is, the longer the elements will remain in a heated state.

Normal long-term trouble-free operation of power transformers is ensured under the condition of constant monitoring and compliance with all parameters, one of which is the temperature regime. Compliance with the temperature regime within the limits established for each type of transformer is individual, which must be ensured by specially provided cooling systems.

The efficiency of transformers at the moment can reach 95%. But with prolonged operation of the equipment, due to the heating of individual elements, the efficiency drops rapidly. To correct this, the concept of superheat control by the cooling system was applied. There are two main types of cooling - air and oil.

There are several cooling systems for power transformers:

- natural air;
- natural oil;
- oil with blowing and natural oil circulation;
- oil with blowing and forced circulation of oil through air coolers;
- oil-water with forced oil circulation;
- oil-water with a directed oil flow

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УДК 66

INCREASING TOOL WEAR RESISTANCE BY DISCRETE DIFFUSION HARDENING

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Wear resistance is a highly complex property, which depends both on the structure and properties of tool steel and on the properties of the machined material (hardness, corrosion attack). It is also affected by the coefficient of friction and the external conditions under which wear occurs: the temperatures in the friction zone and the mechanical influences. By changing some of these conditions, in turn, the wear resistance of tool steel changes [1].

Of these external causes, the influence of loading conditions and the thermal factor must be taken into account: the magnitude of dynamic and alternating loads, the role of the corroding effect of the mating pair and the pressure.

A cutting tool made from a correctly selected tool material can have a high or low tool life. This is due to the fact that the high cutting properties of the tool are ensured not only by the material, but also by the optimal geometry, correctly performed tool processing technology (heat treatment, grinding, sharpening, etc.) and tool operating conditions. After a properly performed heat treatment, the cutting edge of the tool acquires the required hardness and wear resistance characteristic of the tool material.

There are a number of methods that can be used to increase tool life of the cutting part (all other things being equal) by carrying out additional operations.

These methods include [1]:

- saturation of the tool surface layer (cyanidation, chromium plating, sulfiding);
- increase in resistance by improving the structure under heat treatment (cold treatment, steam treatment);
- improving the tool surface quality (finishing, lapping).

In this paper, we consider a fairly new way of improving the wear resistance of a cutting material - discrete diffusion hardening.

The performance of a complex-profile tool is determined by complex, stochastic processes of contact interaction between the tool material and machined material and can be improved by changing the surface properties of the tool material so that the contact areas of the tool material will most effectively resist adhesive fatigue wear. In this case, the tool must have a sufficient margin of compressive strength and hardness [2–5].

The tendency to improve cutting tools made by traditional coating methods suggests that these methods have largely been exhausted, especially due to the inability to balance the properties associated with hardness and heat resistance on the one hand, and toughness and strength on the

other, since the causes of destruction are high contact force and temperature loads. One of the causes of premature destruction of coating is the occurrence of critical stresses at the interface "coating - base material" during thermomechanical loading of tool contact areas. These stresses depend on the difference of thermos-physical and physical-mechanical properties of wear-resistant coating and tool materials, as well as their own microstresses in the tool material [6–9].

During mechanical processing at the initial stage, the accumulation of elastic distortions in the crystal lattice occurs. This leads to the destruction of the coating in a microscopic volume, i.e. a quasi-brittle fracture of the material with the formation of micro-cracks. The micro-cracks further develop into a macro-crack which leads to a material failure characteristic of cyclic loading.

One of the reasons for creating discrete coatings is the possibility of using the effect of braking or even stopping a local crack formed during operation. The mesh structure prevents crack propagation, as it reduces the stress concentration at the "coating - tool material" interface by compensating for the difference in thermal expansion coefficients and reducing the elastic modulus of the coating and tool material [10-11].

Thus, a cutting tool with a discrete diffusion mesh coating is characterized by an increased ductility margin while maintaining strength and hardness, which reduces the tendency to lose shape stability and elastic deflections when thermomechanical loads are applied.

Discrete diffusion hardening was carried out on equipment consisting of a UIV-1 ionized air device with a unipolar positive corona, a working frame, fasteners, electromechanical units, electrical wiring, air piping, as well as a pressure regulator and flexible lines. Additionally, a computer, a driver unit, a monitor and system software were connected to the equipment. The UIV-1 device is an ionizer nozzle that combines the functions of airflow direction and its activation with positive ions. The tool is fixed into a stepper motor chuck with a stepper motor control unit.

The tool is then set to the preset rotational speed and linear feed rate according to the computer program. The machined tool can rotate as well as reciprocate. The technological process of blanching or chemical oxidation was carried out at the company in accordance with standard technology. The determination of the mechanical properties of coating is carried out by kinetic indentation on a PMT-3M microhardness tester according to State Standard 9450-76. The research was carried out on a Ray Feng RC-32G bar lathe. The objects of research were re-sharpened blued taps made of high speed steel R6M5K5 with subsequent application of bluing and re-sharpened taps made of high speed steel R6M5K5 with following discrete diffusion oxidizing. A nut made of steel 38KhGS was used as a workpiece. The criterion for blunting was the wear along the posterior surface of the tool tooth.

Discrete oxidation produces a non-stoichiometric structure which subsequently converts to stoichiometric structure, creating a thin oxide film on the surface [4–5]. During the positive corona treatment of the surface, electrons cause the destruction of long chains resulting in an increase of free bonds in the metal structure. Loose bonds form carbonyl groups with high surface energy which are created by electrical discharge. A thin layer with a variable stress state is formed on the surface due to its discreteness. The oxygen penetrates into the crystal lattice of the metal to form solid solutions, increasing the hardness and strength of the tool material, but without changing the structure of the substrate. As a result of discrete oxidation of high-speed steel, a thin oxide film of a polycrystalline structure with a grain size of 4 microns is formed on the surface.

Metallographic studies have shown that the hardened layer after discrete oxidation has a polycrystalline structure with a grain size of 4 microns. The micro X-ray diffraction analysis has established a significant decrease in the Fe content in the surface layer, which is due to the oxidation process and the formation of oxides FeO and Fe2O3 [4].

Thus, discrete diffusion hardening has a number of advantages. This method allows to increase the wear resistance of materials.

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УДК 66

SUBLIMATION COATING METHOD

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An important direction in modern technology, including mechanical engineering, is the use of coatings for various functional purposes, among which the most promising are coatings based on polymer powder compositions (PPC). In this regard, research on the development of compositions, improvement of equipment and technology for applying corrosion-resistant, protective-decorative and other types of coatings is of particular importance.

One of promising directions in coating technology is the development of methods for obtaining coatings for various functional purposes based on polymer powder compositions under non-stationary conditions, when traditional technologies using stationary drying units are unsuitable. For practical implementation of powder coating technology in unsteady conditions on the surface of materials of various nature and products based on them (metals, ceramics, silicate materials, etc.) by electrostatic-thermogasdynamic method based on a combination of electrostatic and flame methods [1].

The complex of specialized equipment for powder coating consists of an air conditioning unit with a pneumatic control panel, a compressed air preparation and supply unit, a gas supply system with control and regulation equipment, and two thermogas generators (TGG) [2].

The first TGG creates a preheating of the painted surface to the required temperature, while the second one provides the supply of a charged powder-air mixture (PVA) to the coated surface for final coating formation for a short time (within a few seconds), during which complex physical and

chemical processes of PVA transformation take place: fusion, spreading, particle fusion and film formation. The combustible gas (propane) is supplied through ducts into the combustion chambers of both TGGs from a gas cylinder, the pressure of which is regulated by a pressure reducer. At a certain pressure, air is blown into the TGG through a side opening using a fan, and at the same time a vortex flow of varying intensity is generated in the combustion chamber across the cross section. The supply air pressure is adjusted by increasing the rotation speed of the fan motor and is set to ensure a stable gas-air flow in the TGG. The inner layers of the vortex air inflow capture the flow of combustible gas and, mixing with it, create a rotating stream of combustible gas-air mixture. By adjusting the air flow, the TGG jacket, the process compartment and powder-air nozzle are cooled. The temperature is controlled by thermocouples built into the process compartment. The hot flow temperature varies between 350 and 700 °C due to the regulation of the combustion gas and air supply. The hot-flow temperature is stabilized in the process compartment of the TGG. A spark ignition device is used to ignite the combustible mixture, which produces high voltage pulses using a spark plug. When ignited, the gas-air mixture burns in the form of a cylindrical spiral, and when the airflow increases, the flow of the burning mixture curves and breaks away from the inner wall of the combustion chamber. The air flow is controlled by changing the rotation speed of the fan motors. Stabilization of the gas flow temperature and complete combustion of the combustible mixture is carried out in the technological chamber compartment, from where the combustion products are fed through the nozzle to the surface to be coated for preheating.

An additional powder-air mixture is additionally fed to the nozzle outlet of the second thermo-gas generator through a spiral channel, and the PPC particles are heated and electrically charged at 30-70 kV. The cathode is a set of needles installed in the nozzle section of the PVA supply, and the anode is a grounded substrate on which the coating is applied. A high voltage generation system is provided to generate the electrostatic field, comprising a power supply, a generator and a voltage multiplier. The electrical equipment is powered by an external 24 V supply, which is fed through a special power supply unit. The simultaneous action of a high voltage electric field and a hot gas stream produces a PVA burner, and the charged PDA particles are deposited uniformly on the surface of the grounded painted surface with the subsequent formation of a coating film.

In contrast to stationary equipment, where the coating formation process on the surface of products, depending on the type of the PPC, occurs in the temperature range 70-200 ° C for 10-15 minutes, the developed complex makes it possible to obtain coatings on the surface of various materials and products under non-stationary conditions by placing them into drying chambers. The main parameters determining the efficiency of PPC deposition and the quality of coatings are: powder composition deposition coefficient on the painted surface, the flux density of the powder composition, PPC flow rate, electrode voltage and the distance between the TGG nozzle and the substrate.

The intervals for varying the operating parameters of the coating were selected in the following ranges: PPC flow rate from 4 to 20 kg/h, electrode voltage from 30 to 70 kV, flux density from 3 to 8 kg/h·m2, the distance between the TGG nozzle and the substrate from 0.025 to 0.150 m.

The main advantages of the developed method of applying powder coatings in comparison with electrostatic and gas-flame methods are: high mobility of the unit, the possibility to obtain coatings with guaranteed quality on large-sized products from materials of different nature under unsteady conditions; reduction of PPC consumption by 20-30%; short technological cycle and high productivity of the coating spraying process. The unit is designed for the application of information markings on runways, highways, streets, parking lots, on the floors of industrial plants, etc., as well as for coating large-sized metal and non-metal structures in non-stationary conditions.

One of the most promising trends in polymer powder coating technology is so-called sublimation decoration, which is widely used to obtain protective and decorative coatings in the manufacture of products made of metal materials [2].

The technological process of sublimation decoration consists in the fact that a pattern imitating the texture of precious woods, stones, etc. is transferred from a special film to the surface of a

product with a polymer powder coating applied in a vacuum and at elevated temperatures (above 100°C). [2].

Currently, the main suppliers of films and equipment for this technology are foreign companies. However, it is not always possible to obtain high quality coatings using such equipment, especially on products of complex geometry with varying wall thicknesses, and, consequently, different thermal conductivity in individual zones.

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УДК 66

THERMALLY CONDUCTIVE CARBON FOAMS: COMPOSITION, PRODUCTION TECHNOLOGY, PROPERTIES AND STRUCTURE

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Scientists around the world have recently placed great emphasis on new materials that combine many properties. Such materials certainly include carbon foams. These are foams consisting mainly of two phases: gaseous and solid (or liquid), which are produced either with or without a blowing agent.

Analysis of existing domestic and foreign literature has shown that, depending on the initial components and technology, it is possible to obtain both thermally conductive and thermally insulating carbon foams. In the first case, pitches (petroleum, coal) are most often used, and in the second – phenol-formaldehyde resins. When comparing the structures, it can be seen that heat-insulating foams are characterized by high porosity (80-90%), while thermally conductive foams have a higher solid phase than gas phase.

Thermal conductivity is the ability of material bodies to conduct energy (heat) from the more heated parts of the body to the less heated parts of the body by the chaotic motion of the body particles. Thermal conductivity of CF depends on three main factors: thermal conductivity of carbon bonds and gas inside the cell, thermal convection of gas inside the cell, thermal radiation of carbon bonds and gas inside the cell [1].

At room temperature the thermal conductivity of foams is determined by bonding (solid) conductivity (λs) and gas conductivity (λs). Fig. 1 shows schematically the thermal conductivity mechanism of the foam.

The heat transfer capacity of the carbon bonds is reduced when the oscillation of the molecule is restricted to the cells between the carbon bonds due to the mean path (red arrow) of heat transfer through the carbon bonds.

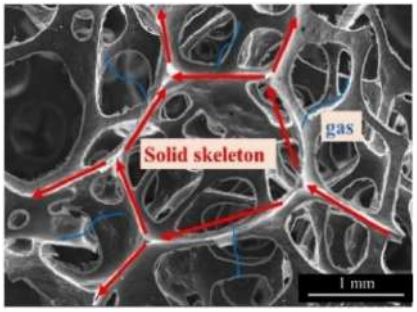

Fig. 1. Mechanism of heat transfer in carbon foam

However, in the cross section of the sample the thermal conductivity is suppressed due to the high porosity and the presence of a certain proportion of amorphous carbon, which can be calculated according to the formula [2]:

$$\lambda_g(T) = \frac{\Pi\lambda_{g,0}(T)}{1 + 2\beta\frac{lg}{D_{pore}}}$$

where $\lambda g_{,0}$ (T) is the thermal conductivity of the free gas; Π is the porosity of the carbon foam; β is a constant involving the interaction between gas molecules and cell walls; lg is the average free path of gas molecules and D_{pore} is the average cell size. According to Equation 1, the thermal conductivity of the gas increases with increasing cell size. Consequently, λg in the pore depends on both porosity and cell size.

As mentioned above, carbon thermally conductive foams are obtained mainly from pitches. Pitches are residues from the processing of coal or oil raw materials and are semi-solid amorphous substances with a softening point above room temperature, at which they pass into a viscous state. They are characterized by a high (more than 60 wt. %) yield of carbonaceous residue during thermal treatment in an inert atmosphere (coking) [3].

In order to improve the physical and mechanical properties it is customary to add various particles and additives to the pitch. For example, work [4] describes a method for producing carbon foam from Arcelor-Mittal coal furnace by mixing it with thermally expanded graphite. To do this, the pitch was heat-treated at 437 °C and then crushed. The resulting powder was mixed with a concentration of 1 to 10 wt.% graphite, foamed at 460°C, and carbonized at 1000°C in a helium atmosphere. The last operation was graphitization, where the temperature reached 2600 °C. As a result of the operation performed the foam obtained with 5 wt.% expanded graphite was the most attractive. The foam had, after graphitization, a strength of 0.46 MPa, a bulk density of 0.249 g/cm3, and a thermal conductivity of 21 W/mK. The structure of the resulting foam is shown in Fig. 2.

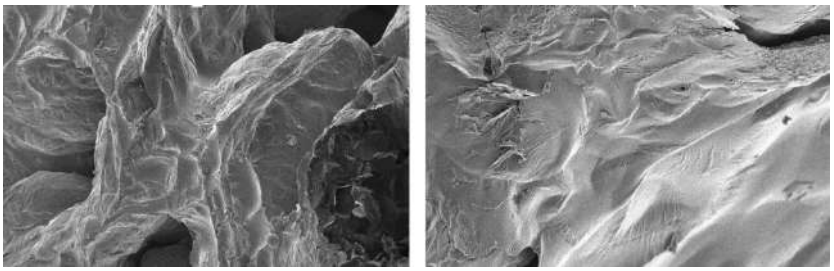

Fig. 2 Structure of carbon foam obtained from 5 wt.% graphite and pitch

In a study [5] it was possible to obtain a thermally conductive carbon foam from phenolic resin by the addition of carbon microspheres. The microspheres were added to the resin in several stages to avoid agglomeration. The composition was then molded at a pressure of 2 MPa for 24 hours and heat-treated at 230 °C, followed by cooling. The resulting samples were then carbonized in 3 stages: first pre-carbonization at 400 °C, second pre-carbonization at 600 °C and carbonization at 900 °C. As a result of the work done, the thermal conductivity was increased to 12 W/mK, and the electrical conductivity to 1.2 S/cm. The structure of the resulting foam consists of 3 phases: a hollow microsphere, a carbon matrix and internal voids.

In scientific work [6] scientists obtained heat conductive carbon foam from coal furnace by mixing it with NH4HCO3, carbonization at 1000 °C and graphitization at 2200 °C. The structure of the resulting foam is shown in Fig. 4. It should be noted that the resulting foam had a good strength value of 7.5 MPa and thermal conductivity of 27.5 W/mK. A great advantage of this foam is its thermal stability up to 700 °C.

In another work [7] a method for obtaining inexpensive carbon foam, with thermal conductivity up to 60 W/mK, is presented. The initial component was coal tar pitch, which was thermally treated at 460 °C to obtain mesophase pitch. The polyurethane, which acts as a template, was then

impregnated with the crushed mesophase pitch. The resulting composition was then dried and subjected to heat treatment at 300 °C. The carbonization was carried out in stages: first heating to 1000°C and holding for 1 h, and then increasing the temperature to 1400 °C and holding for 1 h. After carbonization, the resulting foams were graphitized at 2400°C. The density of the obtained foam reached 0.58 g/cm3, with a strength of 5.0 MPa, porosity 68% and thermal conductivity 59.78 W/mK.

The high thermal conductivity, low weight, relatively large surface area with open cell structure and low coefficient of thermal expansion of graphite foams determine their potential applications in thermal management systems. Foam-graphite has thus become a very important material and is now considered as a new class of thermal management material and is manufactured with a wide range of thermomechanical properties that can replace bulky heat exchangers and radiators.

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УДК 66

APPLICATION OF CARBON FOAMS IN THE MODERN WORLD

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Carbon foams (CF) are non-toxic, highly porous (over 60-70%), lightweight monolithic materials. The value of such a high porosity is achieved by using fillers which have their own porosity, or blowing agents (compounds which are volatile at high temperatures).

Due to their unique properties, carbon foams find their application in various fields of production. For example, in [1] a method of producing CF used as a palladium catalyst is presented – a device for purifying oil from harmful impurities.

Recently, CF has also been actively used as an anode material for lithium-ion and sodium-ion batteries. For example, in the article [2] carbon foam obtained from polystyrene was alloyed with nitrogen. This made it possible to create an anode for lithium-ion batteries with a capacity of up to 600 mAh/g.

On the basis of CF, it is possible to create electrodes for supercapacitors. So in work [3] CF was alloyed with nitrogen to improve wettability of surface. Electrochemical measurements show that specific capacity of such sample as electrode material in 6M KOH aqueous solution reaches 198 F/g

at current density 1.0 A/g. At the same time, the specific capacity of such foams can remain at 159 F/g even at a high current density of 20.0 A/g.

US Patent No 5260855A "Carbon Foam Super Capacitors" created a condenser made of carbon foams obtained from the pyrolysis of resorcinol formaldehyde and related polymers, which had high electrical conductivity and surface area (400-1000 m^2/g).

Due to non-toxicity, bioinertness, absence of corrosion in contact with living tissues, CFs are also used in medicine.

Carbon foams have great prospects for application in tissue engineering [9–13]. In [9] it was shown that the use of PFS-based CF accelerates the processes of reparative regeneration of bone tissue. It is important to note that complete regeneration of the bone defect was achieved without the use of additional growth factor [4]. Significant adhesion of PFS-based CF to in-vitro mesenchymal stem cells and complete integration of the implant into the bone tissue were shown, which indicates the bioactivity of PFS-based CF. However, it should be noted that the ultimate compressive strength of PFS-based CF does not exceed 0.1 MPa, which is significantly lower than the values required to withstand a normal load. For example, the compressive strength of cancellous bone ranges from 5 to 60 MPa. Although the strength characteristics will improve in the course of bone mineralisation, the PFS-based CF implant will be susceptible to mechanical stress in the early stages of healing when the graft area is under stress. Mechanical properties can be improved by applying metallic coatings [11], impregnation with a polymer [10].

The application of a titanium coating allows an insignificant increase in the bending strength and an increase in the modulus of elasticity of the samples by about 1.5 and 2.5 times, respectively, compared with uncoated CF samples [11]. Similar results were obtained when copper coating was applied on CF based on phenol-formaldehyde resin, when the compressive strength increased from 0.055 MPa to 0.170 MPa [12]. A significant increase in the modulus of elasticity and compressive strength was achieved by deposition of tantalum from the gas phase onto the surface of CF based on phenol-formaldehyde resin. In this case, the elastic modulus and compressive strength were 1.5 GPa and 60 MPa, respectively [13].

The most promising way to increase physical and mechanical characteristics is impregnation of CF based on phenol-formaldehyde resin with a mixture of a copolymer of lactic and glycolic acids with calcium hydroxyapatite [10]. It has been shown that the content of hydroxyapatite in the composition in an amount of 15% increases the modulus of elasticity in compression up to 73 MPa, which is 30 times higher than the value of the modulus of elasticity of the original CF based on PFR [5].

In [5] the authors created a UE capable of capturing oil and solvent spills. To obtain UP, first polymerization of lignin, resorcinol and glyoxal was carried out, then polyurethane was added, and then the resulting composition was carbonized at 1000 °C. The foam structure is shown in Fig. 1.

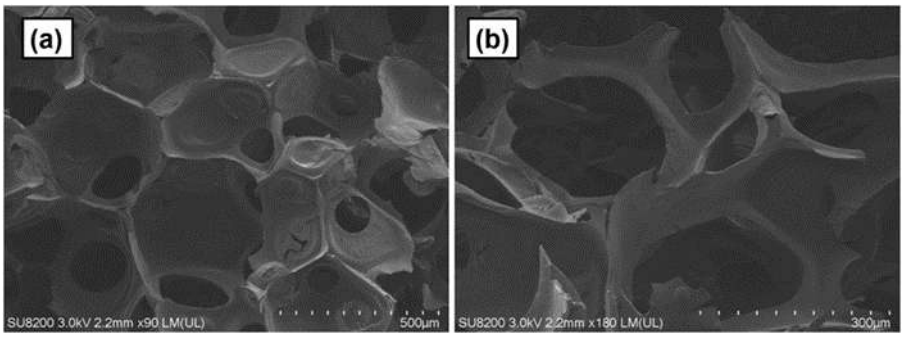

Figure 1. SEM image of carbon foam

Research is currently underway to introduce UP as implants used in traumatology, orthopedics, ophthalmology, maxillofacial surgery, and dentistry [14]. There have been studies on the possibility of using CF in an intervertebral disc implant, as a matrix for bone tissue growth [15]. The implant is a shell of a carbon fiber reinforced polymer (polyvinyl ketone) porous carbon foam core. After

implantation, osteogenesis begins, which includes the process of tissue growing into the pores of the material, the formation of a bloodstream inside the implant matrix, which ultimately leads to the formation of new bone tissue [15]. In [9] the possibility of using CF implants for the delivery of drugs, osteogenic factors, as well as bisphosphonates to inhibit bone resorption processes is noted. The work [16] shows the possibility of using CF for the atrophy of the alveolar process of the lower jaw, for limited defects of the jaw after removal of cysts and neoplasms, as well as for restoring the anatomical structure of the bone tissue.

US Patent No 9119728B2 "Reinforced Carbon Fiber/Carbon Foam Intervertebral Spinal Splicer" - this patent describes a method for manufacturing an intervertebral implant, with a core made of CF.

For several years now, new radiators and heat exchangers made from CF have been developed. For example, in 2002, a heat exchanger was developed for a heat pump driven by a natural gas engine. This resulted in a higher heat transfer coefficient and reduced weight compared to conventional radiators. In 2006, a warm gas film radiator with YSH50 faceplates and a terminated core of high thermal conductivity polystyrene foam (PocoFoam) with a serpentine configuration of Inconel tubes was produced [6].

With the rapid development of wireless communication and electronic devices, there is an urgent need for effective electromagnetic noise shielding and thermally conductive materials to prevent electromagnetic radiation and overheating of electronic devices. For example, in the article [7], a CF based on PFR with the addition of mesocarbon microgranules was obtained. As a result, the electromagnetic interference (SE) protection efficiency increased from -27.5 dB to -62.4 dB at 8.2 GHz, thermal conductivity increased to 2.4 W/m K, and compressive strength was 8.2 MPa.

Due to their thermal insulation properties, carbon foams have found their way into the construction of the Parker Solar Probe. It is a multilayer structure consisting of a layer of highly porous cellular material based on glassy carbon with a thickness of about 11 cm, located between layers of carbon-carbon material 0.076 cm thick [8].

Carbon foams have also found use in sound insulation. For example, in patent FR No 2545608, carbon foams are used to create a soundproof panel for an aircraft engine.

Thus, numerous scientific and technological developments have been made in recent decades in the field of new raw materials, fillers of various kinds or their combinations and also in the field of foaming compositions. As a result, a whole range of new materials belonging to the class of foams, including syntactic ones, which are used in various branches of science and technology, has been obtained.

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УДК 6228

MOBILE AUTONOMOUS HEATING POINT

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Nowadays there is a huge number of thermal and energy installations of various types and designations, but any device can fail at the most inopportune moment. That is why it is so important to develop mobile autonomous installations for unforeseen emergencies, such as watercuts, heating shortages or blackouts at hospitals, fire stations or a factory. Also, there is often a need for temporary facilities for specialized teams eliminating the consequences of emergencies or teams rescuing people, as well as temporary accommodation centers for refugees. For such cases, special installations, that can be quickly and easily installed anywhere, are required.

The fundamental human need for heat and minimum comfort, especially in emergency, has determined the main purpose of the work - the design and calculation of a mobile autonomous heating point.

The main tasks of the work are:

- a literature review of the current state of autonomous heating networks [1-3];
- the calculation of a heat supply system of a mobile autonomous heating point;
- the selection of the power plant of a mobile autonomous thermal point;
- the arrangement of a mobile autonomous heating point.

A methodological and theoretical basis of the research werethe works of teachers of Russian universities in the field of thermal engineering systems and installations. In particular, "Calculation of standards of technological losses in the transmission of thermal energy" by Popov I. A. [1], as well as the Internet resources and a review of patents for thermal installations.

To calculate the heating point, six special emergency tents were chosen. The specific volume of the polypropylene pipeline, the required length of pipes with certain internal and external diameters were determined, the temperature of the coolant at the inlet and outlet, as well as the above-ground type of laying were selected.

For choosing a heating cogeneration plant, it was necessary to calculate the required power, including the calculation of the required amount of heat for heating buildings, the calculation of heat losses for leakage in the pipeline, the calculation of the amount of heat for filling pipes and heat losses through insulation.

The calculation of the required amount of heat includes such values as: a correction factor that takes into account the area of construction of the building, the average calculated indoor air temperature of heated buildings, the calculated outdoor air temperature, the specific heating characteristic of the building, the volume of the building by external measurement, an increasing coefficient to account for heat losses by heat pipelines, the average indoor air temperature for buildings of various purposes, length sections of the heating and hot water heating network,average hourly capacity of the heat supply network, the average hourly rate of heat carrier losses, the average hourly density of the heat carrier, the specific heat capacity of the heat carrier, the proportion of the mass flow of the heat carrier lost by the supply pipeline, the heat flow rate, the calculated coefficient of local heat losses, the total hourly electricity costs for services for the transmission of heat energy and heat carriers [1].

As a result, the calculation of the heat network of an autonomous heating point for temporary accommodation of people was carried out.

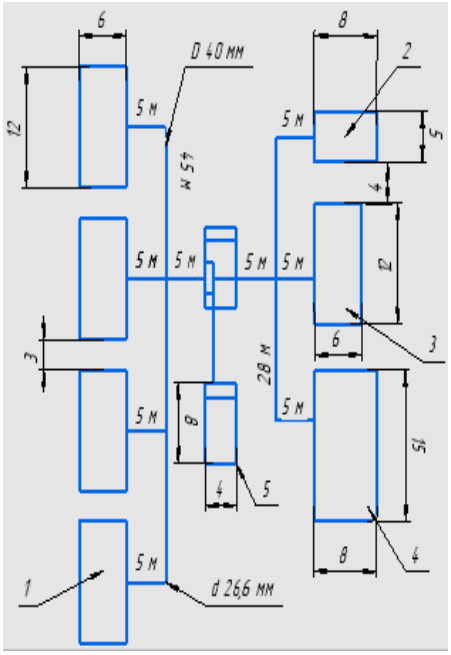
Also, the following selections were made: fuel – natural gas, type of laying – aboveground, pipeline material – polypropylene, Vitobloc cogeneration plant with an electric capacity of 50 kW and thermal energy of 81 kW, inner diameter of the pipeline, outer diameter of the pipeline, length of pipes, type of transport – KAMAZ, type of buildings – emergency tents.

Calculated: the required amount of heat, heat losses and insulation losses.

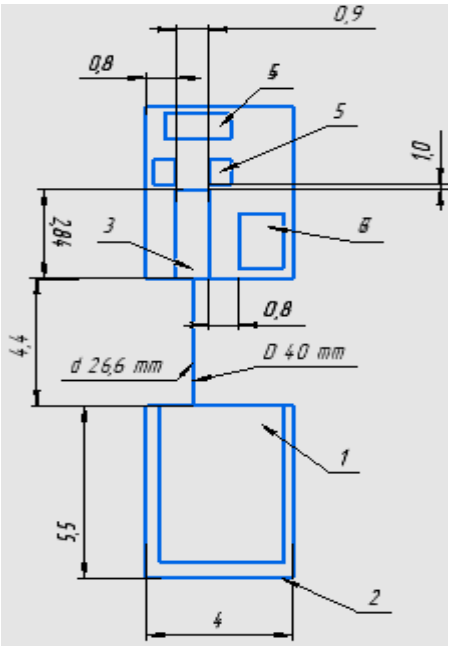
A scheme of a mobile autonomous thermal point has been developed.

Next, the layout of the mobile autonomous heating station took place.

Scheme 1



Scheme 2



Scheme 1 –layout diagram.
1- fuel tank;
2 – KAMAZ x2 body;
3 - cogeneration plant;
4 - operating current cabinet;
5 – pumps x2;
6 – coolant tank.

Scheme 2 – layout.
1 – residential tents of the Ministry of Emergency Situations x4;
2 – field bath;
3- administrative tent of the Ministry of Emergency Situations;
4 – sanitary part;
5 – KAMAZ 65201 x2.

Thus, the developed scheme of a mobile autonomous heating point allows you to get heat and electricity cheaply, quickly, easily and in any conditions.

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УДК 621.01

WAYS TO IMPROVE THE QUALITY OF ELECTRICITY AT OIL PRODUCING ENTERPRISES

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Abstract: this article discusses devices that consume electricity at oil-producing enterprises and ways to compensate for electricity to improve the quality of energy

Oil production plays an important role in the formation of the state budget, which stimulates and develops the level of the economy. The Russian Federation is one of the major owners of oil reserves, and the volume of oil produced is growing every year, as a result of which the development and improvement of oil producing enterprises is an urgent problem. Electricity costs account for half of the cost of oil production, and most of the electricity is consumed by well pump installations. Thus, reducing the unit costs of electricity per unit of production, reducing the cost of creating an electrical complex for autonomous power supply to an oil producing enterprise is an urgent problem. [1]

In addition, mechanized oil production is a process that consumes a large amount of electricity. In mechanized oil production, oil wells are equipped with electrocentrifugal pumps or rod depth pumps. These pumps are equipped with three-phase asynchronous electric motors, but recently synchronous electric motors have been increasingly installed. The pump motors are powered by transformer substations.[2]

Power transformers have different types of winding connections, but in the power supply of oil enterprises, a triangle winding connection is used for high voltage, and a star for low voltage, however, with grounded windings, harmonics of multiples of three are likely to occur, as a result of

which the quality of electrical energy deteriorates, since forward and reverse sequence currents can be formed under asymmetric mode[3].

To improve the quality of electrical energy, a power factor adjustment is used to reduce the current and power consumption without affecting the power of the load, this method allows more efficient operation of electrical machines, lines of transmission of electrical energy and its distribution, as well as the use of wires and cables with smaller conductors.about the section. As a compensating device, capacitor batteries connected by a triangle scheme are most often used. This installation allows you to increase the reliability of the transformer in the event of an increase in load, but it is worth considering the reactive power absorbed by the transformer. In transformers, reactive power is absorbed by both the reactive resistance of the shunt (magnetization) and the sequential resistance (leakage). Full compensation can be provided by a bank of capacitors with a connected shunt. [4]

Due to the increase in frequency, the capacitive resistance decreases, so the capacitors are particularly sensitive to the harmonic components of the supply voltage, which in turn will lead to distortion of the waveform of the voltage or current, while the degree of distortion is directly proportional to the harmonic content. A partial resonance may occur when a certain harmonic and the natural frequency of the reactive power of the capacitor battery coincide, which will lead to overheating of the capacitor and its distorted operation, due to the flow of increased current through the capacitor.

To solve this problem, shunt harmonic filters, active power filters, as well as hybrid filters can be used.

Shunt harmonic filters reduce the effective values of harmonics, but such filters, despite their low cost and durability, are sensitive to changes in network parameters and are passive.

Active filters are an analog electronic filter with the presence of active components that better attenuate harmonics at low frequencies.

Currently, there is a tendency to use hybrid filters, which have the advantages of passive and active filters, which, unlike passive filters, are more effective in compensating when changing the network mode, in addition, they are more compact and cheaper compared to active filters.

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УДК 681.78

RAY TRACING IN THE SCHEME OF A COMPOSITE WAVEGUIDE HOLOGRAPHIC DISPLAY

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Abstract

Waveguide type displays with volumetric phase holograms are characterized by small size, large eyepiece and high transmittance both in the projected image and in through channels. However, with an increase in the aperture, field of view and operating spectral range, the spread of conditions for reproducing a hologram over its surface increases, which imposes restrictions on spatial resolution and diffraction efficiency. To overcome it, it is proposed to use a composite hologram grating (CHG), recorded by joining several elementary fields. The use of such an element is considered on the example of a display operating in the range of 480-620 nm with a field of view of 6° x 8° and an output pupil of 8 mm.

Keywords

Diffraction efficiency, volume – phase hologram, waveguide holographic display, augmented reality.

Problem statement

For each ray passing through the hologram, we can consider an elementary grating and write down the equations for ray tracing. The elementary grating for the case of a volume-phase grating is shown in Fig.1.

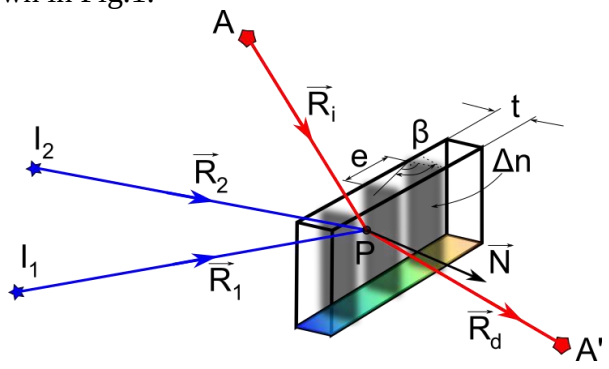

Fig.1. Scheme of recording and operation of an elementary volume-phase grating:

I_1 and I_2 – record sources, A – source, P – a point on the surface of a hologram defining an elementary grating, A' – source image, N – local normal to the surface.

In this case, we use the Welford equation [1] to determine the directional vector of the diffracted beam.

$$\vec{N}\times(\vec{R_i}-\vec{R_d})=k\frac{\lambda}{\lambda_0}\vec{N}\times(\vec{R_1}-\vec{R_2}), \qquad (1)$$

where R_1 и R_2 — guiding ray vectors in the recording scheme, R_i и R_d — the guiding vectors of the incident and diffracted rays, respectively, N – the normal vector at the point of incidence, k — diffraction order, λ — working wavelength, λ_0 — recording wavelength.

Ray tracing algorithm

Diffraction at an arbitrary lattice point is described by the Welford equation. To trace rays in the recording scheme, it is necessary to solve a system of nonlinear equations. In this case, the problem can be reduced to minimizing the scalar error function using the Nelder-Mead simplex

algorithm [2]. In Fig.2. a software implementation of the code in the C programming language for the Zemax library is presented. The dll describes a new, custom surface type and is a complete code. The main task is to account for the aberrations of the auxiliary mirror without external files. The library has high performance and speed of operation. Using the library, you can work with a variety of configurations when modeling a mosaic, which is necessary for a composite lattice by definition. Next, we will consider the application of this algorithm to the optical scheme of the display.

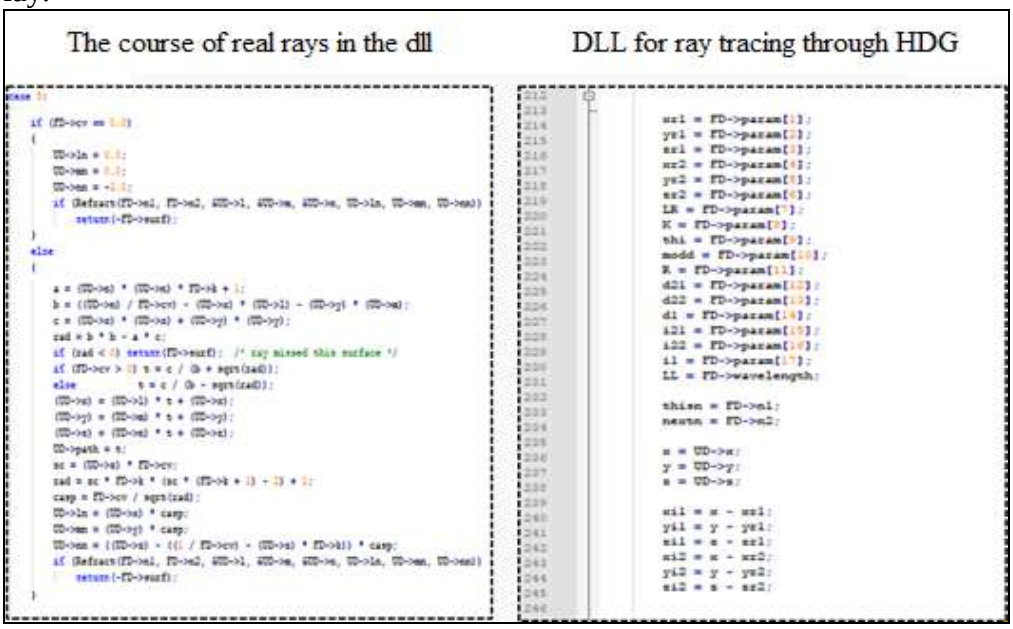

Fig.2. Software implementation of the code in the C programming language

Example of calculation of an optical system

We assume that the waveguide display (Fig.3) operates in the spectral range of 480 − 620 nm and has an angular field of view equal to 8° × 6°. The augmented reality image is projected from an 8 mm × 6 mm light-emitting matrix. The working beams are collimated by a simple glued two-lens lens with f' = 57 mm and introduced into the waveguide plate through a transmission grating. The grating has a spatial frequency of N = 1060 mm^{-1}, the substrate is made of TK21 glass (n_d = 1,6569) and has a thickness of 1 mm. The beam propagates through the waveguide due to air defense and is output through a transmission hologram. For reasons of symmetry, it has the same frequency N = 1060 mm^{-1}.

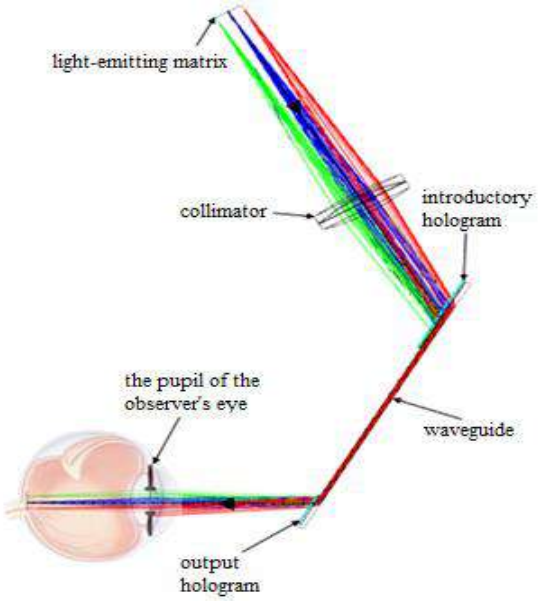

Fig.3. Optical scheme of composite waveguide holographic display

Conclusions

Using the example of a color AR display with a field of view of 6°×8° and an output pupil of 8 mm, the advantages of a composite hologram are demonstrated. The essence consists in a more uniform distribution of diffraction efficiency (DE) over the field and the working band of the spectrum. For the worst point in the corner of the field, the DE gain reaches 13,8% even for a simple composite hologram consisting of 2×2 sub-apertures. From the point of view of image quality, the use of a composite hologram makes it possible to reduce sagittal aberrations in the corner by 0,4', although the overall effect on spatial resolution is moderate.

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УДК 681.78

SPECTROGRAPH WITH COMPOSITE HOLOGRAM GRATING

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Abstract

In this paper, we consider the expansion of the functionality of the spectrograph by creating a composite hologram element. The optical element in question is a hologram recorded by combining several elementary fields with independently varying parameters. In this paper, we consider ray tracing through a composite hologram array recorded using an auxiliary deformable mirror. It is shown that when using such an element, it is possible to reduce aberrations up to 2,4 times in the spectrograph scheme for the visible range of 400 – 560 nm.

Keywords

Composite hologram element, computer modeling, spectrograph, auxiliary mirror, aberration correction.

Let's consider the recording and operation scheme of a hologram grid recorded using an auxiliary mirror (Fig.1), classified as a 2nd generation grid [1].

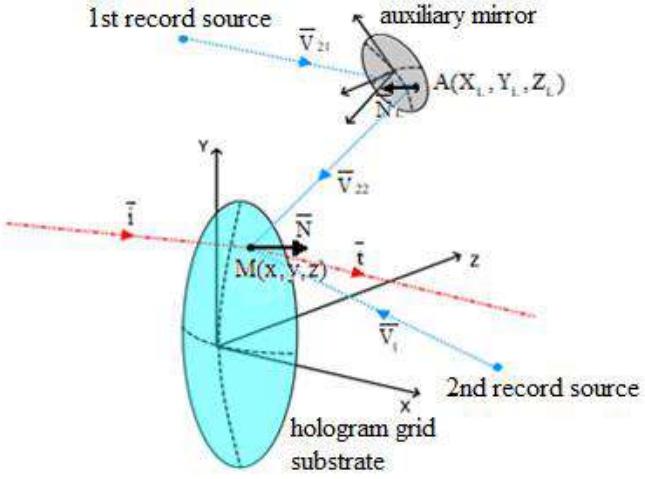

Fig.1. HDG recording scheme: $\overline{N}$ – normal vector at a point on the substrate, $\overline{N_L}$ – normal vector at a point on the auxiliary mirror, $\overline{V}_{21}, \overline{V}_1$ – direction of the beam vector from the 1st and 2nd sources, $\overline{V}_{22}$ – direction of the vector of the aberrated beam.

Diffraction at an arbitrary lattice point is described by the Welford equation (1):

$$\vec{N}\times(\vec{i}-\vec{t})=k\frac{\lambda}{\lambda_0}\vec{N}\times(\vec{V_{21}}-\vec{V_1}), \qquad (1)$$

Using the Welford equation, ray tracing is carried out in the scheme of operation [2]. To trace rays in the recording scheme, it is necessary to solve a system of nonlinear equations.

The reflection equations (2) are the relations between the vector $\vec{V}_{21}$ going from the source to the surface of the auxiliary mirror and the vector of the aberrated beam $\vec{V}_{22}$ going to the surface of the substrate in the global coordinate system. The error function (3) is defined as the length of the deviation vector between the parts of the reflection equation. And the minimization procedure is applied to this function.

$$\left.\begin{aligned} x&=\vec{V}_{22y}\cdot\vec{N}_z-\vec{V}_{22z}\cdot\vec{N}_y=(-\vec{V}_{21y})\cdot\vec{N}_z+\vec{V}_{21z}\cdot\vec{N}_y;\\ y&=\vec{V}_{22z}\cdot\vec{N}_x-\vec{V}_{22x}\cdot\vec{N}_z=(-\vec{V}_{21z})\cdot\vec{N}_x+\vec{V}_{21x}\cdot\vec{N}_z;\\ z&=\vec{V}_{22x}\cdot\vec{N}_y-\vec{V}_{22y}\cdot\vec{N}_x=(-\vec{V}_{21x})\cdot\vec{N}_y+\vec{V}_{21y}\cdot\vec{N}_x. \end{aligned}\right\}, \qquad (2)$$

$$Error(XL,YL)=\sqrt{x^2+y^2+z^2}, \qquad (3)$$

Modeling of an additional spectrograph channel

As a control example of calculation, the optical scheme of a two–channel spectrograph is considered (Fig.2), in which the first channel operates in the ultraviolet range, and the second in the visible [3]. In a two-channel spectrograph, we consider only the second channel, since it is necessary to compensate for the aberrations of the first reflective concave hologram diffraction grating (RCHDG). It is convenient to use an auxiliary mirror for this.

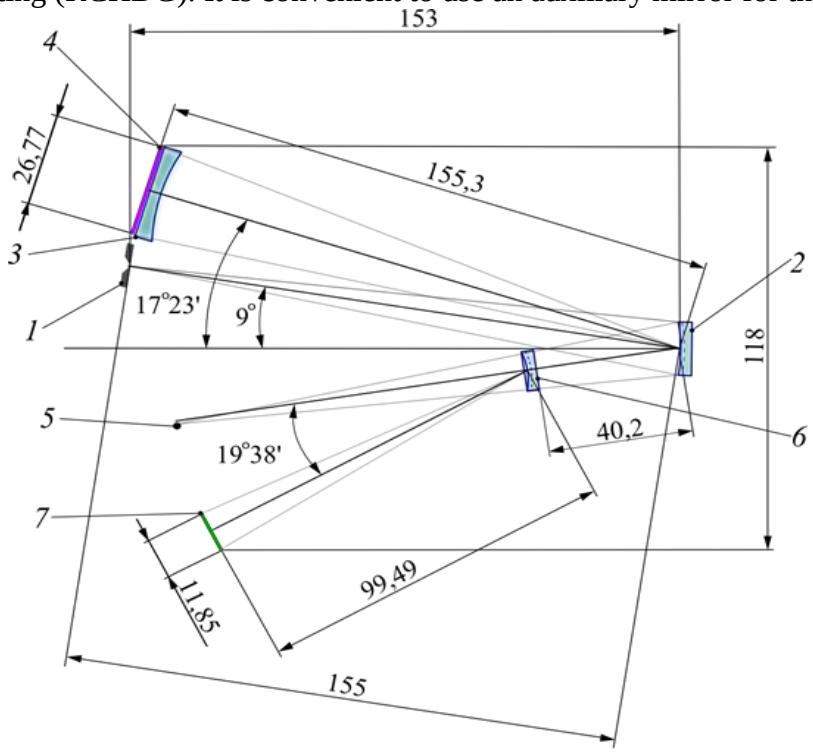

Fig.2. Schematic diagram of a two – channel spectrograph: 1 – input slit, 2 – RCHDG, 3 – cylindrical lens, 4 – UV channel photodetector, 5 – imaginary entrance slit of the visible channel, 6 – TCHDG, 7 – visible channel photodetector.

Thus, the second channel operates in the range of 400 – 560 nm and is built on the basis of a transmissive volume-phase grating is considered as a composite hologram diffraction grating (CHDG). The spectrograph [4] operates with a relative aperture of 1:7 and an inverse linear

dispersion of 13.3 nm/mm. The frequency of the grid strokes at the vertex is 700 mm^{-1}. The grid is recorded using an auxiliary mirror mounted at an angle of 59,6° at a distance of 49.9 mm from the point source of recording and 81,79 mm from the grid substrate. It is assumed that the auxiliary mirror is deformable, its light diameter is 3,26 mm, and the maximum deflection arrow is 30,3 microns.

The Zemax OS program analyzes the image quality with different generations of gratings in accordance with dot diagrams (Fig.3). Based on the figure, we see that with the use of KGDR for a wavelength of 560 nm, the RMS value of the scattering spot radius has noticeably decreased by 2,4 times.

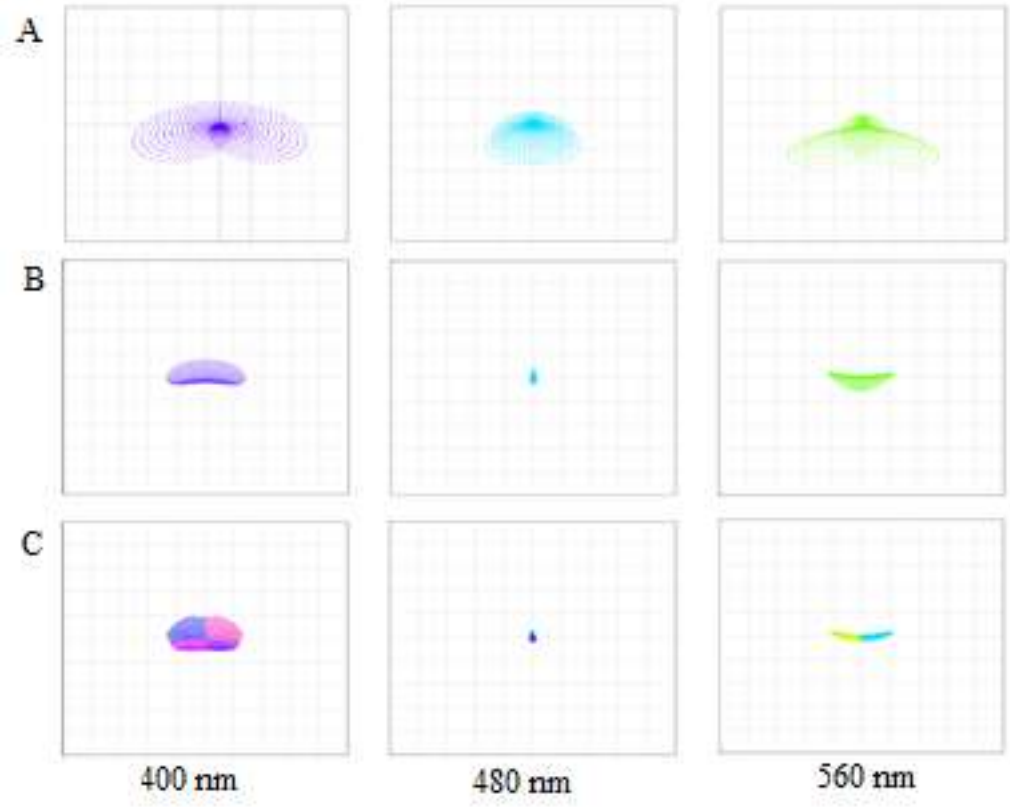

Fig.3. Schematic diagram of a two – channel spectrograph: A – spot diagrams of a spectrograph with HDG of the 1st generation; B – spot diagrams of a spectrograph with HDG of the 2nd generation; C – spot diagrams of a spectrograph with CHDG.

Conclusions

Thus, the beam was traced through a hologram array recorded using an auxiliary mirror. The use of such a surface allows optimization for several elementary fields at the same time.

In the future, it is planned to include calculation and optimization of diffraction efficiency, take into account technological limitations and prepare experimental confirmation of our calculations.

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УДК 681.5

ROBUST MODEL PREDICTIVE CONTROL FOR TRAJECTORY TRACKING OF A QUADCOPTER

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Unmanned Aerial Vehicles (UAVs), such as quadcopters, have become popular due to their numerous benefits such as high maneuverability, low economic cost, and small size. As a consequence, UAVs are employed in a variety of applications such as search and rescue, delivery, or monitoring missions. However, these autonomous systems are susceptible to uncertainties such as unpredictable air flows (wind gusts) and modeling errors. Thus, the need for a high-performance robust controller arises to accommodate these uncertainties. One possible control strategy is model predictive control (MPC), which is an optimization-based method commonly used for feedback control of dynamical systems (e.g. stabilization and tracking problems). Within the scope of this research, a robust trajectory tracking model predictive controller for a quadcopter model has to be developed.

The quadcopter is an unmanned aerial vehicle (UAV) with four propellers. It has six degrees of freedom and four controllable variables. The amount of manageable variables is equal to the sum of propellers, which influence the position and attitude of the quadrotor in space. The spacecraft cannot move without inclination. On the way to achieve this, it is necessary to change the torque on one or two fans. One of the dilemmas of the plane is unpredictable changes with wind gusts. In the direction of realizing stable flight, it is essential to organize a robust control algorithm based on model predictive control (MPC) [1].

The aim of our research is to develop robust model predictive control (MPC) for trajectory tracking of a quadcopter. To fulfill the aim the following objectives of the research must be accomplished:

1. Design and implementation of a drone model in Matlab,
2. Design and implementation of a model predictive control (MPC) controller for trajectory tracking for a quadcopter,
3. Evaluation of the efficiency and robustness of the developed controller under uncertainties in different scenarios, e.g. disturbances due to wind.

Many studies in control theory have been devoted to the problem of synthesis of optimal control, only not many researchers pay attention to the problem of the regulation law associated with Model Predictive Control (MPC). As a result, the relevance of this project is to investigate the issue of Robust MPC, and the nonlinear model of the quadcopter is the object of control.

It is also necessary to study the plethora of auxiliary and reference materials, such as articles, research publications, published books, and university research, which cover and present 2 main topics while being relevant to this research:

1. Mathematical Modelling and Systems Identification [1],
2. Control Systems Design and Simulation and Implementation [2], [3].

The movement of the quadcopter can be determined by two coordinate frames, which move relative to each other. Moreover, each frame consists of 3 orthogonal axes in which rotational and translational movement can occur. The mathematical model can be represented using Euler angles. Consequently, the movement of the quadrotor obeys the laws of kinematics and kinetics due to all the assumptions. The Newton-Euler method is represented, which deduces the equations about the dynamics of the system using Newton's 2nd law, where all the forces acting on the rigid body are designated. In order to represent the state-space model, it is necessary to use the equations of the rotational angular acceleration and equations of the translation [1].

MPC is a controller, which detects optimal control. A feature of the method is that the cost or performance function of the technique considers future states on some finite horizon. Also, control signals can be defined. MPC is also known as receding horizon control (RHC) because the principle of operation is defined as follows [2]. It initially realizes a solution only at the first step in the state horizon. But, if the goal is not achieved, then it recalculates and performs this action again. In this way, it acts in subsequent steps. Robustness when using the predictive control can provide a guaranteed minimum deviation from the given trajectory at the worst parameter values and parameter uncertainties [4]. Thus, the problem of robust MPC is considered in the form of the minimax formulation [3].

As for the results of the control object of the quadcopter, the response of the output parameters x, y, z,ϕ,θ,ψ for each control is shown, and also the actual and reference trajectories of the quadrotor are shown in 3-dimensional space. The results were obtained using the Matlab program.

Before presenting the results of the output parameters of the quadcopter for each control, it is necessary to set the required flight path of the drone.

The given trajectory can be taken as follows:

$$x(t) = 6 \times \sin(t/3),$$

$$y(t) = -6 \times \sin(t/3) \times \cos(t/3),$$

$$z(t) = 6 \times \cos(t/3),$$

where an interval of 20 seconds [5].

Also, it is necessary to reduce the control actions in the range from 0 to 12 $(rad/s)^2$.

Simulation of the quadcopter under the action of disturbances using the linearized robust MPC:

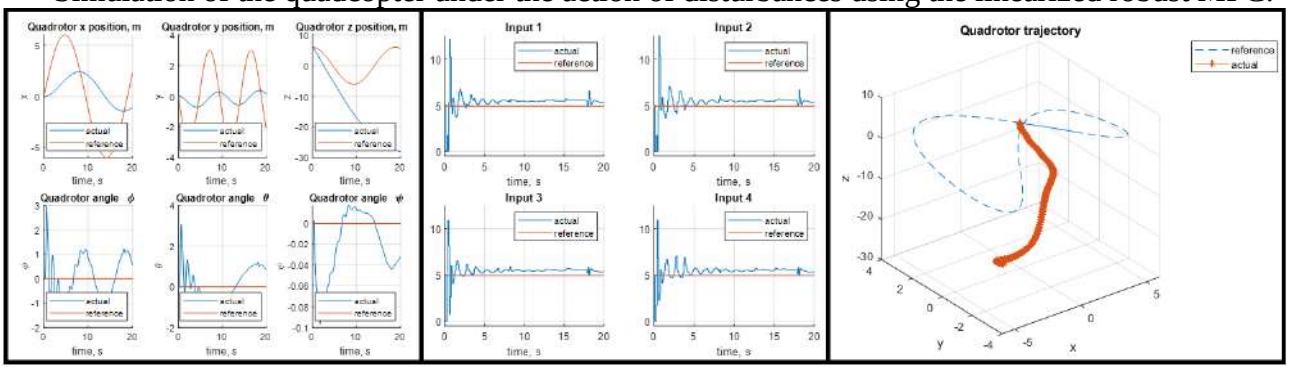

Figure 1. State and control changes and flight trajectory under the action of disturbances for 3D

The solution is not satisfactory, since the prediction horizon is too small (N = 3). The solution can be improved by increasing N, but the solution time increases very quickly. Already at N = 4, the solution time is calculated in hours, and the quality of the solution remains unsatisfactory.

Simulation of the quadcopter with the simplification of the model under the action of disturbances using the Min-Max Robust MPC:

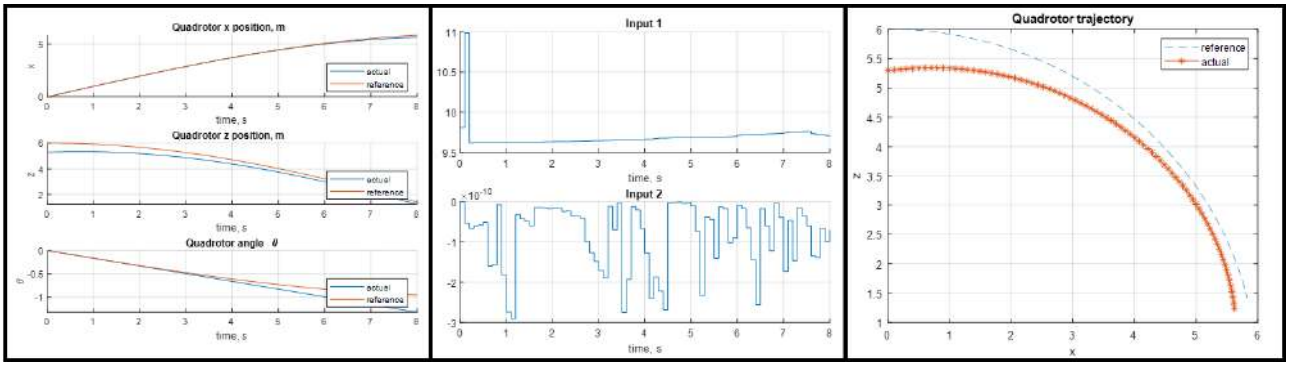

Figure 2. State and control changes and flight trajectory under the action of disturbances for 2D

Here, the quadcopter does not move along a given trajectory. The result is that in the Min-Max robust model there is some kind of offset in height, maybe there is a small error.

In conclusion it should be noted, that the developed Robust MPC controller does not yet stabilize the drone on the given trajectory. In the future, the drone will be able to follow the desired trajectory with high accuracy by trial and error.

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УДК 004.031.42

DIGITAL SCENT TECHNOLOGY

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Purpose: to find out what digital sense of smell is, how far has scientific activity aimed at the development and promotion of digital sense of smell progressed

Research methods:

1. Theoretical research methods:
- search for the necessary literature in the library and on the Internet
2. Empirical research methods
- study the articles and interviews of scientists who are engaged in the study of digital smell

Actuallity:

Until now, the technology has been aimed mainly at our sight and hearing. To further enhance the virtual reality experience and give it a new flavor, the technology is now aimed at your nose and tongue. The field of application of virtual reality is extensive - from ordinary entertainment to the Internet and e-commerce applications. You will be able to smell the product before buying it online.

Introduction:

In our modern age, computers have fully established the reason for their existence. They

have practically captured all spheres of modern life. Today, computers occupy an important place in every household, and mainly Internet access. There are various reasons why computers occupy such an important place in our lives. It provides good fast audio and image processing capabilities. The concept of virtual reality has provided more opportunities for computer systems. Available several concepts of virtual reality, such as digital smell, virtual cinema, electronic gloves for hands, multi-point surround sound system, 3d glasses. Digital smell is essentially a combination of hardware and software. The digital smell hardware will create a smell, and the software part will evaluate the smell equation and generate certain signals for a certain smell, and finally, this smell will be emitted by the device. A hardware device is a device similar to a speaker, just like a speaker,

this device is also connected to a computer system. There is also a driver program for this device that will calculate a digital equation for generating a certain gas.

Research results:

The smell has a strange power over human beings. It can affect the mood or atmosphere. It can enhance emotions such as fear or love. It can also give the feeling of virtual reality.

“The sense of smell is closely related to memory and emotions, which makes smell a powerful way to reinforce ideas. ”There are several streams in which this digital smell is used, for example, on

television, in the theater and on the Internet. From here we conclude that this digital smell will revolutionize world. And wherever we need this device, for example, for flavored mail, flavored

movies, flavored songs, we will definitely need this device. This device will become our need in the future

Main:

In the present, more and more companies are realizing that the main advantage of direct marketing is the ability to be a three-dimensional advertising medium that is attractive to all five senses. The sense of smell is the ability to detect odors. As humans, we are limited to feeling the seven basic smells and their combinations. Although this sense of perception is not as strongly developed as in various other mammals, it can have a significant impact on how we perceive various objects and messages. As Watson says from Sherlock Holmes, "there is nothing better than a good nose." The sense of smell is the only sense that cannot be turned off. A person smells constantly and with every breath, up to 20,000 times a day. There are more than 400,000 smells in the world, and it has been proven that they can significantly affect individuals and, more importantly, consumer moods and behavior. The sense of smell is closely related to memory and emotions, which makes smell a powerful means of reinforcing ideas. “If a picture is worth a thousand words, then a fragrance is worth a thousand pictures.”

The latest gas sensor technology is designed to digitize the smell, simulating the human nose and brain. Our noses are full of receptors that react to gas mixtures, and over time our brain learns to recognize a certain smell. Just as we are not born capable of distinguishing roses from lilies, electronic noses also require a period of training. The so-called "electronic noses" combine arrays of gas sensors with machine learning algorithms that can detect patterns in response to a certain smell. The capabilities of miniature sensors and machine learning software are growing and have now reached the level of commercial readiness to create a digital odor industry.

In addition to quantifying odor, many new electronic nose technologies are aimed at more sensitive and selective air quality measurements than existing gas sensors. It is thanks to these capabilities that they began to be used in smoke detectors, including in home alarms and sensors installed outside to monitor forest fires.

There is a growing interest in air quality and its impact on our health, especially prolonged exposure to low concentrations will also create demand for electronic noses. The success of this use case in the smart city and home sectors may depend on effective marketing by OEMs, which is the main obstacle to mass market adoption in the medium term.

Opportunities and challenges for electronic noses

The use of matrices in electronic noses creates opportunities for several types of gas sensors. Data from well-known sensors, such as metal oxide, electrochemical and infrared, photoacoustic and others, can be used by software to quantify gas mixtures. At the same time, modern materials can create ultra-miniature sensors with the potential for integration into smartphones and wearable devices.

Some problems with the electronic nose technology remain. For example, the use of inexpensive and low-sensitivity commoditized sensors and expensive software imposes a significant burden on the training of the required artificial intelligence. However, initially high-performance equipment for electronic noses, such as printed carbon nanotubes, is not yet amenable to large-scale production and is still looking for a "killer application" and large-volume orders.

In addition, today the infrastructure for training electronic noses and data exchange is limited. Although the images have been simplified to RGB format, there is no equivalent for the smell yet. Some, such as Aryballe, have identified this problem, but more standardization is needed before the digital scent industry can reach its full potential.

Market prospects and forecasts

Digitizing the smell would be an exciting addition to the sensory capabilities of consumer electronics. Technology has historically had a reputation for being over-hyped, but off-the-shelf devices represent a real process created by the sector. This is largely due to innovations in the fundamental technology of gas sensors, which are required in parallel with the development of machine learning software. The latest IDTechEx report "Gas Sensors 2022-2032: Technologies, Opportunities, Players and Forecasts" compares and compares more than 15 different gas sensor technologies that can be used in e-nose systems, as well as in many other applications such as air quality, automotive industry and safety.

IDTechEx has been covering the broad topic of sensor technology since 2008, offering a range including wearable, printed sensors and image sensors. In this special report on gas sensors, the performance of several technologies is evaluated in detail - their key characteristics and compatibility with various applications are compared. It includes numerous company profiles from interviews with both major manufacturers and startups specializing in various technologies.

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УДК 535-94

POSSIBILITIES FOR MEASURING REFRACTIVE INDEX OF OPTICAL MATERIALS WITH DOUBLE SENSITIVITY

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In this paper the possibility of reducing the error of measuring the refractive index of absorbing media when measuring the external reflection is considered. The measurement is performed by comparing the incident and reflected radiation, and the dependence of the intensity of the reflected radiation on the refractive index is described by the Fresnel formulas [1]. This method allows measurements locally without high requirements for the quality of the studied sample and is subdivided into measurements of transparent and absorbing materials.

It is known that the parameters of optical materials affect the quality of the image formed by the optical system. And if there is an actual deviation of any parameter from its calculated value, which was used when designing optical parts or whole system, the image quality will change. In the present work one of the key parameters of optical materials is considered - refractive index [2, 3].

The refractive index n of an optical material is described by the well-known law of Snellius and is equal to the ratio of the sine of the angle of the incident beam a to the sine of the angle of refraction of the beam b, or the ratio of the phase speed of light in air υ_c and the speed of light in matter υ_c (Fig. 1).

$$n = \sin a / \sin b = \upsilon_в / \upsilon_c. \qquad (1)$$

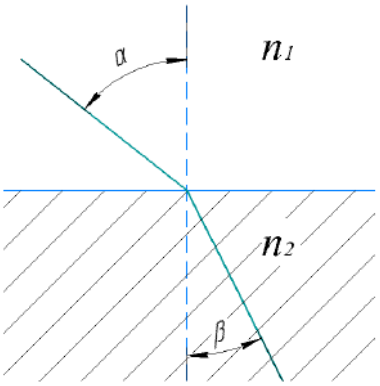


Fig. 1. Light refraction

Earlier a detailed review of known methods of measuring the refractive index was carried out [4]. To measure the refractive index of optical glass according to GOST 28869-90 it is accepted to use the following methods [2]:

– goniometric methods:

- method of least deviation;
- autocollimation method;

– refractometric methods:

- Pulfrichrefractometer method of measurement;
- V refractometer method;
- Abbe refractometer method;
- method of measurements on a compensation refractometer;
- interference comparative measurement method (Obreimov method).

The most precise method of measurement is the method of autocollimation which allows to measure in a wide spectral range of 400–12000 nm with an error of $\pm 6\times10^{-6}$, but in this case the requirements to the quality of side treatment and to the form of a studied sample are very high. Therefore, the autocollimation method is applicable to the control of refractive index of optical material intended for manufacturing elements of high optical resolution devices. The interference method (Obreimov's method) with the working optical spectral range of 400 – 700 nm and an error of $\pm 5\times10^{4}$ requires the use of a specimen under study with reduced requirements for the quality of surface treatment of its facets. In this connection, the Obreimov method is suitable only for controlling the refractive index of optical material for obtaining optical elements for photometric devices.

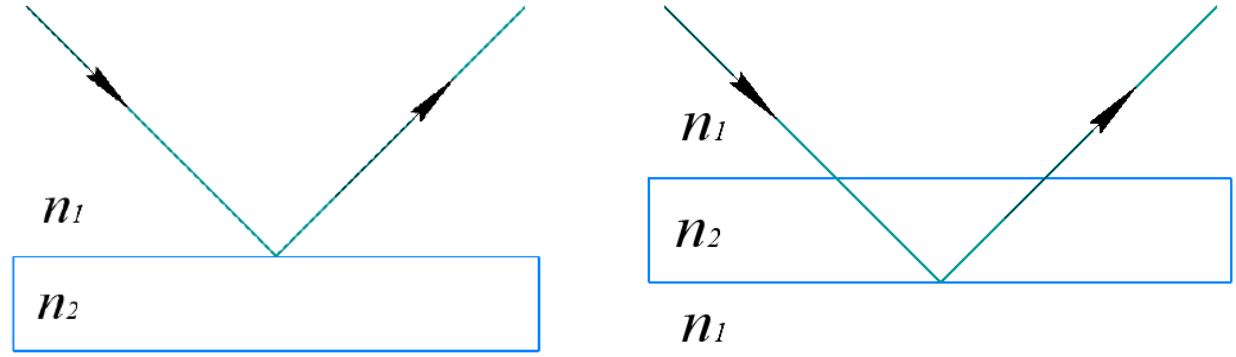
It should be noted that GOST 28869-90 regulates a group of classical methods of measuring the refractive index of optical media that require high quality material, a certain shape and size of the sample and high quality of their polished surfaces, while some methods and devices for measuring the considered optical parameter were not included in it. Further we will stop on consideration of new methods and devices of refractive index measurements, revealed as a result of patent search and analysis of literature devoted to optics, the patent search was carried out according to the international patent classifier G01N 21/41:

- method for determining the refractive index of an optically transparent material;
- a method for measuring the refractive index and a device for its realization (a modified method of measurement on an Abbe refractometer);
- a method for measuring refractive index of optical materials in solid or molten state;
- laser triangulation-interferometric method;
- interferometric method [5].

The described methods and devices differ greatly from those presented in GOST 28869-90 and allow to measure refractive index of samples not only in the form of trihedral isosceles or rectangular prism, but also in the form of powder or thin film. Ways of calculating the refractive index based on the results of measurements of thermal radiation intensity diagrams, the angle of total internal reflection taking into account the value of the reflection coefficient derivative by the angle in the local measurement area have also appeared. The solutions found in the process of patent search and analysis

of technical literature go beyond refractometric and goniometric methods and make it possible to measure the refractive index of optical media without requiring the use of multi-component optical schemes and high quality of the material of the sample under study. This increases the flexibility of the measurement process and simplifies the refractive index measurement technique many times over.

In contrast to the presented methods, the photometric method describes the process of measuring the refractive index by means of reflected radiation from the material interface [1]. In this case, the refractive index of absorbing media can be measured by internal and external reflection with an error of $\pm 10^{-4}$ and $\pm 10^{-1}$, respectively. For external reflection $n_{21}>1$ and for internal reflection $n_{12}<1$.



a b

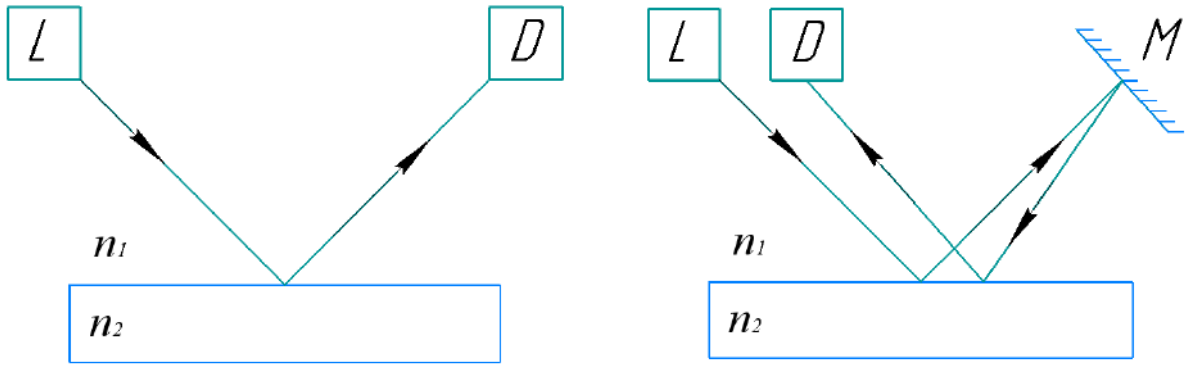
Fig. 2. Reflection from the interface: a) external; b) internal.

The optical circuit of measurement at a single reflection from the surface of the studied sample is as simple as possible and contains a source of laser radiation with a wavelength, at which the study takes place, the studied sample and a receiver of radiation. In this case, the reflection index at the interface is measured by comparing the monochromatic light fluxes - the one reflected from the sample and the one incident on it. To measure the incident flux, the sample is taken out of the course of the light flux and the photodetector is installed along the optical axis of the illuminator. The Fresnel formula is used to determine the refractive index of the material:

$$R = \left(\frac{n-1}{n+1}\right)^2 \qquad 2)$$

where: R - experimentally obtained reflection coefficient.

In order to increase the sensitivity of the measurement it is proposed to implement a double reflection from the surface of the studied sample by introducing a mirror with a known reflection coefficient into the optical system of the measuring stand.



a b

where: L - laser, M - mirror, D - radiation detector.

Fig. 3. Measurement method: a) with single reflection; b) with double reflection.

In the case of double reflection using a mirror with a known reflection coefficient from the sample under study, the formula for determining the refractive index of the medium will look as follows:

$$\frac{R}{r} = \left(\frac{n-1}{n+1}\right)^4 \qquad 3)$$

where *r* is the reflection coefficient of the mirror.

Double reflection will give a more objective result, because the refractive index may differ in the places of measurement of the studied sample.

As a result of the performed work, a variant of the optical scheme for measuring the refractive index by photometric methods in the external reflection, in which a more accurate measurement result is possible when comparing with a single reflection. This variant can be considered promising because it has a very simple optical scheme that does not require precise alignment and the quality of the surface of the studied sample.

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УДК 535.421

HIGHVOLTAGE DIAGNOSTIC DEVICE

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The report presents a new optical scheme of the device for remote fault diagnosis of high-voltage equipment operating in 3 spectral ranges. Modeling and optimization of Cassegrain type mirror lens with dichroic coatings on fluorite and germanium substrate were performed in OpticStudio Zemax program. The optical parameters of the optical system are given.

The number of operated high-voltage equipment (HVE) and power transmission lines (PTL) is growing every year, and to ensure its timely diagnosis to prevent accidents, defectoscopic devices are used. Portable device for fault diagnosis of high-voltage equipment was previously proposed in [1, 2] and improved in [3]. The purpose of this work is to create an optical circuit with simultaneous image acquisition in three spectral ranges of the spectrum to improve the efficiency of the diagnostic process.

The corona discharge radiation on the surface of insulating structures of HVE and PTL has a characteristic spectrum in the ultraviolet (UV), visible and near-infrared (NIR) ranges (Fig. 1). Fig. 1 shows that the main radiation is concentrated in the UV wavelength range of 200 - 400 nm and it becomes more intense when the HVE and PTL voltage increases [4]. Part of corona discharge spectrum is overlapped by strong UV solar radiation in spectral range with wavelengths over 325 nm (Fig. 2) [5]. Therefore, the optimal range to study the spectrum of corona discharge in daytime and nighttime is 200

– 325 and 200 – 400 nm.

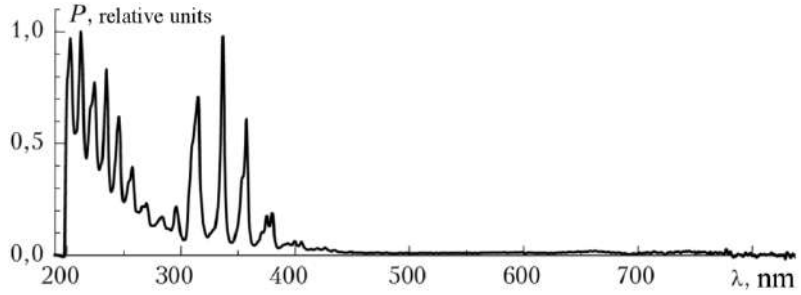

Fig. 1. Corona discharge emission spectrum

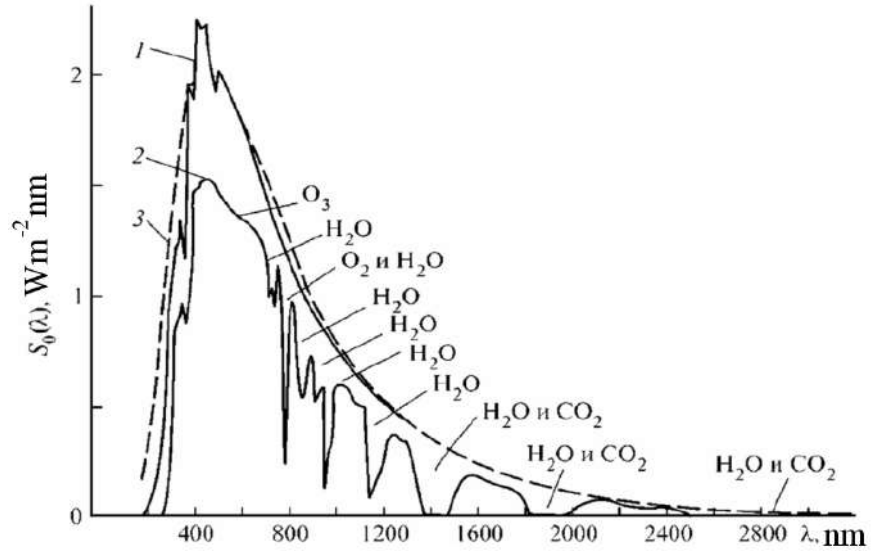

Fig. 2. Solar radiation spectrum

To study the spectrum in the measuring channel of the device (in the UV spectrum range) it is proposed to use a matrix photodetector (MPD) with a pixel size of 6.5 × 6.5 μm and number 2048 × 2048. MPD should have high spectral sensitivity in the UV wavelength range of 200 – 300 nm.

For the observation of the object of study in the observation channel (in the visible and infrared spectral ranges) it is proposed to use:

- a matrix MPD for the visible range with pixel size 1.55 × 1.55 μm and number 7.564 × 5.476 with good sensitivity in the wavelength range of 400 - 780 nm;

- a matrix infrared MPD with a pixel size of 12 × 12 μm and number of 640 × 512 with good sensitivity in the wavelength range of 8 - 12 μm.

Previously, three variants of a mirror lens with the use of a Cassegrain-type diffraction grating were proposed for the device under development [3]. In order to increase the spectral resolution obtained in the UV spectrum range, it was decided to optimize the optical parameters of the mirror lens with dichroic filters.

Table 1. Parameters of the Cassegrain-type lens variants

	f', mm	D1/D2, mm	F/#	r1, mm	r2, mm	d, mm	k1	k2	Worksurface area, mm2
	220	40/14	1:5,6	100	46,081	32	-0,078	3,215	1218
	261	60/20	1:4,4	80	28	28	-0,851	-1,000	2748
	185	80/34	1:2,4	80	34	24	-0,838	-1,519	4800

In Table 1 we use the following designations: *f'* is focal length of the objective, *D1* and *D2* are diameters of apertures of the primary and secondary mirrors, r_1 and r_2 are radiuses of curvature of vertex spheres of the primary and secondary mirrors, *d* is distance between mirrors, k_1 and k_2 are conic constants of the primary and secondary mirrors.

Table 2 shows the results of numerical simulations obtained with the CAD "OpticStudio Zemax" - the values of scattering spot size for the UV, visible and IR spectral ranges, in which 80% of the energy is concentrated.

Table 2. Simulationresults

№	Averagewavelength, μm			
	0,275	0,546	4,0	8,5
	Scattering spotsize, μm			
1	2,3	6,0	40,0	90,0
2	2,5	5,0	31,0	67,0
3	2,5	6,0	18,0	39,0

Results of simulation in CAD "OpticStudio Zemax" (Table 2) show that lens variant #3 (according to Table 1) gives the best image quality for observation and research: for visible spectrum range the scattering spot size is 6.0 μm, for middle infrared spectrum range - 18.0 μm and for far infrared spectrum range - 39.0 μm, for UV spectrum range - 2.5 μm. According to the Kotelnikov-Nyquist theorem, this is enough for the selected MPD with a pixel size of 6.5 × 6.5 μm.

To create an optical scheme with image in three spectral ranges of the spectrum to increase the efficiency of the diagnostic process it is proposed to use dichroic filters on substrates with a wide transmittance spectrum (Fig. 3).

In this case the optical system contains a mirror lens, which is common for the three spectral ranges. The lens operates in the spectral ranges of UV (200 – 400 nm), visible (400 – 780 nm) and IR (8 – 9 μm). The first dichroic filter separates UV radiation from visible and IR radiation due to a special dichroic coating on a fluorite substrate. The second dichroic filter spatially separates the visible range radiation from the IR range of the spectrum by using a special dichroic coating on a substrate of optical germanium.

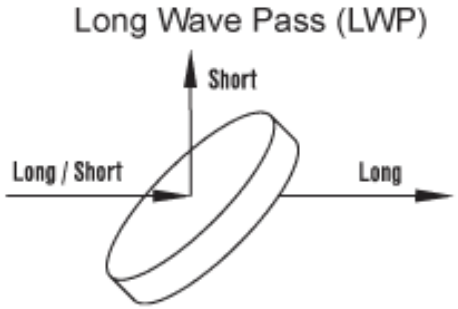

Fig.3. Principle of operation of the dichroic filter.

The first filter in this optical scheme contains a dichroic coating has good reflectance in the spectral range of 200 to 325 nm and good transmittance in the spectral range of 400 – 12000 nm. The second filter in its turn contains a dichroic coating with good reflecting characteristics in the spectral range of 400 – 780 nm and good transmitting characteristics in the spectral range of 8 – 12 μm.

In this case the spectral transmittance of the optical circuitry of the device will increase from 4.5% to 20.2% for the 275 nm wavelength and from 13.6% to 61.2% for the 290 nm wavelength.

The chosen sequence is due to the fact that the UV spectral range is more important because it contains key information about the presence of corona discharge and is more susceptible to defects in the manufacture of optical parts due to the small wavelength.

As a result of this work a variant of a Cassegrain type mirror lens was calculated in which, in comparison with the variants presented in [3], the values of scattering spot radii in the middle infrared spectral range were reduced from 26.0 to 18.0 μm and in the far infrared spectral range from 46.0 to 39.0 μm with its slight increase in the visible range from 3.4 to 6.0 μm, which will not significantly reduce the optical quality of the image of observed objects. A dichroic filter was used for extraction of radiation in the UV spectrum range, which allowed to obtain a resolution of 2.5 μm, which is comparable with the pixel size of the matrix-type MPD.

Also, by replacing the diffraction grating with dichroic filters, the sensitivity in the UV spectrum range will increase by up to 4.5 times, while the sensitivity in the visible and infrared spectrum ranges will decrease by no more than 5%.

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УДК 621.01

SCHEMATICS OF THE INTERNAL STRUCTURE OF A HYDROPOWER PLANT

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Abstract: The article deals with a hydropower plant, which is based on the piezoelectric method of operation. A detailed description of the electric circuit is given by considering its functional blocks.

Today, an important environmental topic is the development of electricity by processing the mechanical energy of water, without causing any damage to water bodies.

We are developing a hydropower plant that contains piezogenerators in its basis. They are the source of energy production, which is not harmful to river fauna. Let's consider in detail internal circuit of the device. Figure 1 shows an electrical schematic diagram of hydropower plant (HPP) [1].

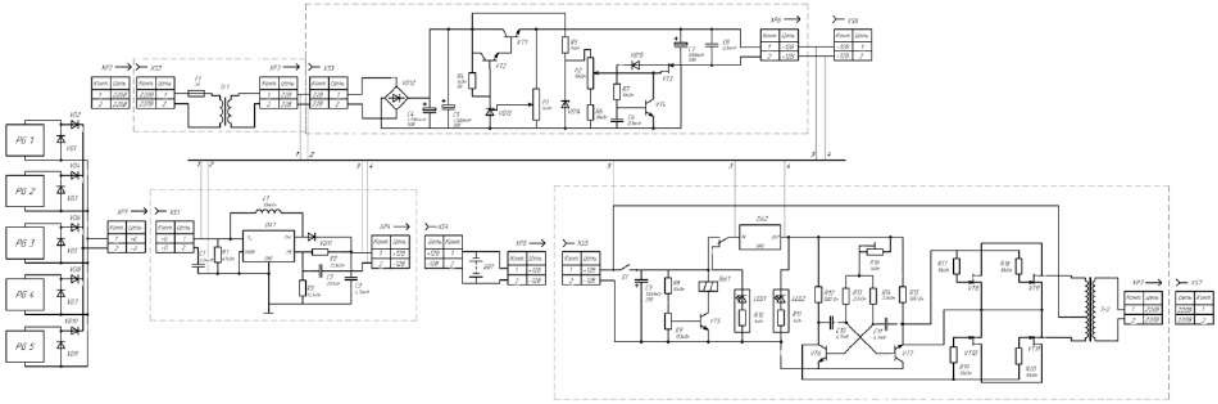

Figure 1: Electrical circuit diagram of the main power unit

For a more detailed study of the components of this circuit, consider separately its functional blocks.

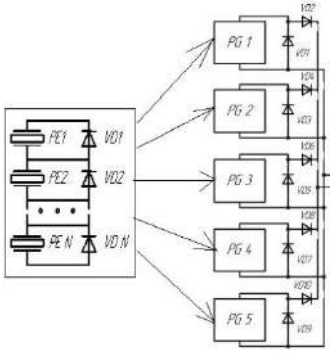

Figure 2: Piezo generator unit

The piezo sensor/piezogenerator unit can be compared to an electrical capacitor in terms of its type of device. The amount of electricity q generated by the mechanical force charges the faces of the piezo element and the conductors connected to it to a voltage U, defined as $U= q/C$, where C is the capacitance between the conductors (including the capacitance of the piezo element). The sensitivity of the sensor is defined as the increment of the output voltage corresponding to the change in force F. When n plates are connected in parallel, their capacitance is added. The sensitivity of the piezo-sensor in this case:

$$S_d = \frac{n*K_0}{C_{in}+C_0*n} \quad (1)$$

where n is the number of plates; K_0 is the piezoelectric modulus of the plate material; S_{in} is the capacitance of the measuring circuit; C_0 is the capacitance of one plate. Since in our device the piezoelectric generator is already the input link of the circuit that forms the signal, let's assume that the formula will be of the following form:

$$S_d = \frac{n*K_0}{C_0*n} \quad (2)$$

Then the capacitance of one sensor plate of thickness d and area s can be defined as the capacitance of a plane-parallel capacitor:

$$C_0 = \frac{\varepsilon*\varepsilon_0*s}{d} = \frac{1650*8{,}85*10^{-12}}{21} = 6{,}95 * 10^{-10}F. \quad (3)$$

where ε_0 is the absolute dielectric permittivity of vacuum; F/m. The capacitance of piezoelectric element C in practice is small and is expressed in picofarads ($1pF=10^{-12}F$). The output signal of the piezo-sensor , where F is the measured force [2].

To proceed to the calculations, it is necessary to choose the shape of the piezo element and the material of which it will be made. The form - washer and the material - CTS-19 piezoceramics - were chosen.

With such parameters as internal and external diameters of 64 and 74 mm, respectively, and a width of 21 mm, the area of the piezo element will be 0.02276 m^2. Then for 10 piezo beads the sensitivity of the piezo generator is: $S_d = \frac{n*K_0}{C_0*n} = \frac{10*360*10^{-12}}{6{,}95*10^{-10}*10} = 51{,}799 * 10^{-2}$. If on the piezogenerator water flow will exert a pressure of about 4.05 barr, then we get the voltage of one piezogenerator, equal to: $U=S_d*F=4.05*51.799*10^{-2}\approx 2.1V$. Altogether from 5 sensors you can get about 10V.

Then everything goes to the voltage stabilization unit (Fig.3).

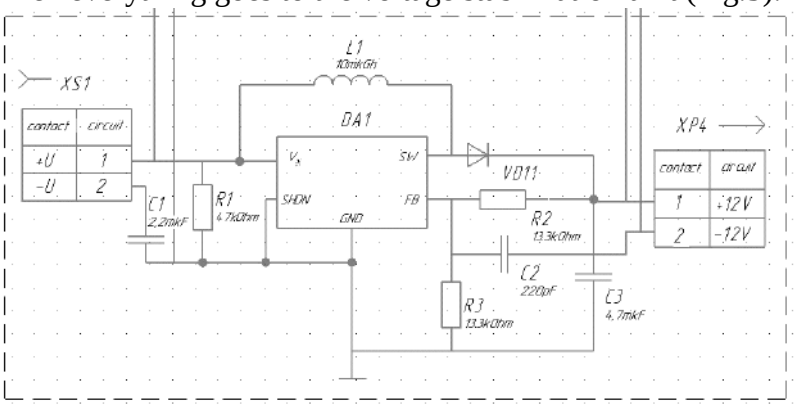

Figure 3: Voltage stabilization unit

As it has been calculated, about 3-14V will be obtained from the piezo generators. In order to stabilize this voltage choose the LM2731XMF/NOPB, 1.6MHz [SOT-23-5] pulse voltage step-up converter.

Since this unit was chosen as a ready-made device, the ratings of its elements are known and will be given in the description of the element base.

The maximum duty cycle of the pulse controller determines the maximum ratio of the output voltage to the input voltage, which the inverter can achieve in continuous operation. The duty cycle for a particular boost application is defined as:

$$Work\ cycle = \frac{V_{out}+V_{diode}-V_{IN}}{V_{out}+V_{diode}-V_{SW}} = \frac{12+0.5-5}{12+0.5-0.5} = 0.625 \quad (4)$$

Such a device circuit will consume about 56mA.

An important part of this device is the microchip power supply (Fig.4).

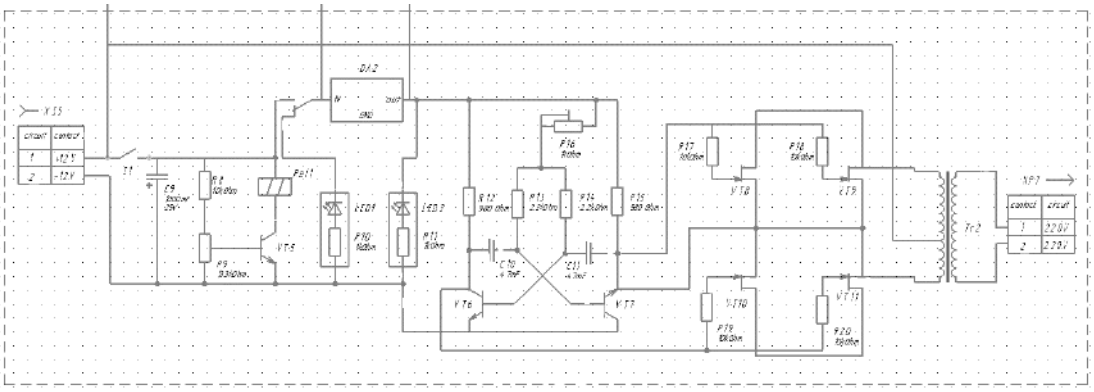

Figure 4. Power supply

In this circuit the voltage regulator is assembled on transistors VT1, VT2. As a generator of the reference voltage is used regulated stolitron VD13. It is possible to regulate the voltage in the range of 2.5...20*V* by means of a resistor P1.

Current regulator is assembled on transistors VT3, VT4 and stabilitron VD14, which acts as a source of reference voltage. The field-effect transistor VT4 is used as a current-measuring element. If the voltage drop across it exceeds a certain threshold, transistor VT3 will open and shunt VT4, forcing it to close and limit the current through the load. The limiting threshold is adjusted with the trimmer resistor P2.

In the circuit instead of diode assembly KBPC2510 you can use separate diodes withstand current of 10*A* and reverse voltage of at least 30*V*. Suitable, for example, D245, D242. In place of VT1 can work KT805 or KT819, VT2 can be replaced by KT867A. KT315 can be replaced by KT315B-D, KT3102A, KT312B, KT503B-G, P307. The domestic analogue of TL431 is KR142EN19A. The diode bridge, VT1, VT2, and VT4 should be mounted on heat sinks.

Thus, the "stuffing" of the GEC was developed, namely - the electrical circuit diagram of the device. Also the functional blocks included in this circuit were considered in detail.

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УДК 621.01

MODELING A PIEZOELECTRIC GENERATOR IN PRINTED CIRCUIT BOARD SOFTWARE

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Abstract: the article deals with the simulation processes of the piezoelectric generator of a hydroelectric power plant in the MultiSim / Ultiboard program.

In recent years, the design and simulation of electrical circuit design is accompanied by physical or mathematical modeling. If physical modeling is based on making a mock-up of the device, conducting experimental studies and thereby accompanied by costs, the second direction allows to make mathematical calculations and modeling of the process under study, thereby facilitating the approbation of the theoretical studies obtained [1]. Also it allows you to reduce the

time and cost of development, but also provide the developer with a number of tools for analysis, or inaccessible in the physical simulation, or with extremely high cost and eliminate inconsistencies. Based on the models of integrated circuits in this section of the UE was solved the problem of modeling digital assemblies and systems based on the software Ultiboard [2].

Designing the printed circuit board of the information processing channel device and inverting values obtained from the piezo generator in the application Ultiboard will be carried out according to the following algorithm:

Based on the circuit diagram of the device being designed. Before integrating the circuit into the Ultiboard instead of the virtual elements you need to pick up real electrical elements from the program base.

1) The design of the printed circuit boards will begin with the voltage regulator board, the scheme of which is shown below (Fig. 1). Then by the same technology boards of voltage converter block are made with the elements of the indication (Fig.2) and power supply (Fig.3). Since the software is not of a domestic desing, it is necessary to replace the selected element base with elements similar and appropriate to the base of this program. The results of the replacement will be presented in the tables under each circuit for clarity.

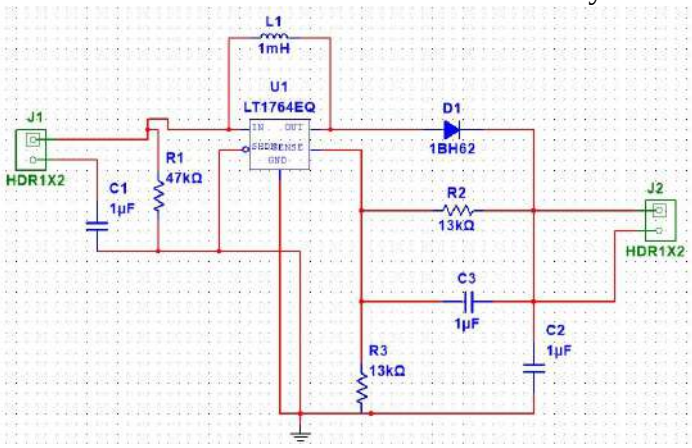


Figure 1 - Schematic diagram of the voltage regulator for simulation in Multisim.

Since Multisim is not of a domestic desing, it is necessary to replace the selected radio elements for the electrical circuit with those that are present in the program database.

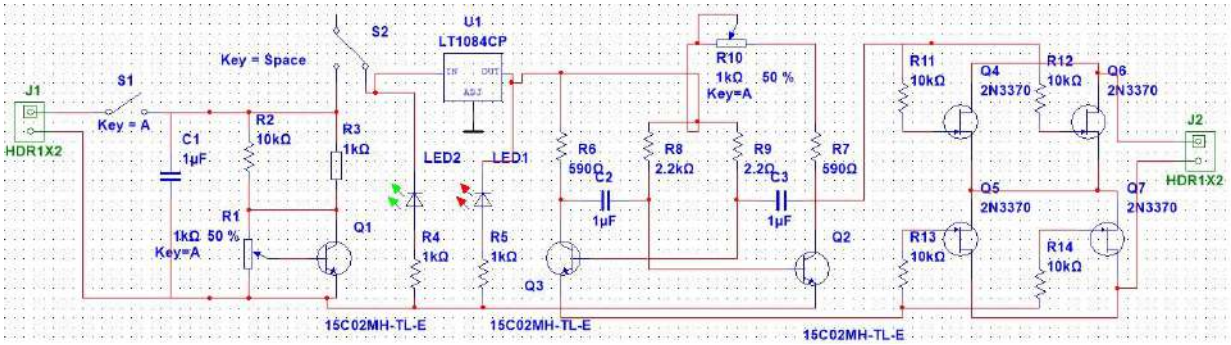


Figure 2 - Schematic diagram of the voltage converter block with indication elements for modeling in MultiSim

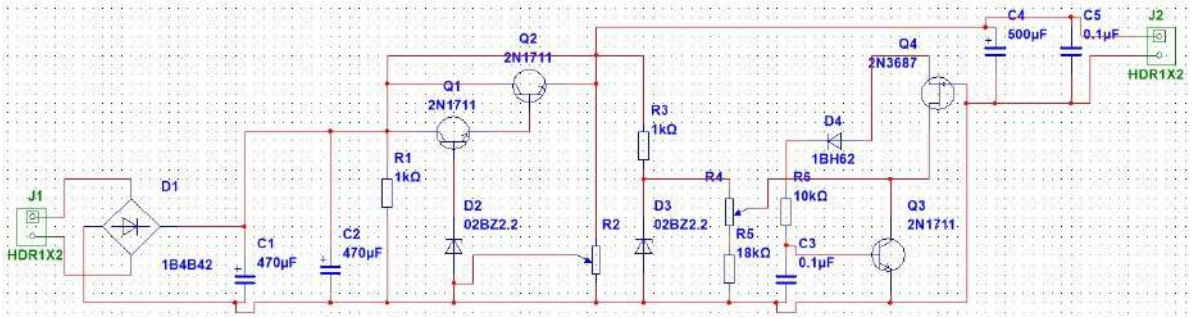
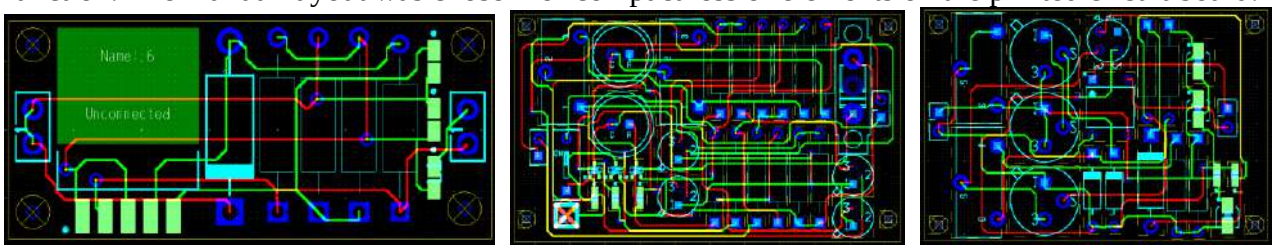


Figure 4 - Schematic diagram of the power supply unit for modeling in MultiSim

2) Now integrate this scheme into Ultiboard (Fig. 5, a-c). After you have done this, the Ultiboard opens automatically. The layout can be done manually or by using the "Auto Trace" function. The manual layout was chosen for compactness of elements on the printed circuit board.

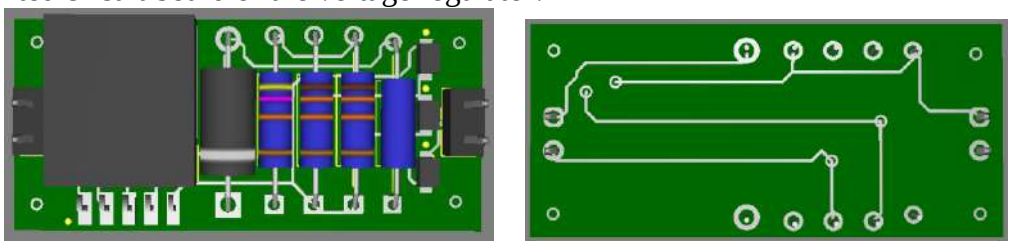


a b c

Figure 5. PCB trace, a - voltage stabilization unit, b - voltage converter, c - power supply unit.

The dimensions are also set manually. Then we display a 3D view of the printed circuit board model.

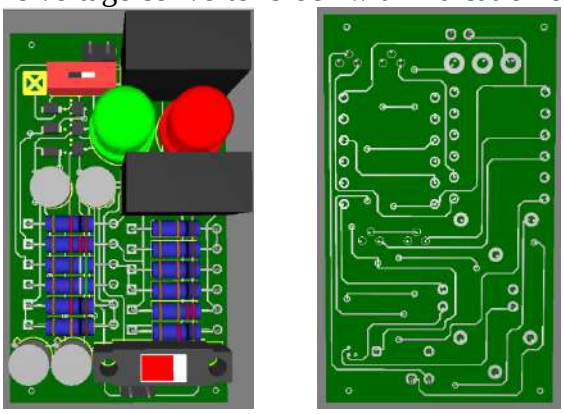
- The printed circuit board of the voltage regulator:



a b

Figure 6. 3D model of the voltage stabilization unit board, a - top view, b - bottom view

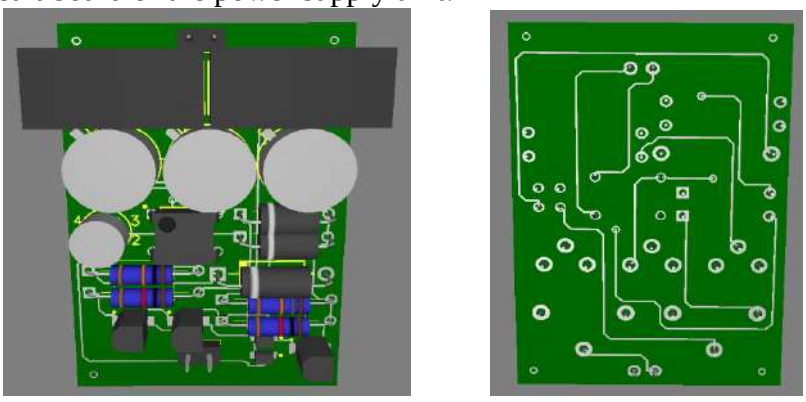
- Printed circuit board of the voltage converter block with indication elements:



a б

Figure 7. 3D model of the voltage converter board with indication elements, a - top view, b - bottom view

- The printed circuit board of the power supply unit:



a б

Figure 8. 3D model of the voltage converter board with indication elements, a - top view, b - bottom view

The dimensions of each printed circuit board are shown in the table below:

	Voltage regulator board	**Voltage converter board**	**Power supply board**
Width, mm	36,068	56,134	32,004
Height, mm	16,256	33,020	47,752

Next, reliability calculations were performed for each component of the boards and the following results were found:

Probability of failure-free operation	**Operating time, h**			
	10	100	1000	1000
$\mathbf{P_C}$	1	0,996	0,955	0,663

To summarize, the PCB modeling work was done, which showed that:
- Failure probability ranges from 1 to 0.663 depending on operating time;
- the average time of failure-free operation of the device is 24318 hours;
- shortcomings that need to be corrected were identified.

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УДК 69.001.5

ENERGY EFFICIENT CONSTRUCTION IN EUROPE AND RUSSIA.

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The state of the state economy and the standard of living of the population are mainly determined by the availability of fuel and energy resources and the efficiency of their use. The depletion of reserves has become a major factor in determining the need for energy conservation, and forced the world community to seriously turn to the development of energy conservation programs.

Thus, many countries have developed national targeted programs for saving the use of fuel and energy resources, which cover a wide range of measures to improve the structure of energy consumption, develop the material and technical base for resource conservation, and collect and recover secondary raw materials and for smart control [1]. Modernization and creation of an effective reliable energy base for the progression of the regions of the Russian Federation is today one of the most important strategic tasks that requires the full use of various sources, the adoption of a balanced regulatory framework that takes into account the specifics of regional development.

The main role in increasing efficiency belongs to modern energy-saving technologies. These include new or improved technological processes, characterized by a higher productivity of fuel and energy resources.

Residential buildings account for a large amount of energy consumption. Therefore, one of the main methods of saving is to increase the productivity of buildings. A progressive direction in construction is the creation of energy-efficient houses. The main principle of designing such houses is to reduce the cost of heat supply compared to standard buildings while increasing the comfort of

the microclimate of the premises due to the maximum sealing of the building and the use of alternative energy sources.

There is a classification for energy consumption:

- if the annual heating cost is less than 90 $\frac{kWh}{m^2}$, the house will be in an energy saving state;
- if less than 45 $\frac{kWh}{m^2}$, the house will be considered with an average level of energy consumption;
- if less than 15 $\frac{kWh}{m^2}$, we will talk about zero energy consumption [2].

European builders have been successfully implementing projects of energy efficient houses for a long time. In the countries of Western Europe, projects have been implemented to build from 10 to 20 thousand such houses. Denmark, Germany and Finland are considered leaders among the countries where targeted government plans for the construction of energy efficient buildings have been developed.

A full-fledged energy-saving zone VTTKKT has been created in Helsinki, 10 km from the city center. In the designated micro-district covering an area of 1132 hectares, where 5,500 inhabitants live, the use of solar energy provides 50% of the need for heating and hot water, and the total area of solar collectors is 1248 square meters. Compared to traditional houses, the use of energy-saving technologies and alternative energy sources can reduce consumption by up to 40%. Energy consumption at home does not exceed 15 $\frac{kWh}{m^2}$ per 1 square meter [3].

Implementation of the first "passive house" in the village of energy-efficient houses "Three Rivers in Shava" in Russia. The house is a wooden spatial frame filled with thermal insulation ISOVER type FRAME P32. The average thickness of thermal insulation in the construction of the exterior walls was 358 mm, the floor 408 mm, the roof 520 mm, the roof above the first floor 595 mm. REHAU GENEO plastic window profiles with thermal insulation inserts are used. The house uses renewable energy sources: solar and ground energy. A vacuum solar collector is located on the roof of the first floor. The heating system consists of several low-power wall-mounted electric convectors from ENSTO with a capacity of 750, 500 and 250 watts [4].

According to the results of the analysis, it can be concluded that with the reasonable use of advanced technologies, conducting a national policy, raising the level of consciousness of the population, it is possible to achieve great success in the field of energy conservation.

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УДК 811.111-26

AIRGEL LABORATORY FACILITY

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Abstract: The article provides information on the production of airgel using critical drying, which takes place in the main plant.

Keywords: airgels, critical drying.

Aerogels are materials that are a gel in which the liquid phase is completely replaced by the gaseous one. As a result, the substance has a record low density, as well as a number of other unique qualities: they are strong (an airgel sample can withstand a load of 2000 times its own weight), have an extremely low thermal conductivity and a developed specific surface. All this makes it possible to use aerogels for a wide range of tasks. For example, on the basis of such materials heat-insulating materials for industrial application are made [1].

Such large countries as France, Austria, Germany, and the USA are developing systems and apparatus for carrying out the process of supercritical airgel drying. It should be noted that there are no companies on the territory of the Russian Federation that are engaged in the development of installations for carrying out the process of supercritical drying of gels.

Carrying out the supercritical drying process requires special high-pressure equipment. It is important to develop appropriate technological schemes, which include in their composition: high-pressure apparatuses, high-pressure pumps, separators, intermediate tanks, complex shut-off and control valves, a set of instrumentation and automation. Of particular importance is the precise control of the parameters of the supercritical drying process, since the properties of the supercritical fluid, the rate of heat and mass transfer strongly depend on temperature and pressure.

To carry out the process of supercritical drying, installations of various configurations and various sizes are used, depending on the required performance and goals.

Figure 1 shows a schematic diagram of an installation for the production of aerogels based on silicon dioxide at the laboratory level [2].

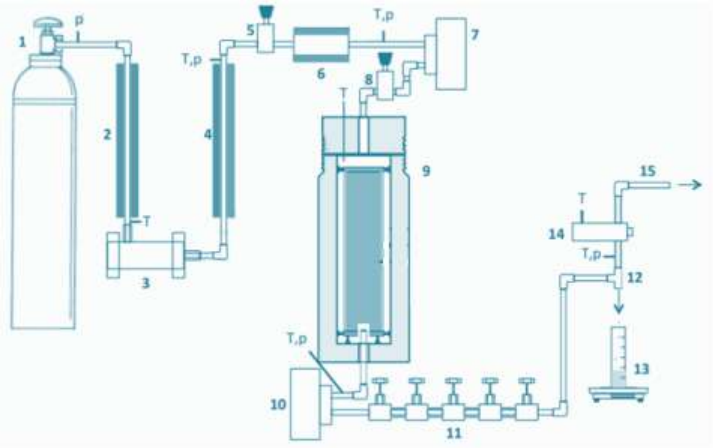

Figure 1 - Schematic diagram of the installation for the production of aerogels: 1 - carbon dioxide cylinder; 2 - cooling circuit; 3 - piston pump;4 – heating circuit; 5 – main pressure regulator; 6 - heating element; 7, 10 – Coriolis flowmeters; 8 - secondary pressure regulator; 9 - high pressure apparatus; 11 - a series of heated decompression valves; 12 - tee; 13 – collection of liquid solvent; 14 – IR solvent vapor sensor; 15 - gas outlet

Liquid carbon dioxide is fed into the system at ambient temperature and pressure of 5.7 MPa. Next, the carbon dioxide is cooled to a temperature of 5°C using a cooling circuit (2), to supply carbon dioxide to a nitrogen-driven piston pump (3) in liquid state only. The piston pump raises the pressure up to 14 MPa. Then the carbon dioxide is heated above the critical temperature in the heating circuit (4), passes through the pressure regulator (5) and the heating element (6). The carbon dioxide then passes through coriolis flow meter (7) connected to converter for signal processing. Mass flow measurement error ±0.1% of reading and density ±1 kg/m3. The carbon dioxide then passes through the secondary pressure regulator (8), where the pressure is reduced to the value at which the drying process takes place. Also, the pressure regulator (8) suppresses oscillations that occur during pump operation. The high pressure apparatus (9) is made to order from CF Technologies in stainless steel, internal diameter 7.62 cm, height 25.56 cm (volume 1.165 l), equipped with heating. After the high pressure apparatus, a Coriolis flow meter (10), similar to the flow meter (7), is installed. A series of heated decompression valves (11) provide precise control of carbon dioxide flow. After the decompression valves, the carbon dioxide/solvent mixture passes through a tee (12) with vertically oriented outlets to collect the liquid solvent in the liquid solvent reservoir (13). The gaseous flow passes through a tee branch to an infrared solvent vapor sensor (14), which measures the solvent content with an accuracy of ±4.5g/m3. The solvent concentration display allows you to determine when you need to complete the supercritical drying process. Temperature is measured using T-type thermocouples (accuracy ±1.0 °C), high pressure is measured by PX-309 sensors (accuracy ±51.5 kPa), low pressure by PX-209 sensors (accuracy ±0.52 kPa). The process of supercritical drying on the presented equipment is carried out at a temperature of 323 K and a pressure of 12.4 MPa [3]

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EFFICIENCY OF THE FUEL CELL CYCLE IN THE EXPERIMENTAL INSTALLATION

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One of the basic needs of an industrial society is energy. The trend towards increasing energy consumption is observed throughout the world every year, and will increase, as expected by 2050, which requires the solution of major energy problems. [2].

The growing shortage of natural energy sources makes it necessary to solve such problems as the modernization of high-performance electrochemical systems for energy conversion and storage.

Nowadays, hydrogen energy appears to be a generally recognized solution to the economic and environmental problems of power engineering. It's also a guarantor of stable energy generation with significant development perspective. Hydrogen energy is a priority area in all developed countries [2].

The main purpose of this work is to analyze the efficiency of the fuel cell cycle, and to analyze the data obtained during the experiment with the installation on the base of the fuel cell.

Hydrogen and natural gas are highly efficient fuels, their use in modern power engineering is extremely valuable. Natural gas and hydrogen are more environmentally friendly than fuels obtained by processing oil, coal and peat [1].

Heat engines, which are based on Diesel, Otto, Brighton cycles, are used to convert the chemical energy of fuel into other forms of energy. These heat engines are the most commonly used and the efficiency of these power grids is 0.3-0.55. Therefore, it is advisable to use fuel cells to convert chemical energy of fuel into other forms of energy (electrical energy). According to theoretical studies, the fuel cell efficiency can reach 100% (theoretically). Any fuel can be used in fuel cells. Modern fuel cells use hydrogen, natural gas, etc. as fuel. Thus, the development of energy supply systems using fuel cells is a topical trend in the power engineering sector. In the 20th century, internal combustion engines, steam engines, and electric motors competed for advantage. Now, different types of FCs are also competing.

Usually, the hydrogen cycle is considered as a chain that combines such important parts as the primary power source, hydrogen production, hydrogen storage system and hydrogen power grid. If this cycle is used with renewable energy sources, the chain will be presented in the sequence: hydrogen production by electrolysis, storage of hydrogen in a compressed or in the bound form of the solid phase, generation of electrical energy using electrochemical generators (fuel cells) or hydrogen combustion systems (including internal combustion engines) [3].

Benefits of hydrogen systems are:

- long-term storage of energy without loss;
- high density energy storage;
- relatively low capital investment.

The experimental layout of the installation includes a photoelectric converter, an electrolyzer, pure hydrogen and oxygen storage tanks, a fuel cell, and a load. Using the sun's rays directed perpendicular to the photoelectric converter, using a photoelectric converter, we obtain a current and a potential difference that are connected to the electrodes in the electrolyzer. In the electrolyzer, under the action of a potential difference and installed membranes, the incoming water will dissociate into hydrogen and oxygen, which, in turn, enter the storage tanks through the tubes. From there, the fuel and oxidizer enter the fuel cell, which generates electrical energy.

Picture 1 shows a photograph of the experimental installation.

Picture 1 – Top view of the experimental installation

Experimental research of the characteristics of the installation that converts solar radiation into electrical energy have been carried out. The efficiency value of the photoelectric converter is 7%, the efficiency of the electrolyzer is 11.5%, and the efficiency of the fuel cell is 22.5%. In fact, with the improvement of catalysts, the efficiency will be much higher, which significantly exceeds the performance of modern internal combustion engines. The high efficiency of the fuel cell supposes that such a cycle is the most efficient, the absence of a fuel combustion process makes it possible to call this cycle the most environmentally friendly, compared with Diesel, Otto, Brighton, etc. cycles. Also, the efficiency of fuel cells can be increased by using the thermal energy released in the reaction, for example, using a gas turbine.

With regard to the use of cycles similar to the experimental installation, the chain will be presented in the sequence: hydrogen production by electrolysis, storage of hydrogen in a compressed or bound form of a solid phase, generation of electrical energy using electrochemical generators (fuel cells). It is more profitable to install an electrolyzer and a solar cell in an area with prevailing solar radiation, thereby increasing their efficiency. But the fuel cell will be able to produce electrical energy in any part of the planet where it is needed.

Since the efficiency of a fuel cell is not limited by the efficiency of the Carnot cycle, such as Otto, Diesel cycles, etc., the most promising way will be the developments in increasing the efficiency of the fuel cell and the entire system as a whole.

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CALCULATION OF A SHELL-AND-TUBE HEAT EXCHANGER OF A HEATING POINT OF AN APARTMENT BUILDING

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The problem of residential public buildings heating is extremely important today, since about 150 million people live in Russia, and everybody needs to have warm and heated rooms. But it impossible without the use of heat exchange devices of various designs. Heat exchangers can be of

different designs, different sizes, but the purpose of their use always remains the same - to provide people with heat [1].

The purpose of this work was to calculate the heat losses of a residential building in the climatic zone of the city of Kazan with subsequent calculation of the specified value of the thermal power of a shell-and-tube heat exchanger [3].

The tasks of the work were:

- consideration of the principle of operation of heat exchangers, the study of various classifications of heat exchangers and their functionality, as well as the principles of their operation. In addition, an important goal was to study the theoretical foundations for the heating of multi-apartment residential buildings (the concept of heating networks, heat points, consideration of the types of heating of residential buildings, features of heat supply, as well as the study of the rules regarding heating of multi-apartment buildings).

- determination of the thermal power of the heating system of a multi-apartment residential building (calculation of transmission heat losses, calculation of losses due to air infiltration, determination of domestic heat gains into premises). Calculation of a given heat output of a shell-and-tube heat exchanger of a closed heat supply system (determination of heat transfer coefficients, heat transfer, finding the required heating surface of the heat exchanger).

- construction and analysis of drawings of the heat exchanger.

The methodological basis of the study was based on the works of teachers of Russian universities in the field of heat engineering systems and installations. Among the researchers whose works formed the basis of this work are: Bolgarsky A.V., Gortyshov Yu.F., Grigoriev V.A.

A two-story residential building was chosen to find the heat output of the heating system. Each floor has 18 rooms (9 from the south side of the world and 9 from the north), as well as two rooms for entering the building. The location relative to the cardinal points was taken into account when calculating heat losses through the building envelope [2].

The thermal power of the heating system of a residential building is the sum of heat losses through the building envelope (transmission heat losses) and heat losses due to air infiltration, minus domestic heat emissions for residential premises [1].

To calculate heat losses such parameters as materials for enclosing structures, area of enclosing structures, heat transfer coefficient of enclosing structures, outdoor air temperature, indoor air temperature were used [3].

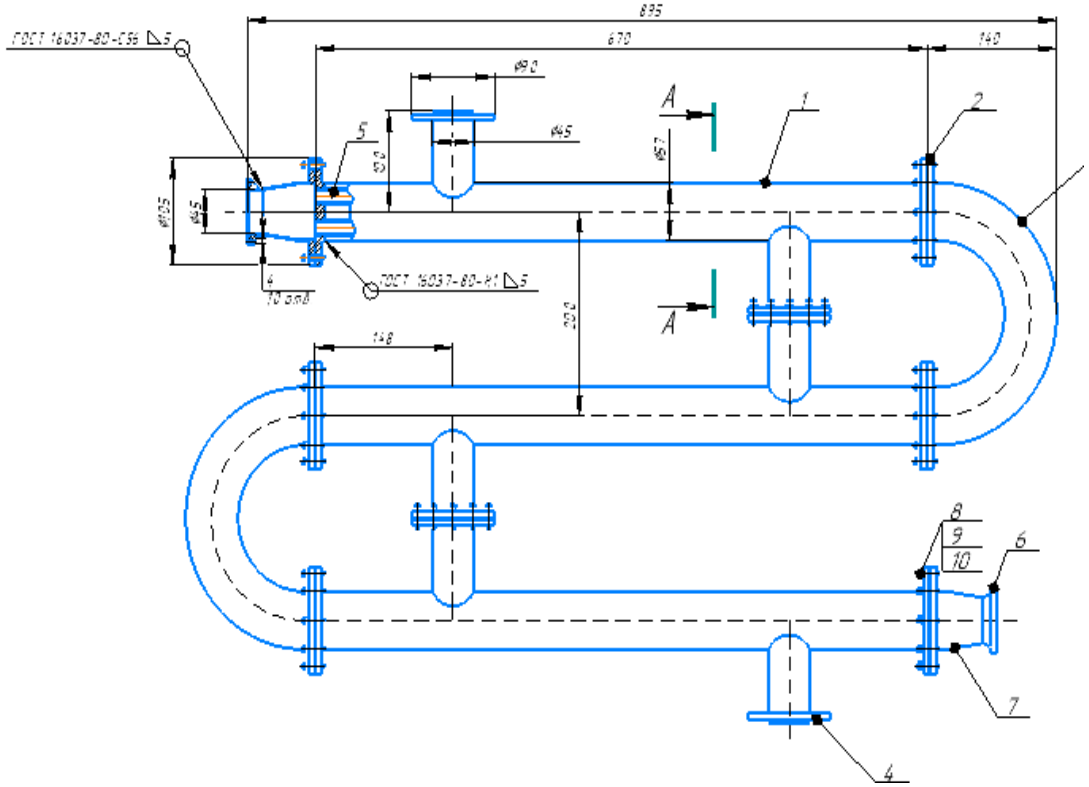
Further, the calculation of the shell-and-tube heat exchanger of the heating point was carried out. In this work, a double-circuit type of heat point was used, since the two heat carriers in the heat exchanger did not mix with each other. Water was used as a heated and heating coolant. The heat exchanger is necessary, first of all, to maintain the desired temperature of the coolant coming from the boiler room, since it cools down during transportation. The use of a shell-and-tube heat exchanger for heating is more profitable, since it has less hydraulic losses than in a plate heat exchanger, this can be checked by the Kirpichev criterion [2].

The initial data for calculating the heat exchanger were: the thermal power of the heating system of a residential building, the temperature of the heating and heated water at the inlet and outlet of the heat exchanger. Data for coolant temperatures were selected in accordance with ”Set of rules 41 – 101 – 95 Design of heat points” [1].

In the course of the calculation, the thermal characteristics of the heat carriers were obtained: the mean logarithmic temperature difference, the heat transfer coefficient from the heating water to the tube wall, the heat transfer coefficient from the tube wall to the heated water, and the heat transfer coefficient of the heat exchanger. In addition to the thermal values, the geometric characteristics of the heat exchanger were also obtained: the estimated area of the pipe and annular space, the equivalent diameter of the annulus, the inner diameter of the tube, the required heating surface, and the number of sections of the heat exchanger.

Based on the results of this calculation, as well as using the main parameters from GOST 27590 and GOST 21646, a drawing of a horizontal shell-and-tube heat exchanger was built.

Scheme 1 - Shell and tube heat exchanger



Scheme 1 shows a general view of a shell-and-tube heat exchanger, consisting of three sections. The main elements of the heat exchanger are also presented here: flange connections 2.4 and their fastening with tie bolts 8, connecting cable 3, water heater transition 7, and heat exchanger tubes 5.

Based on the results of this work, the thermal power of the heating system of a residential building was calculated, and the calculation of the horizontal shell-and-tube heat exchanger necessary for heating this building was carried out.

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УДК 621.31

CALCULATION OF SHORT-CIRCUIT CURRENTS IN THE OPERATIONAL DC SYSTEMS

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Introduction

Over the past decades, the electric power industry has distinguished itself by the development and implementation of various devices, tools, instruments, methods, techniques and systems designed to improve the efficiency, reliability and continuity of power supply to consumers. When

reviewing and analyzing this problem field, it is impossible not to note that in the modern power industry, the so-called Operational Direct Current Systems (ODCS) are particularly widespread. Researchers define the term ODCS as a set of converter, storage and distribution devices of electric energy, the single purpose of which is to supply direct operating current to all secondary switching devices connected to them, both in normal mode, and for a specified time when the voltage on auxiliary buses disappears [1]. For qualitative realization of the latter process it is extremely necessary and important to carry out the calculation of short-circuit (SC) currents, an attempt to present the key information about which is undertaken in this paper, which is the purpose of this article.

Materials and methods

As the basic materials used in this study, we chose the standard of the organization of JSC "FGC UES" STO 56947007- 29.120.40.093-2011 "Guidelines for the design of operational direct current systems UNES substation. Typical design solutions" [2] and the methodical instructions on diagnostics of the operative direct current system at the electric substations of JSC "MUEGC" [3]. The research methodology consists of such theoretical principles as objectivity and consistency. Methods of research were conditioned by the necessity to solve the set goal, therefore, required a general scientific approach. First of all, these are such methods as analysis of literature, comparison of data.

Results

Before directly proceeding to the stages of the calculation of short-circuit currents, we should present a general characteristic of ODCSs themselves. It is well known that ODCSs should provide an uninterrupted operating and backup power supply to consumers of operational direct current. On 35-750 kV substations, it is obligatory to use 220 V ODCS. The ODCS can have a centralized or decentralized structure. Two or more galvanically isolated DC power supplies, providing power to individual groups of electrical consumers, are used in a decentralized ODCS, while in a centralized ODCS only one is used. An ODCS integrates four main components into a single whole (Figure 1).

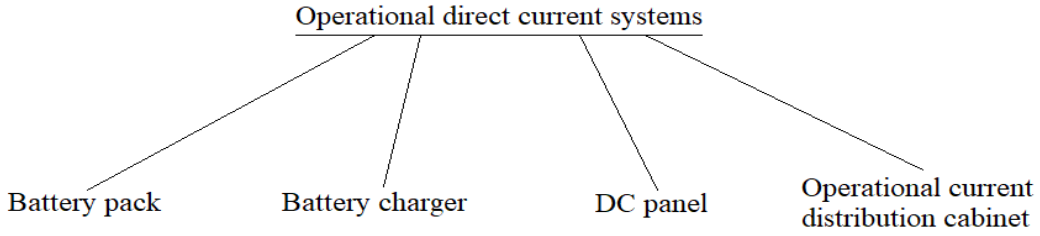

Fig. 1. Structure of OCDS [1]

These components are directly connected to the corresponding protective devices by means of electrical lines. Measurements and calculations of short-circuit currents should be carried out to check the selectivity, breaking capacity and sensitivity of protective devices, as well as to check the thermal resistance and non-combustibility of the ODCS cable lines. On the basis of comparison of the calculated and measured values of short-circuit currents at characteristic points of the ODCS network, a conclusion about the state of the contact connections is made. In the calculation model, the transient resistance of contacts of network elements in the normal state is taken into account. Measured (real) values of short-circuit currents, as a rule, are less than the calculated values, since during operation the transient contact resistance increases as a result of oxidation. Measurement of metal short-circuit currents at characteristic points of the ODCS circuit is carried out with a special loading device (LD). The value of the metal short-circuit current at a point in the circuit is determined by the formula:

$$I_{sc} = \frac{U(U - \Delta U)}{\Delta U R_l},$$

where U – voltage at the circuit point before the connection of LD, V; ΔU – voltage dip at the circuit point after the connection of LD, V; R_l - resistance of the load resistor of LD, Ohm.

Calculation of short-circuit currents should be carried out with a special computer program, e.g. GUDCSETS. Substitution scheme of ODCS for carrying out the calculations of short-circuit currents should be made on the basis of the executive scheme. When preparing the initial data for the calculations of short-circuit currents it is necessary to determine: the calculation scheme (normal, repair mode of the equipment); the location of the short circuit (bus bars of the DC panel, beginning or end of cable lines); type of short circuit (metal, arc); duration of the short circuit; the preceding mode (initial temperature of cables depending on operating conditions).

To check the breaking capacity of the protective device, the metal short-circuit current on its terminals on the power supply side must be calculated. For protective devices installed in the DC panel, the calculated current is the metal short-circuit current on the bus bars of the DC panel. To check the sensitivity of the protective apparatus the mode of minimum currents should be considered, i.e. the arc fault current at the end of the cable line it protects or at the terminals of the final electric receiver for the repair mode of operation of equipment in the mode of maximum allowable discharge of the battery pack is calculated. To calculate the minimum currents it is necessary to focus on the preceding mode, corresponding to the maximum initial core temperature (+70 °C for cables with polyvinyl chloride insulation). To verify the thermal resistance of a cable line, maximum currents should be considered, i.e. metal short-circuit currents at the end of the line and arc short-circuit currents at the beginning of the line are calculated. Verification of thermal resistance of cable line is performed for the highest current value selected from the two calculated values. To check the flameproofness of a cable line when the main protection fails and the backup protection works, the maximum current mode must be considered, i.e. the metal short-circuit current at the end of the cable line and the arc fault current at the beginning of the line, behind the redundant protective equipment, are calculated. Verification of flameproofness of the cable line should be carried out for the highest current value selected from the two calculated values. The calculated duration of the short-circuit, when checking the flameproofness of cables, must be set on the basis of the total time of tripping of the short-circuit by the redundant protection apparatus. By comparing the calculated values of metal short-circuit currents with the measured short-circuit currents in the same points of the ODCS network, the state of their contact connections is evaluated. If these values differ significantly (more than 20%), then measurements should be made to determine the contact connections with increased resistance, and indicate them in the list of defects [2, 3].

Conclusions

This paper presents a brief characterization of ODCSs and key information regarding the calculation of short-circuit currents in them, designed to test the selectivity, breaking capacity and sensitivity of protective devices, as well as to test the thermal resistance and non-combustibility of ODCS cable lines. Thus, the calculation of short-circuit currents in ODCSs has its own rules and a step-by-step structure, and is a prerequisite for achieving highly effective indicators of continuity and reliability of electricity supply to consumers.

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УДК 66

ANALYSIS OF THE RECEPTION OF RETROREFLECTIVE MATERIALS

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Reflective materials (RM) are used in many areas of industry today. These are materials that are capable of returning light back to them. They are used for marking vehicles, special technology for the manufacture of information signs, highway dividing strips, etc. [1].

An analytical review of scientific, technical and patent information shows that there are numerous technologies for producing RMs of various structures. For example, the patent [2] describes a flexible and durable retroreflective sheet material, which is attached to a polymer-coated flexible fabric material consisting of a polymeric prismatic retroreflective layer with high retroreflective coefficient and a polymer combining layer for attachment to the flexible polymer-coated fabric based on polyester or other types of fibers. Polyvinyl chloride compound is applied to the fabric, which gives the products increased flexibility, resistance to abrasion, resistance to ultraviolet radiation and increased frost resistance. However, the resulting RMs are characterized by a comparatively low retroreflective coefficient.

The patent [3] describes a method of producing high-brightness RM, containing microspheres as light-reflecting elements and working as reflecting reflectors. Such materials are used in the manufacture of road signs, directional signs, screens, billboards, car number plates, special elements for dark detection, etc. The RM contains a layer of transparent coated on a reflective surface of a substrate. The material is produced by applying on a substrate in the form of paper, fabric, a film of a binding layer in the form of an adhesive composition. To create a reflective surface, this layer is covered with the reflective particles made from aluminum, bronze or silver powder and also with finely dispersed mica particles or polyethylene terephthalate film with the reflective layer of aluminum coated on them. A range of grades of aluminum foil with a high reflection coefficient are also used to produce a reflective surface.

The reflective surface of the RM can be formed by thermal spraying aluminum onto a substrate in a vacuum. Micro beads with a certain refractive index must then be applied to the particles with the reflective surface as an image, using for example the roller printing method or simply by spraying micro beads onto an area of the image protected from other areas of the material using a mask. Similarly, micro beads with a different refractive index, for example, from polystyrene or another optically transparent material, are applied to other areas of the material after protecting the resulting image with a mask. The micro beads are then immersed on the reflective surface until they come into contact with the binder layer using a protective transparent polymer film.

The patent [4] proposes a technology for producing RM, which consists of a transparent layer that has a front light-receiving surface and a rear surface on which an array of a reflective element is formed. Light falling on the front surface, passes through it, falls on the retro-reflective element, forming together a two-dimensional retro-reflective array with a regular arrangement of elements, and is reflected, exiting through the front surface. The divergence interval for the retro-reflective array is defined as the maximum angle at which the returned light is sufficiently intense for a particular application. The main advantage of such a RM is a wide range of light divergence due to the presence of a divergence enhancing layer.

At present, there are a number of methods of production of RMs in industry, differing by used reflective elements, initial components, structure and technological features. Currently, the RMs is produced in the form of thin-film multilayer structures using glass microspheres and retro-reflectors, which are micro-reliefs on a polymer film.

In turn, the technology for producing RMs with corner reflectors is complex. Therefore, its implementation requires a special complex of expensive equipment. The manufacture of RMs using

glass microspherical reflectors is simpler and more technologically advanced than the technology for producing multilayer thin-film RMs with corner reflectors.

To obtain retroreflective materials, various foil films are widely used as a reflective layer. The main producers of such materials are ZM (USA) and MODEM (the Russian Federation). It should be noted that, despite the high optical properties, the above-mentioned RMs are distinguished by a rather complicated production technology and relatively high cost.

It is known [5] that at least six refractions occur when microspherical reflectors are used in RM. The number of refractions can be greater with additional material coating, and the greater the number of refractions, the greater the shift of the reflected beam and the reduction of the reflectivity of the RM. Figure 1 shows the structure of a retro-reflective multilayer film with corner reflectors.

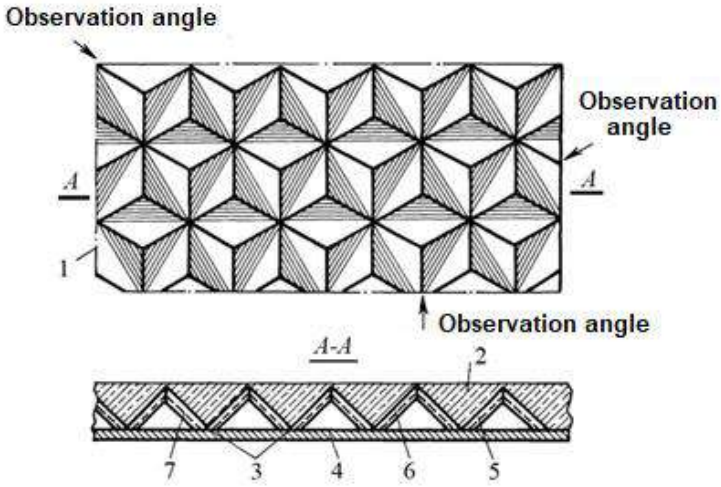

Figure 1. Film with corner reflectors:

1 - RMA; 2 - transparent protective layer; 3 – corner reflector; 4 - substrate; 5 - reflective coating; 6 - color of the reflecting surface; 7 - particles dispersed in the binder

The light-reflecting part of the film is formed in the form of a micro-relief from corner prisms. The reflection process in films based on microprisms differs from the reflection process in films based on microspherical reflectors, and is based on the effect of total reflection in RM [6–7]. In such films there is much less refraction, and the RM geometry makes it possible to direct the incident light in the opposite direction with a higher accuracy than in films with microspherical reflectors.

Of the known RMs, the most widely used materials are those in which the effect of direct retroreflection is provided by embossing trihedral pyramids with right angles at the top in the film. This retro-reflective geometry ensures that the light returns in accordance with the calculated type of reflection signature. Therefore, one or more reflected beams of light can transmit the same or different information in different directions, thereby creating various multi-color luminous information fields when illuminated by the RM.

The RMA with microprismatic reflectors uses the effect of triple mirrors. This effect consists in the fact that if three surfaces are perpendicular to each other, the radiation incident on one of the surfaces is reflected to both other adjacent surfaces, and then reflected back in the direction of the radiation source.

Thin-film RMs using corner reflectors are also manufactured using microreplicative technology [6]. The initial stage in the production of RM is the manufacture of master matrices and dies. In the next step, a film with a predefined embossing texture on the back side is produced. At the same time, film materials with an adhesive backing are produced using the technologies of embossing on calenders, thermoforming on presses and removing varnish matrices.

These technologies are based on electroformed master matrices with a specific embossing pattern in the form of a micro-relief, which produces a retroreflective effect when transferred onto film. Working matrices are galvanic copies of master matrices made by electroforming. In the implementation of these technologies, it is possible to install a protective layer on the front surface

of the films and spray a thin layer of aluminum with high reflective properties on its embossed side. The film is then bonded with an adhesive layer overlaid with an anti-adhesion protective layer.

It should be noted that despite the extremely wide range of multi-purpose RMs, many manufacturers are also developing new types of retro-reflective materials. For example, American company 3M has patented Scotchlite™ C790 Carbon Black RM, made in deep black color with a high light retroreflective coefficient. Such a reflective material allows for a rich dark color both in daylight and a bright glow in the darkness [8].

Thus, a promising direction in this field is research aimed at the developing technological processes for the production of microparticle light-reflective coatings based on PPC, containing glass microspherical light-reflecting agents as fillers. Widespread use of RMs based on PPC is hampered by the lack of scientifically substantiated theoretical and experimental data on the choice of initial components and optimal compositions, structures, regimes, and methods for their preparation.

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УДК 66

POLYURETHANES AND POLYURETHANE-BASED COATINGS

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The production of polyurethanes (PU) is the first industrially important achievement in organic isocyanate chemistry, research in the field of which began about a hundred years ago. Polyurethanes are polymers in which the urethane group is the repeating unit.

In the case of obtaining PU, there are wide-ranging opportunities to modify physical and mechanical properties by modifying their structure.

The main method for producing polyurethanes is the migration copolymerization of di- and polyisocyanates with compounds containing at least two hydroxyl groups in a molecule - polyalcohols, polyethers and polyesters. Glycols and diisocyanates are used to produce linear polyesters, and when using initial components containing three or more hydroxyl or isocyanate groups in the molecule, branched or cross-linked polymers are obtained.

Reaction of glycols with diisocyanates occurs through migration of hydrogen atom of hydroxyl group of alcohol and its addition to isocyanate group [1].

The formation of urethanes is associated with the isocyanate addition reaction described by Wurtz:

$$R-N=C=O + R'-OH \rightarrow R-\underset{\underset{H}{|}}{N}-\underset{\underset{O}{||}}{C}-OR'$$

The interaction of isocyanates with glycols, which occurs according to the method developed by Bayer, proceeds as follows:

$$n\,HO-R-OH \;+\; n\,O=C=N-R'-N=C=O \rightarrow$$

$$\rightarrow (-O-R-O-\underset{\underset{O}{||}}{C}-\underset{\underset{H}{|}}{N}-R'-\underset{\underset{H}{|}}{N}-\underset{\underset{O}{||}}{C}-)_n$$

If the ratio of the two bifunctional starting components is equimolar, linear polymers are formed. Otherwise cross-linked (cross-linked) polymers are obtained. In lacquer coatings, predominantly cross-linked polyurethanes are realized.

The formation of polyurethanes can take place in bulk, but usually the reaction is carried out in a solvent environment of chlorobenzene and dichlorobenzene, which gives a more homogeneous product.

The PU formation reaction proceeds without isolation of low molecular weight products, and the elemental composition of the resulting polymer fully corresponds to the composition of the initial monomers.

In order to obtain high-molecular products, it is necessary to take the initial components of a high degree of purity in strictly equimolecular amounts. If one component is used in excess, it leads, as in the case of polycondensation, to a decrease in molecular weight. A component taken in excess forms predominantly terminal groups. The high reactivity of diisocyanates allows reactions to be carried out at low temperatures (even at room temperature). Under mild conditions, fewer side reactions occur, thus avoiding branching due to the interaction of diisocyanates with the urethane groups formed.

Oligoesters are important starting components for the production of PU. They were first used for the synthesis of PU by Slag. Although other important raw material sources for the production of PU have now emerged, oligoethers continue to dominate. This is due to the simplicity of their synthesis, availability, ease of varying the structure and molecular weight, as well as the valuable properties introduced by ester blocks into polyurethane materials.

A variety of polyurethane coatings are now available which combine decorative properties with wear resistance, optimum physical and mechanical properties and ease of application.

Polyurethane coatings are characterized by high dielectric properties that change little at elevated temperatures and influence of humid environment. Electric strength of polyurethane coating films varies depending on operation temperature (20-125oC) in the range of 220-145 Mv/m, or sq/mm. After stay on-cover in water for 30 days at 20°C, the dielectric strength decreases only slightly.

PU coatings can be one-component, where the isocyanate groups combine with air moisture, or two-component, where they combine with hydroxyl or epoxy groups. When using a one-component polyurethane coating, errors in the ratio of components are avoided, which is extremely important. Errors in the thoroughness and duration of mixing of the components are avoided. Such errors lead to non-uniform curing, color and glossiness.

Two-component PU coatings are distinguished by high durability, chemical and corrosion resistance, hardness and abrasion resistance, and can be cured at low temperatures. They are used to protect underground and underwater structures, to protect against corrosion and rapid wear of

elements of the facade elements of industrial buildings, cooling towers, containers for transporting and storing solvents etc.

Polyurethane coatings based on aliphatic polyisocyanates are weather-resistant: they retain a high gloss while maintaining a constant color tone for several years. The coatings can be used over a wide temperature range (-50°C to 130°C); they withstand the indicated temperature differences without significant changes in properties.

Thermoplastic polyurethane resins which do not contain any functional groups are also used to produce a paint coating. These systems are cured by the evaporation of a solvent which is either an organic compound or water. Aqueous polyurethane dispersions are preferred because of their safety to the environment.

It should be noted that the good physical and mechanical properties and chemical resistance of polyurethane coatings are due to the chemical structure of the three-dimensional polymer formed during the curing process: the resulting urethane and urea bonds are stable when exposed to UV radiation, aqueous solutions of acids and alkalis. Proper selection of polyol and isocyanate results in polyurethane coatings which have good chemical resistance to many substances and can be used in a variety of environments.

Coatings based on polyurethane paints and varnishes have the most complete set of protective and decorative characteristics. This is presumably due to the ability of the urethane groups – HNCOO – to form intermolecular hydrogen bonds, which are destroyed upon stretching, providing the elasticity of the coating, and restored upon relaxation, maintaining a high crosslink density.

Polyurethane coatings are weatherproof, resistant to water and solvents, characterized by low gas permeability and high dielectric properties. Coatings based on polyurethanes have very good adhesion to metal and non-metal surfaces, are characterized by high physical and mechanical properties, in particular, very high resistance to abrasion.

Isocyanates are highly reactive but toxic compounds. The most commonly used in the domestic industry is 2,4-toluene diisocyanate (product 102T) and diethylene glycol urethane (DGU), obtained by interaction of diethylene glycol with 2,4-toluene diisocyanate. Diethylene glycol urethane is less volatile due to its higher molecular weight and therefore less toxic.

Due to high reactivity, isocyanate groups can react with any compounds containing active hydrogen, including water, to form one-pack systems containing prepolymer with isocyanate groups. Curing of such systems occurs at a temperature of 20–60°C as a result of the interaction of the isocyanate groups of the prepolymer with air moisture to form polyurethane urea [2].

One-pack polyurethane protective varnishes (HumiSeal 1A33, HumiSeal l A68, HumiSeal 1 A20) are currently used abroad for moisture protection of printed circuit assemblies in military equipment, aviation, and industrial electronics [3]. It should be kept in mind that the maximum level of physical and mechanical, and hence the protective properties of such coatings is achieved in the distant future (from 7 to 30 days). In order to bring this future closer, short-term heating of printed circuit assemblies to a temperature of +85 0C is used.

Thus, polyurethane coatings are sufficiently versatile surface protectors: they have deep penetration into the surface to be painted, high wear resistance, durability to aggressive environments, low moisture and water permeability, high adhesion to many surfaces. This further expands the scope of their application.

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УДК 66

ANALYSIS OF PARAMETERS AFFECTING THE PROPERTIES OF CARBON FOAMS

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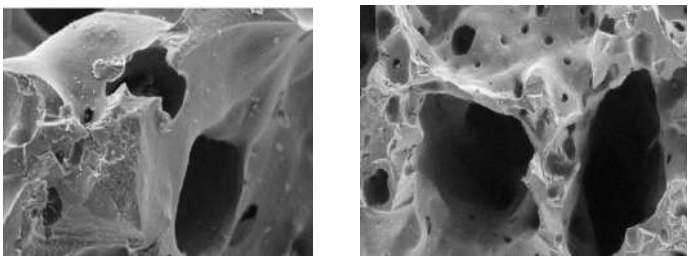
To achieve new heights in the aerospace industry, functionally new materials that combine a number of unique properties are required. New technologies and processing methods are also being actively developed and implemented to reduce the cost of various parts and increase their service life. For example, composite materials with high strength and low weight are being actively introduced in aviation. Looking at technology, the number of companies adopting additive technologies is increasing every year.

Recently, scientists have also succeeded in creating carbon foams, which, depending on the structure, can be both thermally insulating and thermally conductive. By their nature, foams are materials consisting of at least two phases: a solid (liquid) polymer matrix and a gaseous phase obtained using a foaming agent [1].

In this paper, we consider syntactic carbon foams, which stand out as a separate class of carbon foams and are distinguished by the presence of a regular porous structure. The structure of foams of this class consists of macropores of approximately spherical shape and “windows” providing the connection between the cells and the formation of a single open pore system. This combination of structure allows to obtain many unique properties, such as: high (low) thermal conductivity, electrical conductivity, high values of physical and mechanical properties, as well as resistance to aggressive media, high accessible surface area, adjustable specific surface.

An analysis of domestic and foreign literature has shown that the properties of foams are influenced by many parameters, which we will be further considered in the paper.

One of the parameters affecting the properties of foams is the particle size of the initial precursor. Reducing the particle size reduces porosity but increases bulk density and compressive strength. This phenomenon is due to the fact that smaller particles melt faster than larger ones because of the larger heat transfer area. As a result, the liquid bath remains isothermal and the formation of pores with homogeneous bubbles begins (Figure 1, b). For larger particles, by the time the core of the particle reaches the foaming temperature, the outer surface loses volatile substances, and it leads to pore inhomogeneity (Figure 1, a) [2].



a) b)

Figure 1. Foam structure: a - with particles of 500 microns, b - with particles of 75 microns

Another equally important parameter is the pressure during the foaming process. Increasing pressure increases porosity, compressive strength and reduces bulk density. This is due to the fact that at high pressure volatile substances remain in the system, resulting in increased matrix viscosity and greater swelling. The porosity also increases due to the uniform formation of bubbles in the matrix [2].

It is also important to consider the foaming time, an increase in which leads to an increase in bulk density and compressive strength. However, this trend is only observed until the volatile substances are completely released from the composition [2].

Attention must also be paid to the heating rate of the composition, since an even and slow increase in the heating rate prevents the occurrence of cracks [2].

The compressive strength of the foam depends on the porous structure and the cracks in the foam wall. Porosity is the number of pores per unit length (ppi - pores per inch, Figure 2). This parameter influences not only the mechanical characteristics of the foam, but also its thermal and electrical conductivity.

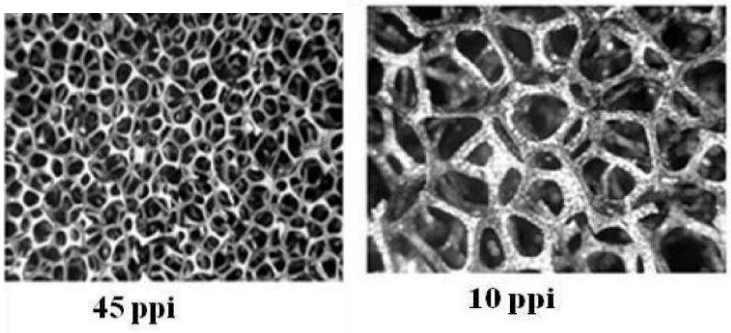


Figure 2. SEM images demonstrating the dependence of the CF microstructure on the linear pore density

A feature of the CF is that the performance properties of the final material can be varied within a fairly wide range by choosing a specific technological route and process parameters within a given selected process flow diagram.

In addition to the ratio of components which determines the density of CF, the important factors on which the properties of this class of materials depend are:

- degree and conditions of cross-linking (curing) of the polymer;
- nature of interaction between the filler and the binder (surface properties of the filler);
- temperature of heat treatment.

Thermal conductivity of carbon foams depends on three main factors: thermal conductivity of carbon bonds and gas inside the cell, thermal convection of gas inside the cell, thermal radiation of carbon bonds and gas inside the cell [3].

Currently, carbon foams can be produced from various starting components. In [4] a newspaper was used which was crushed and mixed with a sugar solution. The resulting composition was carbonized at 900°C. The properties of this foam are shown in Table 1 (1).

Article [5] describes a method for producing carbon foam from sawdust. For this purpose, sawdust powders were mixed with sucrose solution to produce suspensions. The sawdust suspension was poured into a PVC pipe and the sucrose solution was allowed to filter to consolidate the particles.

The consolidated bodies were cooled in a freezer at -70°C to freeze the trapped sucrose solution. The ice present in the frozen bodies was removed by freeze-drying in a lyophilizer. The sublimated bodies were heated in an air desiccator at 160°C. The heat-treated bodies were carbonized in an inert atmosphere furnace at 900°C for 2 h. The properties of this foam are shown in Table 1 (2).

In research [6] carbon foams are made from phenol-formaldehyde resin (PFR) with the addition of cenospheres, which are waste products of thermal power plants. This carbon-cenosphere foam was prepared by a sacrificial template method in which the polyurethane foam acted as a template. The properties are described in Table 1 (3).

In studies [7] carbon foam was obtained by foaming followed by carbonization process of mesophase furnace with SiO2 aerogel additives.

The addition of SiO2 aerogel to carbon foams can optimize the volumetric swelling and viscosity of the molten mesophase pitch resulting in a more uniform cell size of the carbon foam. Foam properties are shown in Table 1 (4).

The article [8] developed a method of foaming and curing a phenol resin solution (FFR) under pressure (4 MPa) followed by carbonization to obtain phenol-based carbon foam with adjustable pore structure (pore size 20–180 Nm) and high strength. The method uses anhydrous ethanol as a solvent for the phenolic resin and foaming agent. The properties of the resulting foam are shown in Table 1 (5).

Table 1. Properties of carbon foams depending on the initial precursors

№	Compound	Thermal conductivity, W/m·K	Density, g/cm^3	Strength, MPa	Porosity, %
1	Sucrose solution + crushed newspaper	0,2	0,39	1,7	-
2	Sucrose solution + sawdust	0,17	0,304	2,1	-
3	FFR + cenospheres	0,1	0,35	5,8	79,0
4	Mesophase pitch + airgel SiO2	0,1	0,61	10,21	67,0
5	FFR	0,09	0,37	21,8	-

Having analyzed the relevant literature, it can be concluded that, depending on the initial composition and manufacturing method, low thermal conductivity carbon foams can be produced, the strength of which can vary in a wide range of values. Mostly the heat-insulating foams are made of phenol-formaldehyde resins, however, lately the trend is to shift to products of secondary raw materials. By adjusting the appropriate parameters described above, it is possible to achieve optimal values of physical and mechanical properties.

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УДК 66

METHODS OF PRODUCING HIGH THERMAL CONDUCTIVITY FOAMS

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Currently, the further development of the aerospace industry requires new materials that combine a number of unique properties. Carbon foams (CF) are a prime example of such materials. These are monolithic non-toxic materials, the porosity of which can reach up to 80%. By their nature, foams are materials consisting of at least two phases: a solid (liquid) polymer matrix and a gaseous phase obtained with a foaming agent [1].

Depending on the choice of the initial precursor, carbon foams can have both thermal insulation and thermal conductivity properties. For example, phenol-formaldehyde and melamine resins are used to produce heat-insulating foams, and various pitches (petroleum and coal tar) are used for thermally conductive foams.

In this paper we consider carbon foams that have thermal conductivity properties. Thermal conductivity is the ability of a material to conduct heat. For foams this value depends on three parameters at the same time:

- thermal conductivity of carbon bonds and gas inside the cell;
- thermal convection of gas inside the cell;
- thermal radiation of carbon bonds and gas inside the cell [2].

In addition to the above mentioned factors the thermal conductivity is also affected by modifying elements, heat treatment temperatures, graphitization and carbonization. Thus, in [3] the initial mesophase pitch (MP) was modified with fluoride resin, which acted as a surfactant. Mixtures of MP and pitch fluoride were heated in a pressure vessel. The foaming of the carbon foam proceeded as follows: first, the temperature was raised from room temperature to 523 K at 4 K/min, from 523 to 733 K at 2 K/min, and finally held at 733 K for 2 h. During the process, the pressure was maintained at 3 MPa under a layer of nitrogen. Foam samples were carbonized at 20 K/h to 1573 K and held for 2 hours. They were then graphitized at 10 K/min to 2873 K and held for 30 minutes. The SEM image of the foam structure is shown in Figure 1.

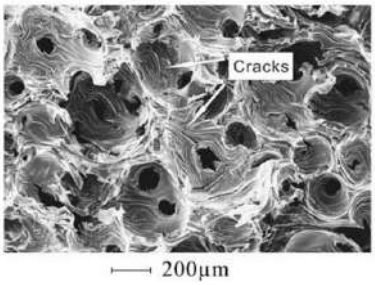

Figure 1. SEM images of CF from a modified MP

As a result of the introduction of fluoride resin, there has been a trend towards a decrease in bulk density from 0.55 to 0.51 g/cm3. At the same time, the specific thermal conductivity increased to 155.4 (W/m-K)/(g/cm3), which is almost 2 times higher than pure mesophase pitch.

In [4] samples of RVC foams (a product of carbonization of polyurethane foams impregnated with phenol-formaldehyde or furfuryl alcohol) with porosity 97% and pore density 10 ppi were used. Copper was electroplated onto these samples so that the coating was uniform on all surfaces (Fig. 2).

During the copper coating process, the porosity of the carbon foam decreased from 97% to 45%, but at the same time the thermal conductivity increased from 5 to 180 W/m-K.

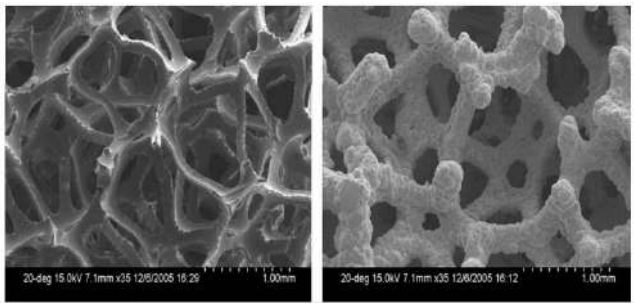

Figure 2. SEM image of CF:
a – before Cu deposition, b – after coating deposition

In the article [5] carbon foams were obtained by the hydrogel template method by adding mesophase pitch to polyvinyl alcohol-acrylic acid solution. Graphite powder (0.1; 0.3; 0.5; 0.7; 1.0 wt.%) was added to the resulting gel solution in order to improve thermal resistance, corrosion resistance, thermal and electrical conductivity. The resulting product was carbonized at 1000°C and graphitized at 2700°C. The samples depending on the content of graphite powder were designated: CFm, CFm-0.1G, CFm-0.3G (Fig. 3), CFm-0.5G, CFm-0.7G, and CFm-1.0G. The characteristics of the powders after graphitization are shown in Table 1.

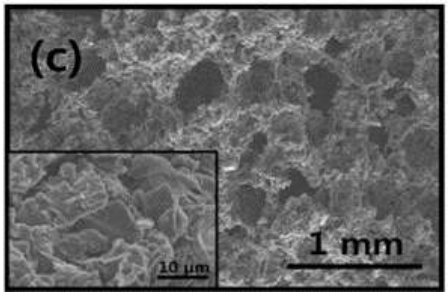

Figure 3. SEM image of CFm-0.3G foam

Table 1. Characteristics of CF filled with graphite

Sample	Porosity, %	Density, g/cm^3	Thermal conductivity, W/m·K	Compressive strength, MPa
CFm	62,89	0,74	60,61	2,29
CFm-0.1G	56,53	0,75	80,01	2,65
CFm-0.3G	52,84	0,77	96,55	5,05
CFm-0.5G	56,89	0,72	82,37	4,02
CFm-0.7G	60,52	0,68	79,98	3,89
CFm-1.0G	64,75	0,63	58,37	2,87

In another study [6] the size of graphite particles ranged from 2 to 8 wt.%. The initial mesophase pitch, together with graphite particles, was crushed to granules of <0.1 mm in diameter and loaded into a mold, which was installed in a chamber with high pressure and temperature.

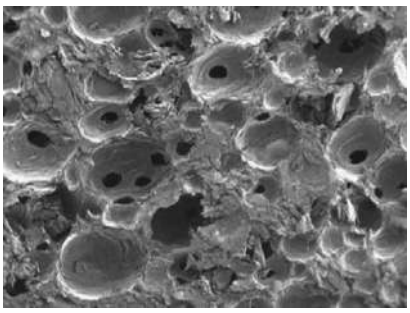

Figure 4. The structure of the CF containing graphite particles (5 wt.%)

The chamber was then filled with nitrogen gas. The pitch was kept at 500 °C and 8 MPa for 1-4 hours. Then the chamber was switched off. As the pressure and temperature decreased, the pitch expanded and formed a foam. Then the foam was carbonized to 1200 °C at a heating rate of 2 °C/min in a nitrogen atmosphere and incubated for 3 h at this temperature. The foam was then graphitized at 3000°C. The structure of the resulting foam is shown in Figure 4, the properties are shown in Table. 2.

Table 2. Properties of CF filled with graphite particles

Sample	Graphite particles, %	Porosity, %	Density, g/cm^3	Thermal conductivity, W/m·K	Compressive strength, MPa
CF0	0	72	0,677	70,2	3,8
CF2	2	68	0,723	85,6	9,3
CF5	5	63	0,757	110,3	12,5
CF8	8	62	0,768	107,4	10,8

Currently, carbon foams are being actively researched and introduced into various industries. Already now these foams are being used to create heat exchangers, bone tissues, supercapacitors, sorbents for oil and water purification, and radiators. Due to their light weight, high thermal conductivity, and good strength, carbon foams can be used as thermal coatings in the near future.

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СОДЕРЖАНИЕ

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