ТЕОРИЯ И ПРАКТИКА СОВРЕМЕННОЙ НАУКИ: ВЗГЛЯД МОЛОДЕЖИ

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PROSPECTS FOR THE USE OF FOAM GLASS IN THERMAL INSULATION OF PIPELINES

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Abstract. The relevance of solving the problems of creating high-performance materials for thermal insulation of pipelines remains in the focus of attention of researchers and practical engineers. The article assesses the prospects of using foam glass as one of the options for thermal insulation of pipelines in heat supply systems.

Keywords: thermal insulation, heat-insulating materials, foam glass, pipeline.

ПЕРСПЕКТИВЫ ПРИМЕНЕНИЯ ПЕНОСТЕКЛА В ТЕПЛОИЗОЛЯЦИИ ТРУБОПРОВОДОВ

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Аннотация. Актуальность решения проблем создания высокоэффективных материалов для теплоизоляции трубопроводов остается в центре внимания исследователей и инженеров-практиков. В статье дается оценка перспективности применения пеностекла как одного из вариантов теплоизоляции трубопроводов в системах теплоснабжения.

Ключевые слова: теплоснабжение, теплоизоляционные материалы, пеностекло, трубопровод.

Energy saving is an urgent and important task in the heat and power industry. World experience shows that one of the promising ways to solve it is to create materials that give the greatest effect for the thermal insulation of pipelines during their laying.

The materials used in thermal insulation must have a preferential ratio between: physical and chemical properties, the cost of the material, the cost of installing thermal insulation on the pipeline, the amount of heat loss during operation.

When laying heat-insulated pipes for heating and hot water supply networks in residential premises, it is necessary to take into account the requirements of fire safety in terms of flammability. The use of thermal insulation structures made of flammable materials such as foamed polyethylene, foam, etc. is not allowed for pipelines located in buildings.

As a relatively new material for thermal insulation, consider a material such as foam glass. According to the structure-foam glass consists of isolated small bubbles that are vapor-and waterproof. At 100 % humidity, the thermal conductivity of this material does not change. The material retains all its physical properties under almost any conditions. The main properties of foam glass include: incombustibility, resistance to acids, rodents, insects and microorganisms, high strength, ease of processing. Foam glass is the only material that has so many useful properties [1].

Figure 1. Foam glass and the construction of thermal insulation from it

Technical characteristics of foam glass are presented in Table 1.

Table 1 – Physical and chemical characteristics of foam glass [2]

Density, kg / m^3	120 – 210
Thermal conductivity at +25°C, W·m * °C	0,045 – 0,070
Compressive strength, kPa	400 – 1600
Bending strength, kPa 200-550	200 – 550
Tensile strength perpendicular to the plate plane, kPa	100 – 500
Deformation under concentrated load 1000N, mm	0,50 – 2,00
Operating temperature range, °C	260 – 400
Flammability	incombustible
Short-term water absorption, kg / m^2	no more than 0,50
Long-term water absorption, kg / m^2	no more than 0,50
Vapor permeability, mg/m·h·Pa	no more than 0,002

For the first time, as a building material, foam glass was mentioned in his report by Academician I. I. Kitaygorodsky in 1932, which also provided information about the production technology of this material.

In 1936, at the International Congress on Glass in London, B. Long presented the results of the scientific laboratories of the French glass corporation “Saint Gobain”, demonstrated prototypes of a new product. However, despite the received patent (No. 786818-1934), this corporation was forced to curtail projects for the production of foam glass. There were serious technological difficulties in the homogeneous creation of sufficiently large blocks of foam glass [3].

By 2011, the volume of foam glass produced in European factories was 1,000,000 cubic meters.

As the main raw material for the manufacture of foam glass, the cullet of bottle, window and other types of glass is used. Consequently, the creation of foam glass is accompanied by the processing of glass in the form of waste, which is practically non-degradable and accumulates over time.

Comparative characteristics of foam glass and mineral wool as thermal insulation materials given in Table 2.

Table 2 – Comparative characteristics of foam glass and mineral wool [2]

Parameter	Glass wool	Foam glass
Thermal conductivity, W / m0C	0,042	0,06
Density, kg / m^3	37	150
Vapor permeability, mg / m*h*Pa	0,3	0,002
Cost, rub / m^3	1 750,00	18 500
Cost of materials for 1m2 of roof 5	5 564,00	6 516,41
The cost of installation works of 1m^2 of the roof	2 964,31	1 378,42
Total cost of construction of 1m^2 of roof	8 528,31	8 394,63

It follows from the Table 2 that the cost of thermal insulation of 1 square meter of the roof with these materials is almost the same.

However, taking into account such important advantages of foam glass as moisture resistance, the ability to maintain volume throughout the entire operation time – indicates the undoubted advantages of this material in the insulation of building structures. Another important indicator is the service life. Mineral wool can last for about 25 years, while foam glass can last for at least 100 years.

Comparative results of calculating the thickness of thermal insulation made of various materials (foam glass, glass wool, polyurethane foam) are shown in Table 3.

Consider a pipeline with a diameter of 400 mm, a length of 1000 meters, the temperature of the coolant is 120 °C. Calculate the thickness of the insulation, allowing for heat loss of 5 %

The calculation is carried out according to the following formulas [3, 4]:

$$\delta_{из} = \frac{d_{н}^{ст}(B-1)}{2};\{m\},$$

where: $\delta_{из}$– insulation thickness,

$d_{н}^{ст}$ – outer wall diameters of the insulated object, m.;

The value of B is found by the ratio:

$$LnB = 2\pi\lambda_{из}(R-R_{н});$$

where: R – linear thermal resistance, m·°C/Vt.

$R_{н}$ – linear thermal resistance of heat transfer of external insulation, (m·°C)/Vt.

$\lambda_{из}$ – thermal conductivity coefficient of the insulation material, Vt/(м·°C).

linear thermal resistance, m·°C/Vt:

$$R = \frac{3{,}6Kl(\frac{t'_в - t''_в}{2} - t_н)}{GC(t'_в - t''_в)}, \text{ m·°C/Vt.}$$

where: K–the coefficient of additional losses, which takes into account heat loss through heat-conducting inclusions in thermal insulation structures.

l – pipeline length, m.

t_{in} – ambient temperature of the isolated object, °C.

t_{out} – ambient temperature, °C.

G – substance consumption, kg/h.

C – heat capacity, kJ/(kg·°C).

Table 3 – Comparative economic indicators of thermal insulation efficiency [2, 5, 6]

Parameter	**Polyurethane foam**	**Glass wool**	**Foam glass**
Thickness, m	0,024	0,042	0,052
Weight, kg	2100	2631	9796
Cost 1p.m., rub.	1470	1070	1065
The cost of insulation material per 1000 m, rub.	1 406 720	1 070 000	1 064 585

The cost of thermal insulation of 1000 meters of the pipeline was calculated without taking into account the cost of installation work.

Thus, analyzing these results, we can draw the following conclusions:

1) These data show the prospects of using foam glass as a thermal insulation for various heat power facilities.

2) An important property of this material is its low water and steam permeability.

3) It is necessary to conduct scientific research in laboratory and field conditions to determine the effectiveness of the use of the materials mentioned in the article as thermal insulation structures under various climatic conditions.

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УДК 681.5

SCADA-SYSTEMS AND MODERN PRODUCTION

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Abstract. This paper contains the most relevant general information about SCADA-systems, namely: structural component, functions and capabilities, alarm state, application area, as well as the most popular examples of SCADA systems produced in different countries today.

Keywords: automation of technological processes, SCADA-systems, scope of application, alarm, processing and control, hardware and software complex.

SCADA-СИСТЕМЫ И СОВРЕМЕННОЕ ПРОИЗВОДСТВО

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Аннотация. В данной работе содержится наиболее актуальная общая информация о SCADA-системах, а именно: структурной составляющей, функциях и возможностях, состоянии тревоги, области применения, а также наиболее популярных примерах SCADA-систем, произведенных в разных странах на сегодняшний день.

Ключевые слова: автоматизация технологических процессов, SCADA-системы, область применения, аларм, обработка и управление, программно-аппаратный комплекс.

Introduction

In the modern world, enterprises and industry as a whole cannot do without a number of extremely important functions, such as: prompt and

accurate collection of information about the state of the technological process, processing of the information received and automatically directing it to the required direction, notification of personnel about emergency and emergency situations, as well as technical problems. The above tasks can be performed remotely, thanks to the multifunctional SCADA system.

SCADA (Supervisory Control And Data Acquisition – Data Collection and Operational Dispatch Control System) is a software and hardware complex used for collecting, scanning, processing and analyzing data in real time.

Structure of SCADA systems

The bulk of modern SCADA systems have a structure of 3 components.

1. RTU (Remote Terminal Block) is a microprocessor-based electronic device that connects objects in the physical world with a distributed control system or SCADA system by transmitting data to the main system, as well as using messages from the main surveillance system to control connected objects. Low-level data processing increases the capacity of communication lines with the main control room;

2. MTU (Main terminal block), MS (Main Station) is a control room (main terminal) that performs high-level data processing and management, usually in real time. MTU can be implemented in a variety of ways from a single computer with additional devices for connecting to communication channels to large computing systems integrated into a local network of workstations and servers. Sometimes this terminal is called a SCADA server;

3. Communication System (CS) – communication system or communication channel between MTU and RTU. CS performs a function without which the operability of the entire SCADA system is impossible – the transmission of data from remote points (terminal objects) to the central interface of the operator-dispatcher and the transmission of control signals to the RTU or remote object, depending on the specific execution of the system. The role of CS is played by communication lines, cellular networks, telephone lines, radio networks, digital networks, etc. Several actuators are used to copy and archive data [1].

Functions and capabilities of SCADA systems

SCADA systems are in demand because of their useful functions:

1. Interaction with the operator (presentation of auditory and visual information, transmission of operator commands to the system);

2. The possibility of automatic regulation and remote control;

3. Automatic high-speed maintenance of the technological “library” – database;

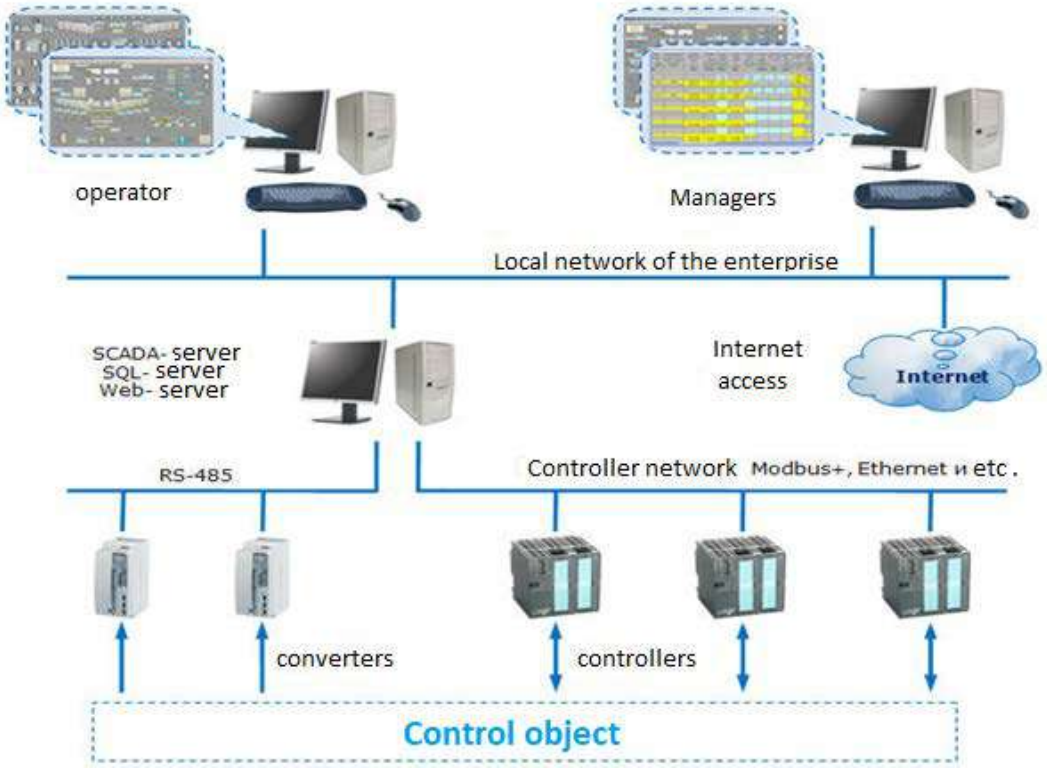

Figure 1. Schematic structure of SCADA systems

4. Automatic signaling of an accident and critical situations that have occurred (alarm subsystem);

5. Automatic preparation of a report on technical processes;

6. The ability to interact with external devices;

7. Accounting of operating time of technological equipment;

8. Automatic reconfiguration of the automated process control system algorithms to the changed conditions of the controlled process;

9. Accelerating the development of projects in the field of automated control systems [2, 3].

Alarm status of SCADA systems

Understanding SCADA systems, one should not miss such a term as “alarm”, because it provides security in SCADA systems.

An alarm is a notification of personnel about technical failures and malfunctions, which are strongly worth paying attention to. The importance of an alarm is determined by the degree of possible consequences that a failure or interference will lead to.

In SCADA systems, alarms are divided into two types.

1. Discrete alarms inform about a change in the state of a discrete variable, for example, the opening or closing of valves;

2. Analog alarms are based on processing the output of variable values beyond the upper or lower limits, for example, deviation from the required value [2].

The most popular SCADA systems

Currently, SCADA systems need extremely fast updates and improvements. Vivid examples of excellent SCADA systems that are in great demand on the world market:

- FIX (Intellution) – USA;
- Genesis (Iconics CO) – USA;
- InTouch (Wonderware) – USA;
- Factory Link (United States Data CO) – USA;
- RealFlex (BJ Software Systems) – USA;
- Cimplicity (GE Fanuc) – USA;
- TraceMode (Adastra) – Russian Federation;
- SARGON (NVT-Automation) – RF;
- Sitex (JADE Software) – United Kingdom;
- Citect (CI Technology) – Australia [4].

When choosing SCADA systems, it is necessary to compare their technical, price and operational characteristics.

Scope of SCADA systems

The main areas of use of SCADA systems [5]:

- control of transmission and distribution of electricity;
- industrial production;
- power generation;
- water intake, water treatment and water distribution;
- oil and gas production and exploitation;
- management of space objects;
- transport management (air transport, metro, railway, automobile, water transport);
- telecommunications;
- military area [6].

Conclusion

Currently, the introduction and use of SCADA systems is the most promising direction in the field of automated control of complex dynamic systems (processes) in vital and critical areas from the point of view of safety and reliability: they allow you to achieve a high level in the collection, processing, storage of information and management from geographically remote locations.

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УДК 621.22

NEGATIVE ECONOMIC COMPONENT IN THE DESIGN AND OPERATION OF HYDROELECTRIC POWER PLANTS

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Abstract. The economic risks in design, construction and operation of a hydroelectric power plant are considered in this article.

Keywords: hydropower, economic disadvantages, water reserves, hydroelectric power plants, flooding, silt, dam.

НЕГАТИВНАЯ ЭКОНОМИЧЕСКАЯ СОСТАВЛЯЮЩАЯ ПРИ ПРОЕКТИРОВАНИИ И ЭКСПЛУАТАЦИИ ГЭС

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Аннотация. В данной статье рассматриваются экономические риски при проектировании, строительстве и эксплуатации гидроэлектростанции.

Ключевые слова: гидроэнергетика, экономические недостатки, водные запасы, гидроэлектростанции, затопление, ил, дамба.

Hydroelectric power plants are the basis of hydrogen infrastructure or hydropower. Hydroelectric power plants are one of the cheapest sources of electricity generation, but this is not always, as it seems at first glance. They provide light not only to cities and villages, but also to factories and mills that require large amounts of energy every day. Their development potential is growing every year. So many countries that do not have minerals in their bowels or have abandoned the nuclear industry may fully cover the energy balance by hydropower [1].

A comfortable human life necessarily begins with affordable energy. The development of new energy sources is inextricably linked with the history of the development of energy and civilization. Turbines using the power of water flow as an energy source occupy the second place in the structure of modern energy after thermal power plants, which represent 62 % of all types of power plants [2]. Hydropower is an opportunity to generate energy using renewable resources: the natural capacity of rivers, geothermal waters, and tidal energy.

Despite the economic benefits of operating hydroelectric power plants, this way to generate electricity has a number of prevailing disadvantages [3].

Starting from the construction itself, hydroelectric power plants show their disadvantages in economic terms. So, the cost of construction of hydroelectric power plants is much higher than of familiar thermal power plants. For greater clarity, we can name the approximate cost of electricity during the construction of thermal power plants, 1 kW will cost $600 – 700, when the minimum cost of 1 kW during the construction of hydroelectric power plants will be $1100 [4].

When designing stations and their construction, priority is given only to areas with large water resourses. They are often much further away from consumers than thermal power plants. In the meantime, other factors are not always considered. That is, there are colossal expenses for the transportation of electricity, for all kinds of transformers, power lines, which also significantly exceeds similar costs in the construction of other types of power plants [5].

It is also indicated that the capital costs are significantly higher compared to the construction of thermal power plants. When constructing dams, huge costs are required for the construction of locks to transfer ships to the desired water level.

Without departing from the construction, it can be said that the construction of a hydroelectric power station is a very complex process, so it needs to withstand a huge pressure. Therefore, it takes a little less than a decade to build a dam, while most of the other power plants can be built literally for 2 – 3 years. The construction of the dam also requires a greater number of craftsmen than in the construction of other power plants.

A good example of a long period of construction of hydroelectric power plants can serve as the construction of the Bureyskaya HPP, which began in 1978, and was put into permanent operation only in 2014. The construction of the Boguchanskaya HPP was carried out from 1974 to 2017. Thus, these are also many other cases when the construction of hydroelectric power plant takes much time [6].

That is, as it becomes clear, only at the stage of construction of a hydroelectric power station, it already has quite significant economic disadvantages.

Large hydroelectric power plants cause the biggest danger. For their use, it is often necessary to flood a large amount of fertile land or entire settlements. There are many examples of flooding of settlements during the construction of hydroelectric power plants. Here are some of the most serious:

– In 1956, the Irkutsk hydroelectric power station was launched – the first Soviet hydroelectric power station in Siberia. During its construction, the village of Taltsy, the village of Bolshaya Rechka, the village of Mikhalevo and dozens of other settlements were lost.

– There were 59 settlements in the flooding zone of the Novosibirsk hydroelectric power station; the city of Berdsk was completely relocated [7].

– When filling the Bratsk reservoir in 1963, about a hundred villages went under water.

– Because of the filling of the Krasnoyarsk reservoir in 1967, 132 settlements fell into the flood zone, including three regional centers – Daursk, Novoselovo, Krasnoturansk [8].

– The construction of a dam in California forced ten thousand people to leave their homes. In addition, it can become an economic threat to this region, since many residents living near river massifs earn their living by fishing. According to the BBC, losses can amount to up to $2 billion.

It is even difficult to imagine what economic losses these are, in those situations we are talking about huge costs for the resettlement of residents of settlements.

It would seem that obvious problems, such as fish or wood getting into the turbines, also cause huge losses. For example, a log caught in a turbine can completely disrupt the turbine impeller, which will lead to its complete failure, which will entail huge costs for the purchase of a new turbine, or the restoration of a damaged turbine.

Another common problem for this industry is considered to be siltation of drains. Silt can collect in the drainpipes and degrade their throughput. On normal days, such a problem will not affect the operation of the station in any way, however, if large amounts of precipitation fall, this can lead to serious problems. For example, in 1975, this was one of the reasons for the destruction of the Banqiao Dam in China. At that time a large amount of silt clogged into the drains, and a typhoon with a record amount of precipitation brought with it thousands of cubic meters of water. The dam simply could not cope with the load and collapsed.

As a conclusion, we can say that during the construction of a hydroelectric power station there are a lot of negative factors and risks that need to be taken into account and calculated in order for the construction of a hydroelectric power station to be possible in principle, pay off and start making a profit.

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УДК 325.1

FACTORS OF REORIENTATION OF TAJIK MIGRANTS FROM RUSSIA TO OECD COUNTRIES

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Abstract. The article reveals a new and emerging direction of labor emigration from Tajikistan to the OECD countries, as a trend of reorientation of migrant workers between recipient countries in the future. The paper clarifies and highlights the internal and external factors that caused the reorientation of the flow of labor migrants from Tajikistan to a new direction – the OECD countries in the mid 2010s.

Keywords: OECD, Tajikistan, reorientation, Russia, labor migration.

ФАКТОРЫ ПЕРЕОРИЕНТАЦИИ ТАДЖИКСКИХ МИГРАНТОВ ИЗ РОССИИ В СТРАНЫ ОЭСР

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Аннотация. В статье раскрыто новое и зарождающееся направление трудовой эмиграции из Таджикистана в страны ОЭСР как тенденция переориентации трудящихся-мигрантов между странами-реципиентами в будущем. В работе определены внутренние и внешние факторы, обусловившие в середине 2010-х годов переориентацию потока трудовых мигрантов из Таджикистана на новое направление – страны ОЭСР.

Ключевые слова: ОЭСР, Таджикистан, переориентация, Россия, трудовая миграция.

A significant increase in labor emigration from Tajikistan began in the mid-1990s, when the socio-economic situation in the country worsened, which forced many people to look for work abroad. Unemployment has been a serious problem for Tajikistan for many years [1]. Despite the relatively low official unemployment figures, according to experts, about a quarter of the economically active population of the republic are actually unemployed. Prices and tariffs for housing and communal services continue to rise in the economy. These trends force families to change the structure of spending not in favor of improving nutrition, health or education.

Throughout the post-Soviet period, the main and traditional directions of Tajik labor emigration were Russia and Kazakhstan [2], but in recent years,

emigration from Tajikistan to the OECD countries has become increasingly noticeable as a new direction of labor emigration.

New Tajik communities are being actively formed in the OECD countries, which may become networks of attraction for new migrants soon. The growing number of labor migrants from Tajikistan in the OECD countries suggests that there is an intensification of emigration of Tajik citizens to new, previously almost undeveloped countries. Such a reorientation was due to a number of reasons, including difficulties in Russia (the introduction of an exam on the basics of the Russian language, history, statehood and the legal system for migrant workers, which, with a low level of educational infrastructure development, leads to an increase in corruption in this area; a decrease in income in dollar terms caused by the fall in the ruble exchange rate in 2014 – 2015.; the rigidity of migration policy and the growing competitiveness in the Russian labor market with citizens of the EAEU countries who do not require permits to work; operational restrictions on the rights and legitimate interests of migrant workers who do not have legal grounds for obtaining a temporary residence permit or residence permit, etc.), the formation of social networks in the countries of new emigration, the active policy of a number of countries in the Central Asian region (for example, Japan and the Republic of Korea) [3].

The countries of the Middle East, East Asia, the USA and Canada, and European countries have become new areas of labor emigration from Tajikistan. In this study, we study the situation in the OECD countries, which includes most of the developed countries that have become new destinations for emigration from Tajikistan.

The active policy of attracting labor migrants from Central Asian countries carried out in the OECD countries and the intensification of the activities of intermediaries for the employment of migrants from Tajikistan, combined with the rigidity of Russia's migration policy, contributes to the reversal of part of the flows of labor migrants in favor of the OECD countries. Therefore, there is a gradual strengthening of the trend of reorientation of flows of labor migrants from Tajikistan to new directions [4].

Given the volume of labor resources and the importance of Tajikistan in the Eurasian migration subsystem, the reorientation of migrant worker flows to new directions in the near future may be fraught with significant losses for the labor markets of Russia and Kazakhstan [5].

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УДК 626

ABOUT FUTILITY AND DISADVANTAGES APPLICATIONS OF HYDROPOWER

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Abstract. This article is devoted to hydraulic structures, which are complex engineering structures that have a significant impact on the formation of the economic and cultural appearance of the regions. In the article, the authors focus on the technical shortcomings of hydroelectric power plants, because they are objects of increased danger due to accidents at which emergencies may occur, leading to significant damage, as well as human casualties.

Keywords: hydroelectric power station, renewable energy sources, alternative energy, energy security.

О БЕСПЕРСПЕКТИВНОСТИ И НЕДОСТАТКАХ ПРИМЕНЕНИЯ ГИДРОЭНЕРГЕТИКИ

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Аннотация. Данная статья посвящена гидротехническим сооружениям, которые представляют собой сложные инженерные конструкции, оказывающие значительное влияние на формирование хозяйственного и культурного облика регионов. В статье авторы акцентируют внимание на технических недостатках гидроэлектростанций, так как они являются объектами повышенной опасности. Из-за аварий на них могут возникнуть чрезвычайные ситуации, приводящие к значительным ущербам, а также к человеческим жертвам.

Ключевые слова: гидроэлектростанция, возобновляемые источники энергии, альтернативная энергетика, энергобезопасность.

Hydroelectric power plants (HPS) are one of the sources of electricity generation. They provide light not only to cities and villages, but also factories, plants and concerns, which require large amounts of energy every day. Thus, many countries that do not have minerals in their depths or have abandoned the nuclear industry cover up to 100 % of the energy balance thanks to hydropower. With all the resource wealth of hydropower, there are many problems in this energy sector, which are discussed by representatives of industry structures and heads of relevant departments.

Despite all the advantages of hydropower and its significant share in electricity generation, hydropower is now the only type of generation for which plans and mechanisms for further development have not yet been determined in Russia, its impact on industrial and territorial development, as well as other sectors, has not been assessed. Economy of the Russian Federation. The Energy Strategy of Russia for the Period up to 2035 does not define specific directions and indicators for the development of hydropower, and there are no measures for its development.

For example, large HPS destroy entire ecosystems, which can lead to an exacerbation of fresh water shortages. Two billion people live in countries with high water stress. This leads to an uneven distribution of water resources: some rivers and streams are drained, huge areas are flooded. The construction of large hydroelectric power plants violates the established balance of ecosystems. Thus, the Irkutsk HPS, built on the Angara River, 65 km from its source, provoked an increase in the water level of Lake Baikal by an average of one meter. This led to the destruction of the banks, landslides and landslides. It took 600 square meters under the water. Km of land, 127 settlements were flooded and 17 thousand people were resettled [1].

By 2030, due to severe water shortages, up to 700 million people may be forced to leave their homes. Today, the use of fresh water significantly outstrips the possibility of natural recovery of its reserves. The scarcity of the most valuable resource for life is increasing due to the uncontrollable growth of consumption around the world. Large hydroelectric power plants are costly, are slowly being built, depend on large sources of demand – industries and cities – and cannot solve the problem of providing mobile electricity to poor regions and remote settlements.

Despite tens of thousands of HPS around the world, almost a billion people lack access to electricity. In Russia, according to data for 2019, 1,5 million households were deprived of it. Without electricity, poor regions and low-income segments of the population will not get access to quality healthcare, education, and jobs.

In Russia, there is no strategic understanding of the use of HPS in the country's energy system, there is also no infrastructure for connecting to general grids, the reverse sale of energy and surplus by individuals to the general energy network, there is no close coordination of the development of regional energy with industry, and the localization of production of technological equipment is extremely weak. In addition, there is a conflict of interest with existing regional electricity suppliers. The ill-considered privatization of generating capacities since 1991 has significantly reduced the possibilities for administrative regulation of the energy market in Russia

In addition, HPS are contributing to climate change. Reservoirs trap organic matter brought in by water streams. When it decomposes, significant amounts of greenhouse gases are emitted. Flooded plants and soil are also sources of emissions. The implementation of dam mega projects runs counter to the conclusions of the report of the World Commission on Dams. The document examined in detail the “rich heritage” of the constructed hydroelectric power plants: environmental disasters and large-scale corruption. The report stated that the construction of large dams should be planned only in cases where there are no alternative options for solving important socio-economic problems.

Some of the significant barriers are also the need to relocate people, high costs for the construction of hydropower plants, low construction speed, dependence on large sources of demand and high environmental damage – all this means that large hydropower plants are ineffective in terms of meeting sustainable development goals such as low-cost and affordable energy, reducing inequalities, combating climate change and preserving terrestrial ecosystems.

Despite the fact that Russia has developed and is operating an Energy Strategy until 2035, renewable energy sources account for only 12 % of the total volume of technological measures and initiatives. Small hydropower is mentioned as one of the promising areas of development, but at the moment there is no proven mechanism to stimulate its development. Also, there is no well-developed regulatory framework within which private farms could generate energy at small hydroelectric power plants and sell surpluses to the general network.

There are two options for the effective use of mini-hydroelectric power plants in Russia. The first assumes their connection to a single power system, the second provides for autonomous use. Both options have significant advantages and disadvantages. Since all generating capacities are designed for a certain optimal load, inevitable deviations reduce the efficiency of the equipment and lead to increased wear. If the power system is centralized, then the region can provide excess energy or receive additional capacity. Energy consumption in a local region always has very strong fluctuations, which means that an autonomous system without additional means of energy storage, the ability to quickly turn off part of the turbine units or other means of ensuring maneuverability will work ineffectively. Power supply by a group of independent power plants will always have less reliability than an interconnected system [2].

On the other hand, connecting to a unified system has its own technical, organizational and economic problems. The scheme for connecting the mini-hydroelectric power station to the network is determined by the existing power grid infrastructure in the area. If it is supposed to be connected to a single network, then the hydroelectric power station must guarantee the performance of such a network in terms of voltage and frequency. For example, to connect to a 110 kW main transmission line, a small hydroelectric power station must have a capacity of at least 25-50 MW and is located at a distance of no more than 150 km. The absence of a reservoir at a mini-HPS leads to fluctuations in the water pressure, and, consequently, to a change in voltage and current frequency. Maintaining the output parameters requires the use of a rectifier and a voltage inverter, which increases energy costs. Mini-HPS are often completely impossible to connect to a single power system, so they have a narrow sector of use – power supply of pumping stations, ventilation, heating systems and other facilities with stable energy consumption

Silt of sewage is considered to be another common problem in the industry. Sludge can collect in the drain pipes and reduce their drainage capacity. On ordinary days, this problem will not affect the operation of the station in any way, however, with large amounts of precipitation, this can lead to serious problems. For example, in 1975, this became one of the reasons for the destruction of the Banqiao Dam in China. Then a large amount of silt was thrown into the gutters, and a typhoon with a record rainfall brought thousands of cubic meters of water with it. The dam simply did not cope with the load and collapsed.

One of the largest accidents at hydraulic structures occurred in the United States in 1976. First, a small leak appeared in the earthen dam that blocked the Teton River, Idaho. At first, they did not pay much attention to it, then, when the leak became more noticeable, they tried to eliminate it with the help of construction equipment [3]. In the end, the bulldozers had to be abandoned to save lives. Finally breaking through the earthen dam, the water washed it away in a matter of minutes.

According to Vyacheslav Skulkin, Deputy Director of the Electricity Development Department of the Ministry of Energy, there are no large projects in the field of hydropower in Russia due to the presence of a large reserve of capacity in the energy system. As a consequence, the potential construction and operation of new large hydroelectric power plants is economically unjustified.

Large hydraulic structures have one unique feature. Unlike a mine or a quarry, they cannot be abandoned, left to the mercy of the forces of nature. Either the dam must be kept in working order forever (which is practically hardly feasible), or after a certain period of time, the hydroelectric complex must be dismantled, and the reservoir is drained or turned into a closed reservoir. This is the only way to avoid the catastrophic consequences of natural destruction. This, by the way, shows the common features of nuclear energy and hydropower. The cost of decommissioning a nuclear power plant is comparable to the cost of its construction. The same goes for hydroelectric power plants. The dams of hydroelectric power stations built in the USSR are designed to operate for a hundred years. On the one hand, a century is a lot, but on the other hand, some hydroelectric power plants, for example the Zhigulevskaya hydroelectric power station on the Volga, have already worked out about half of their term, or even more [4]. Thus, the question of what to do with the used hydraulic structures and how much it will cost to dismantle or overhaul them will already arise before the living generations. It is obvious that working with huge masses of water requires competent engineering solutions, technological discipline and responsibility.

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RECOGNIZING THE TEXT IN THE IMAGE USING THE TESSERACT LIBRARY

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Abstract. This article provides an overview of the technology that enables character recognition and an exploration of the use of the Python Tesseract library. The advantages and disadvantages, as well as the principles of text recognition from images using this software, are given. Presented are small examples of the use of this technology in integration with the computer vision library “OpenCV”.

Keywords: automation, computer vision, optical character recognition, OpenCV, Python, Tesseract library.

РАСПОЗНАВАНИЕ ТЕКСТА НА ИЗОБРАЖЕНИИ С ПОМОЩЬЮ БИБЛИОТЕКИ TESSERACT

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Аннотация. Данная статья содержит обзор технологии, которая позволяет распознавать символы, также проведено исследование возможности использования библиотеки для Python «Tesseract». Приведены достоинства и недостатки, а также принципы распознавания текста с изображений при помощи данного программного обеспечения. Представлены небольшие примеры использования данной технологии в интеграции с библиотекой компьютерного зрения «OpenCV».

Ключевые слова: автоматизация, компьютерное зрение, оптическое распознавание символов, OpenCV, Python, библиотека Tesseract.

OCR – Optical Character Recognition. In other words, optical character recognition systems convert a two-dimensional image of text, which may

contain machine-printed or handwritten text, from its graphical representation to machine-readable text. OCR as a process usually consists of several sub-processes that must be performed with maximum accuracy.

Optical character recognition remains a challenging issue when text occurs in unrestricted environments such as natural scenes due to geometric distortion, complex backgrounds, and varied fonts. The technology still has tremendous potential due to various deep learning OCR use cases such as natural scenes, geometric distortions, complex backgrounds, and varied fonts.

This article will explain the technology behind the most commonly used Tesseract Engine, which has been updated with the latest OCR research. This article will also serve as a guide to implementing OCR in Python using the Tesseract engine.

Tesseract is a program developed by Hewlett-Packard from the mid-1980s to the mid-1990s. Then the program “lay on the shelf” for about 10 years and in August 2006 it was bought by Google. Google Opens Source Code Under Apache 2.0 License To Continue Development.

Today, the library is the coolest solution if you need to read data from any photo.

Python-tesseract is an optical character recognition engine for Python. That is, it recognizes and “reads” text embedded in images.

OCR uses neural networks to search and recognize text in images.

Tesseract searches for patterns in pixels, letters, words and sentences using a two-step approach called adaptive recognition. It takes one pass through the data to recognize the characters, then a second pass to fill in any letters he was not sure of with the letters most likely to match the given word or sentence context.

The first thing to do is to install Tesseract ORC. Tesseract is easy to install on Mac and Linux. If you are on Windows, you will have to do one more movement.

You don’t have to interact with the program itself, just copy its location.

From the very beginning of writing the code, you should include the pre-installed libraries.

```
#Import pytesseract
#import Cv2
```

Next, you need to tell the program to the location of the file

```
img = cv2.imread('C:\\Users\\Vlad\\Downloads\\123.png')
```

By default OpenCV stores images in BGR format and since pytesseract accepts RGB format, we need to convert from BGR to RGB mode:

```
# Img_rgb = cv2.cvtColor (img_cv, cv2.COLOR_BGR2RGB)
```

To be able to recognize different languages (default is English), you should change the lang function belonging to the class image_to_string

#pytesseract.image_to_string(img, config=config, lang='rus+eng')

You can also choose in which format the recognized text will be given to us.

Get Searchable PDF

pdf = pytesseract.image_to_pdf_or_hocr ('test.png', extension = 'pdf')

c open ('test.pdf', 'w + b') as f:

f.write (pdf) # type pdf default is bytes

Get withdrawal HOCR

hocr = pytesseract.image_to_pdf_or_hocr ('test.png', extension = 'hocr')

Get withdrawal ALTO XML

xml = pytesseract.image_to_alto_xml ('test.png')

Support for OpenCV images / array objects NumPy.

If we want to highlight words on the picture itself and form an inscription, then we will need to add the following functions:

First, you will need to apply the "image_to_date" method – it returns the found words and their coordinates.

Next, you should create a loop to iterate over the list and display one element at a time..

for i, el in enumerate(data.splitlines()):

Since the first element is just the field names, it can be truncated.

if i == 0

continue

We will split each element by space, to split the line we will use the method split.

el = el.split()

Now we create variables to store the coordinates of the word, its width and height..

x, y, w, h = list(map(lambda x: int(x), el[6:10]))

To draw on pictures, we use the OpenCV library and the rectangle method, we specify the photo itself, the coordinates where we will draw, the width and height and add coordinates to get a rectangle, and also specify the stroke color and thickness.

cv2.rectangle(img, (x, y), (w + x, h + y), (255, 0, 0), 1)

In order for each stroke to display the inscription that we received with our program, we use the “putText” method, it accepts parameters: photo, text, coordinates, font format, its size, color and boldness.

cv2.putText(img, el[11], (x+x, y-20), cv2.FONT_HERSHEY_COMPLEX, 1, (255, 255, 255), 1)

The final code of the program and the results of its work are shown in the Fig. 1-4.

```python
import cv2
import pytesseract

pytesseract.pytesseract.tesseract_cmd = 'C:\\Program Files\\Tesseract-OCR\\tesseract.exe'

img = cv2.imread('C:\\Users\\Vlad\\Downloads\\hqdefault.jpg')
img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)

config = r'--oem 3 --psm 6'
print(pytesseract.image_to_string(img, config=config, lang='rus+eng'))

data = pytesseract.image_to_data(img, config=config, lang='rus+eng')

for i, el in enumerate(data.splitlines()):
    if i == 0:
        continue

    el = el.split()
    try:
        x, y, w, h = list(map(lambda x: int(x), el[6:10]))
        cv2.rectangle(img, (x, y), (w + x, h + y), (255 , 0, 0), 1)
        cv2.putText(img, el[11], (x+x, y-20), cv2.FONT_HERSHEY_COMPLEX, 1, (255, 255, 255), 1)
    except IndexError:
        print("Операция была пропущена")

cv2.imshow('Result', img)
cv2.waitKey(0)
```

Figure 1. Final program code

Figure 2. The image that was loaded into the program

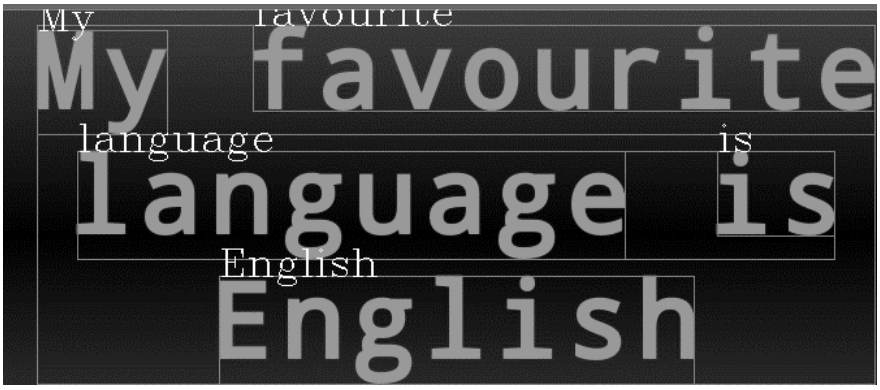

Figure 3. Graphical display of text on an image

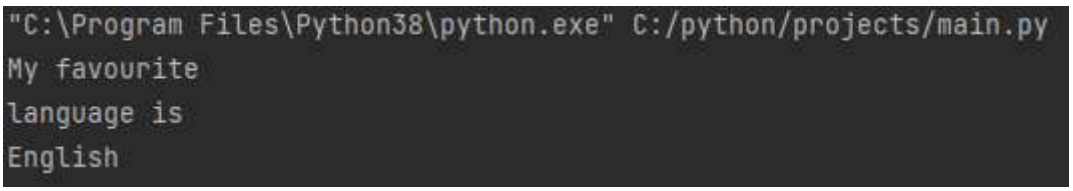

Figure 4. Console display of program execution

Python is the undisputed leader in OCR at the moment. And first of all, all the tools and libraries appear on it. The text reader can always be supplemented by using various functions of OpenCV. Tesseract library together with OpenCV is by far one of the simplest and most convenient ways to recognize text from images.

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УДК 61.007

CARGO LIFT CONTROL SYSTEM

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Abstract. This article proposes a control system for an electromechanical hoist, based on a frequency-controlled asynchronous electric drive using the vector control method, as well as a safety device that protects the hoisting winch mechanism from the overlap of the pulling cables.

Keywords: electromechanical cargo hoist, variable frequency asynchronous electric drive.

СИСТЕМА УПРАВЛЕНИЯ ГРУЗОВЫМ ПОДЪЕМНИКОМ

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Аннотация. В данной статье предлагается система управления электромеханическим подъемником на базе частотно-регулируемого асинхронного электропривода по методу векторного управления, а также устройство безопасности, защищающее механизм подъемной лебедки от перехлеста тянущих тросов.

Ключевые слова: электромеханический грузовой подъемник, частотно-регулируемый асинхронный электропривод.

This article presents a solution to a control system for an electromechanical hoist (Fig. 1) based on a frequency-controlled asynchronous electric drive, as the most reliable, cheap and easy-to-use option with a high load-carrying capacity and accurate positioning in the loading and unloading

zones. In this case, the lifting cabin can be of a sufficiently large capacity, which is important for bulky cargo, and the floor of the cabin can be stationary, with weight meters placed in blocks.

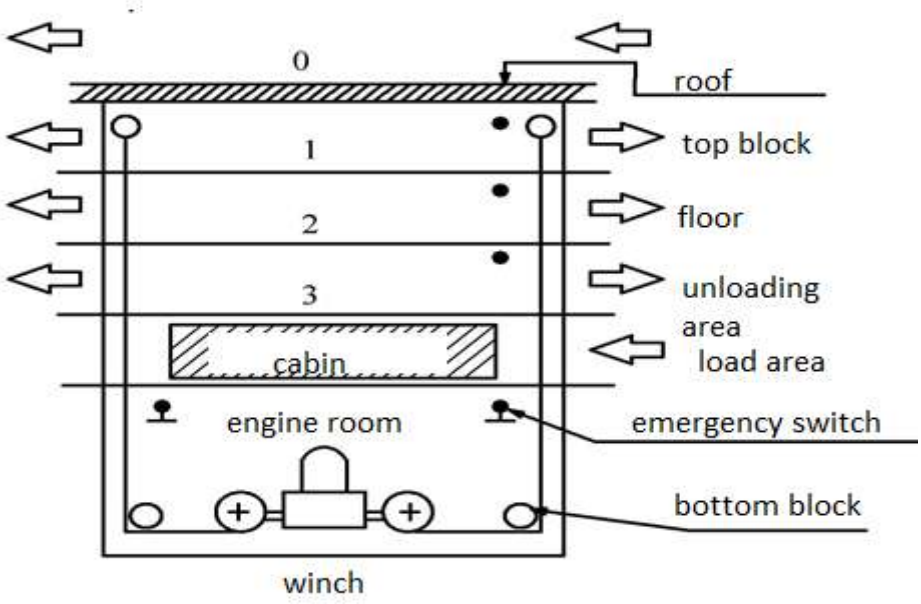

Figure 1. Control system of a cargo hoist,
arrangement of mechanisms and sensors

The proposed block diagram (Fig. 2) of the control system of an electromechanical cargo hoist can be used for vertical movement of bulky goods, for organizing intra-warehouse work, including multi-level storage facilities, garages, etc. A feature of this type of lift is a counterbalanced kinematic scheme, which makes it cheaper and less overall. This type of lift is a cargo lift, the transportation of people in it is prohibited.

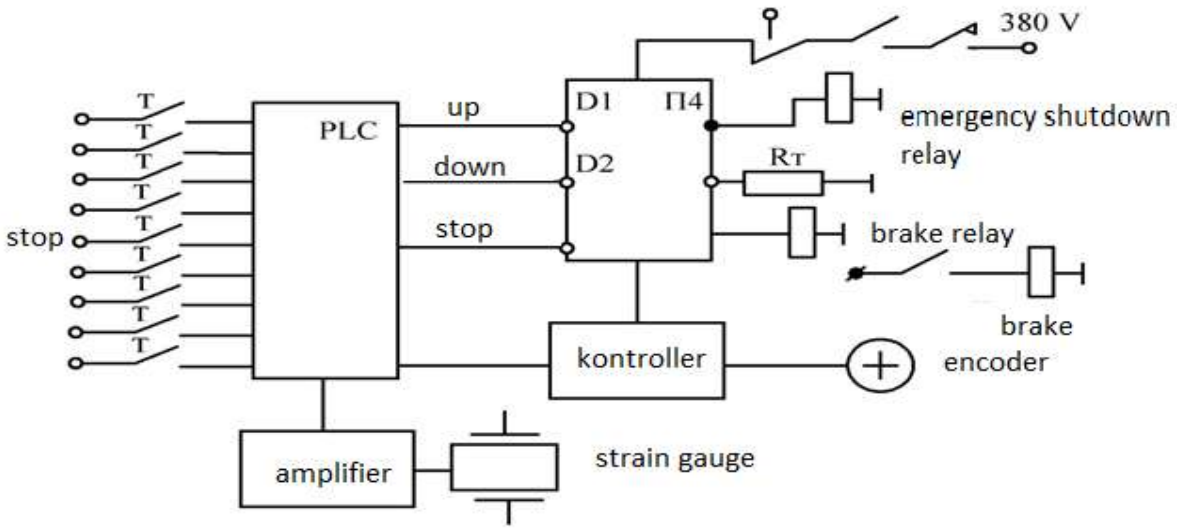

Figure 2. General control block diagram

The main element of the system is a double-drum hoist (Fig. 3) with outlet blocks with 4 points of attachment of the pulling cables. On each floor there are electromechanical limit switches for unlocking the entrance doors of the lifting car. The lifting levels can reach up to 20 m, which is approximately four technical floors and the machine room; this determines the drum capacity and, accordingly, the drive power. With sufficient lifting capacity, the speed of the cab is within 0,25 m/s. The cables are fastened in such a way that it is possible for the cab to reach the zero level, or the technological roof of the building. This circuit uses an incremental encoder with 1000 pulses per revolution.

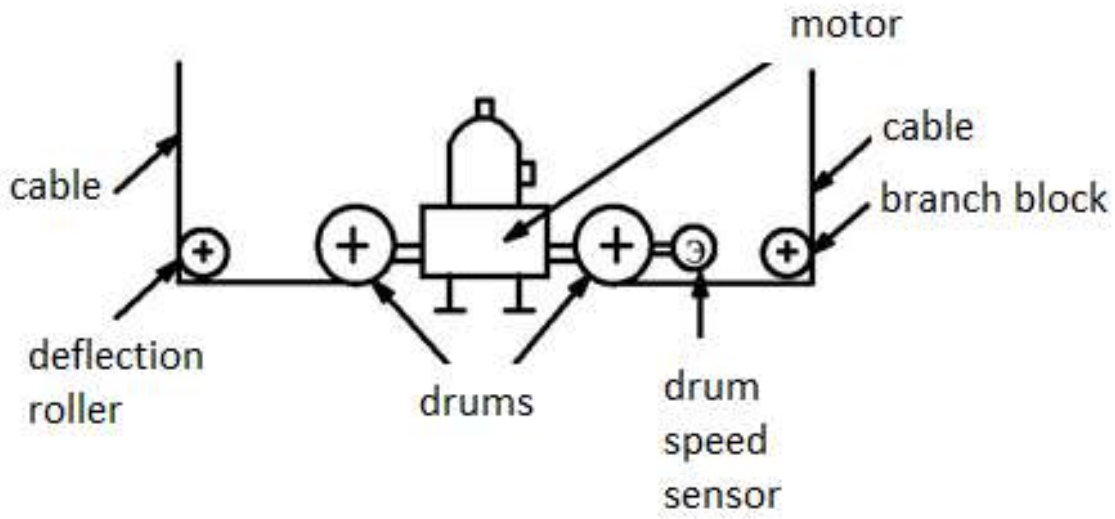

Figure 3. Hoist winch diagram

The functions of memorizing the position are assigned to the controller. In the proposed scheme, almost any modern controller (PLC) can be used (Fig. 4), which has up to 16 inputs – outputs, a counting input (up to 200 kHz), an analog input of 4-20 mA, load measurement by means of axial strain gauges for fixing the weight of the lifted (lowered) loads, and an analog output to perform the function of a smooth approach to the floor by adjusting the speed, acceleration and deceleration of the winch.

Control functions are performed by push-button stations with the indication of the cab location zone, which provides for minimizing the volume of the system as a whole and ensuring ease of operation and equipment repair.

A similar lifting method using hydraulics is much more expensive and more difficult to operate. Cab speeds can reach 0,3 m/s, which is acceptable for use in modern production facilities.

Button functions are as follows:

- blinking button indicates where (floor) cabin is directed;
- constant glow button indicates where the cabin is.

For commissioning and emergency modes, the controller is duplicated by an electromechanical relay circuit to control a frequency-controlled electric drive of the winch. The emergency button makes it possible to stop the movement of the lift immediately.

Depending on the volume and weight of the payload, the power of the electric drive can be from 5 to 16 kW. Optimum payload weight is from 1 to 5 tons. In some cases, a loader (electric car) can drive directly into the cab [1].

The control board, as an option of a variable frequency drive, allows one to control the rotation speed of the hoist winch and disconnect it from the network in cases of emergency.

In this case, to solve the problems of speed and torque control in an asynchronous frequency-controlled electric drive, the vector control method is used, which makes it possible to provide:

- high accuracy of speed control;
- smooth rotation of the engine in the area of low speed values;
- the ability to provide the motor torque rating at zero speed;
- quick response to load changes;
- the possibility of obtaining the maximum moments of the electric drive in starting and braking modes, exceeding the value of the critical moment of the asynchronous electric motor.

When moving loads, both vertically and horizontally, situations arise when the pulling cable gets slack or overlaps on the drum. A safety device was tested in real conditions, which allows disabling the move instruction of the lifting mechanism. Insulated plates on spring stops were used as sensory elements [2]. For the reliable operation of the trip relay for the move instruction of the lifting mechanism, forming amplifiers HRH-5 were used. When the cable of the sensor’s element was lightly touched, the relay triggered and turned off the move instruction of the lifting mechanism. The trip sensitivity of such a sensor can be set up to 1 mm. This is especially important when operating a hoist or load handling device in dusty rooms where the cable is covered with deposits. The relay and amplifier were assembled in a single housing [3]. Thus, the modified device for disconnecting the command for the movement of the lifting mechanism or device for moving the load does not require large investments and is easy to operate. During the prototyping, two duralumin alloy plates on insulators were used, each of which triggered when the load was raised or lowered. A diagram of the safety device is shown in Fig. 4.

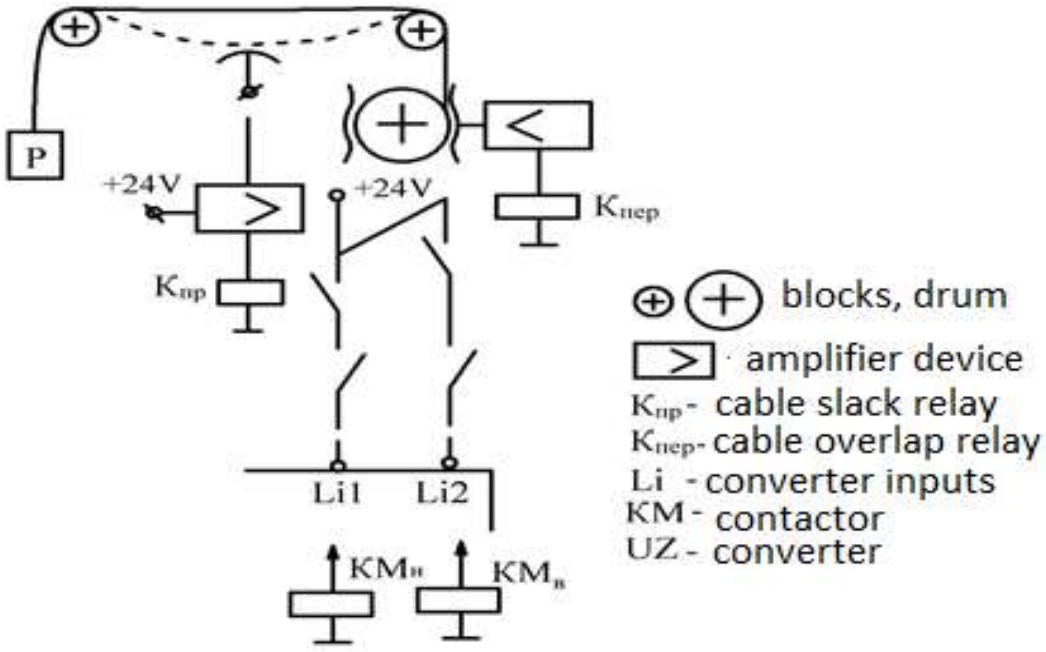

Figure 4. Safety device diagram

The prices for the analogs of the lift are quite high. In the context of the need to solve the problems of import substitution, as well as due to the existing possibility of using domestic software, the relevance of continuing work in the field of research and development in this direction seems to be very promising [2]. Already now we can say that the use of encoder can be considered both as a positioning element and as a safety element; and a strain-gauge in a winch cable system can act both as a control element, and as a feedback link in a closed control system of an electric drive of a hoist. In order to increase the degree of error-free execution of commands, this system provides for the presence of push-button control with a corresponding indication of instruction execution, as an additional factor of reliability [4]. At the same time, it is advisable to consider the possibility of embedding a touch panel into an existing system, which would connect it to a high-level control system through an appropriate interface.

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УДК 62-835

THE NEED FOR INVESTMENT ACTIVITIES FOR NATURAL PERSON

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Abstract. The article presents arguments about the need to re-transform the most valuable human resource – time. The scenarios from earnings received from employment to receiving a passive source of income from invested funds are considered. Productive assets are analyzed and how the creative component of the business is determined, as well as what you can rely on to calculate the future potential profitability from the selected asset class. The author explains why investors call the stock market a casino with a positive mathematical expectation, and describes how you can make money on it.

Keywords: self-development, financial literacy, stock market, economy, investments, stocks, potential profitability, money.

НЕОБХОДИМОСТЬ ИНВЕСТИЦИОННОЙ ДЕЯТЕЛЬНОСТИ ФИЗИЧЕСКОМУ ЛИЦУ

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Аннотация. В статье приводятся доводы о необходимости перетрансформирования самого ценного человеческого ресурса – времени. Рассмотрены сценарии от заработка, получаемого от работы по найму, до получения пассивного источника дохода от вложенных денежных средств. Разобраны производительные активы и как определяется созидательная составляющая бизнеса, а также на что можно опереться, чтобы посчитать будущую потенциальную доходность от выбранного класса активов. Автор объясняет, почему инвесторы называют фондовый рынок казино с положительным математическим ожиданием, и описывает, как на этом можно заработать.

Ключевые слова: саморазвитие, финансовая грамотность, фондовый рынок, экономика, инвестиции, акции, потенциальная доходность, деньги.

What abilities should a person have in the modern world to be successful?

In the XVI century, it was enough to be able to sit perfectly in the saddle and skillfully wield a sword, so that people of that time considered you quite a prosperous person. Now these skills are something rather exotic. In the 80s, 90s of the last century, the ability to use a computer, as well as the ability to drive an electric train, was just one of the options for continuing professional activity. Today, without the skill of typing on the keyboard, or the ability to use a mobile phone, it is extremely difficult to imagine the life of an ordinary person, especially if it is not about people of the older generation.

Many of us have been instilled from childhood with the idea that in order to become successful, you need to study well at school, go to college, get a specialty, get a job at a factory, work hard, become a master of your craft and ... all this will allow you to have a decent salary and ultimately provide a comfortable old age for you and your children.

But it often happens that a person spends almost all of his earned income on consumption, figuratively speaking, he lives “from paycheck to paycheck”. Unfortunately, this is not enough for many of us, they are eager to own something much bigger right now. And instead of systematically increasing their sources of income and accumulating capital, they, on the contrary, get into debt, use loans, which take a significant part of this old, still unchanged income to secure [1]. And, as often happens in such situations, there is a kind of force majeure, a black swan. A person falls under a reduction at work. He or someone close to him is seriously ill and urgently needs money for treatment, and there is no monetary “airbag”. Out of desperation, he has to climb more and more into debt bondage, from which there is no easy way out. He is forced, without raising his standard of living, to borrow more and more in order to give even more in the form of interest on the loan. Thus, a person falls into a closed loop, a kind of trap. He has to work harder and harder to pay off his mounting debts, and this happens day after day, month after month, year after year. Rat race. A person becomes dependent on everyone, from the bank, from the employer, from the state.

In addition, as it turned out, it is not enough to be just a highly paid specialist and a professional in your field. For example, great artists and athletes such as Vincent Van Gogh, Paul Gauguin, Garrincha died in poverty.

So, it becomes obvious that one of the most important skills of a successful person in the modern world is the ability to manage the results of their work.

Sooner or later, some of us think about savings, about becoming financially independent, to ensure a comfortable old age for ourselves, our children and grandchildren. But how to achieve this?

To some extent, the state will take care of us. We work, some part of the money we earn goes to the pension fund, and in the future, upon reaching a certain age (old age) or conditions (for example, disability), these funds are returned to you back in the form of monthly payments – pensions. The problem is that its size is so small that it will not be able to provide even habitual coexistence, not to mention the transfer of some material values to children and grandchildren [2].

In developed countries, the situation is completely different. We have all seen elderly tourists from abroad. They travel the world, rejoice and enjoy life. These are not some bankers and oligarchs, basically they are the same ordinary people as you and me. So why do some manage to enjoy the benefits of humanity, while others have to be content with going to grocery stores, waiting in line at polyclinics or to receive a pension? What allows some to indulge in freedom-loving dreams on a well-deserved vacation, and others to think about how to last until retirement payments or salaries next month?

The thing is that in Western countries, in addition to high pensions, the investment culture is well developed. Many Americans or Europeans save part of their wages from an early age, and buy securities with it, whether they are exchange-traded investment funds or ordinary shares, it does not matter. It is important that they consciously increase not only the size of their capital, but also the investment passive income, which over time may far exceed the size of the official salary.

There are several ways to save and increase your capital – these are deposits, bonds, real estate and stocks. It is worth mentioning raw materials, food and other groups of goods, such as gold, oil, cotton and even corn, as well as jewelry and antiques. All other stock market instruments (such as futures and options) these are the first and second derivatives of these instruments.

So, what types of assets can you invest your free money in?

I think that first of all it is necessary to divide all assets into two large groups: productive and unproductive. Productive assets are assets that involve the creation of added value. These include:

– Business (shares) as an organization whose main purpose of activity is to make a profit;

– Deposits and bonds as instruments in which mainly a predetermined cash flow is a payment for the use of borrowed funds;

– Real estate that, when rented out, brings rental income, and increases in price at different stages of construction readiness.

Unproductive assets are assets that lack a creative component.

Commodities and currencies (cryptocurrencies) are assets that do not generate cash flow, since the very nature of these assets does not imply the creation of any added value [3].

For example, a person who owns a business (stocks), bonds or real estate can receive income – cash flow in the form of dividends, coupons or rent, even if the price of the underlying asset remains unchanged. In the case of investing money in currency or goods (gold, oil, etc.), a person does not become richer only from owning these assets, since they themselves do not create added value, and, as a consequence, cash flow. The whole calculation boils down to the expectation of an increase in the market value of these assets, which is determined by volatile market conditions or inflation.

Thus, it turns out that profit-generating assets make it possible for an investor to earn from the very possession of this asset, unlike assets in which there is no creative component, and in which it is possible to earn only on speculation.

In addition, the value of value-added assets tends to grow faster. This is because in addition to inflation, which increases the cost of goods sold by the enterprise, an increase in the efficiency of the business itself also works to increase the company's revenue.

For clarity, let's analyze the example of gold.

Often people, in an attempt to save their earned money, invest it in gold (directly in the form of bullion, coins or through some kind of index fund). An alternative, which, unfortunately, many do not notice, is to invest the money earned in shares of a gold mining company.

A person who has bought gold with his savings will make a profit only as a result of an increase in the value of this metal. Most likely (sooner or later) this will happen because inflation and the growth of the money supply in the world devalue national currencies. But at the same time, an investor who has purchased shares of a gold mining company will make a profit annually, even if the price of gold has not changed during the year, not to mention the growth of stock quotes. This will happen due to the fact that the company sells its goods at a certain margin, while the investor's profit will be expressed either in an increase in the value of the company's shares or in the amount of dividends paid. Additionally, if this is a high-quality business, but only such, I advise the investor to choose, because unlike a speculator who plays (wants to make money) on fluctuations in quotations. The investor chooses, based on the fundamental indicators of a company that is working to increase the efficiency of its business (greater production, lower cost, better quality of products, most likely in the future all this will be reflected in a higher business valuation and,

consequently, (which by the way does not always happen) more expensive stock quotes [4].

Thus, investing in shares of a gold mining company, in my subjective opinion, is more attractive in terms of investment than buying gold. It is much better to own assets that generate cash flow, since the increase in their value is much faster than the increase in the value of assets that lack a creative component.

It has been scientifically proven that stocks are an asset class that ensures maximum growth of well-being in the long term (I emphasize, in the long term), and they should form the basis of future pension savings. After all, unlike casinos and other peculiar lotteries, there is a positive mathematical expectation of your investments on the stock market here.

But what is an action? And what do you gain by becoming its owner?

A share is a security that assigns the following rights to its owner (shareholder):

– The right to receive part of the profit of the joint-stock company in the form of dividends;

– The right to a part of the company's property remaining after its liquidation;

– The right to participate in the management of a joint-stock company.

Let’s talk in more detail.

So, by opening a limited liability company (LLC), you become a 100 % owner of the business, that is, you own the entire profit (loss) of the company, and you fully manage the daily activities of this company.

In a joint-stock company, all rights are distributed among all shareholders, in proportion to the number of shares owned by them. In this connection, there are such concepts as: controlling, majority and minority shareholders.

A controlling shareholder is a major shareholder who manages himself or together with his affiliates a block of shares, the size of which allows him to ensure the election of his representatives to the board of directors of a joint-stock company in the amount of more than half of its composition.

Majority shareholders are owners of large blocks of shares, the size of which allows them to have a direct impact on the decisions taken on the management of the company. They usually have the opportunity to nominate one or more of their candidates to the board of directors, which will subsequently manage the company’s activities [5].

Minority shareholders are shareholders of the company whose size of the stake does not allow them to participate directly in the management of the

company (for example, by forming the board of directors). Such a block of shares is called non-controlling.

Since most citizens of the Russian Federation do not have the so-called “commercial vein” and cannot competently manage their own business, it turns out that the status of a minority shareholder is the only possible status for the vast majority of the population to invest their money in a working business. After all, investing in stocks is one of the few ways to protect your savings from inflation, and the best in the long run.

Of course, we, as minority shareholders, are not able to manage the joint-stock company directly, and I doubt that we will receive an equivalent replacement for our investments in the event of liquidation of the joint-stock company (I understand that you can argue, but what about the P/B ratio. Market capitalization / Book value, because if it is less than 1, it means that after the sale of the issuer's property and other assets, shareholders are more likely to be able to receive the entire amount due to them. But... there are a few nuances.

Have you ever wondered why, if the market value of the company is cheaper than the book value, the management will not buy part of its shares from the market, because it is beneficial for shareholders? There are two main options here, either the price of fixed assets in the reporting is displayed as historical minus depreciation and may differ greatly from the market value, or the purchase price was initially clearly inflated, conditional teaspoons for 100,000 rubles. Therefore, as a rule, in the Russian market, most state-owned companies trade with relatively low P/B multipliers, reflecting the inefficiency of management, from the investor”s point of view.

For example, Gazprom currently has this coefficient of about 0,6. That is, the market estimates the company at 60 % of the value of its book capital (pipes, plants, equipment, etc.). For nothing, and you need to rush to buy before the market wakes up? Or is there still some reason, since even its own board of directors has not done anything for so long?

If everything is more or less clear with the right to distribute part of the company’s property remaining after its liquidation and the right to participate in the management of a joint-stock company. And in my subjective opinion, an ordinary investor does not have to count on anything here in case of extremely negative events. That is, all shareholders without exception, of course, in equal shares, and in proportion to the number of shares “on hand”, claim to receive part of the profits of a joint-stock company in the form of dividends (if the company’s management decides that it will be distributed). That is, conditionally, Bill Gates will receive $ 10,000 for 10,000 Microsoft shares, as well as Vasya Pupkin $ 1 per 1 share (here and further we will talk about ordinary, not preferred shares ... yes, there are also such). The main thing to

remember is that everyone will receive the same amount of dividends per share (if they are distributed anyway), and the rest depends on the initial size of the investment in this company.

I think you have already guessed that the entire market can be divided into value stocks (these are those companies that already distribute a significant part of their income among shareholders) and growth stocks (which leave all profits inside the company and let it go for their further development, for example, for a store it can be an increase in the range of products, the opening of new outlets, etc.). This is all done so that someday in the future these same dividends are significantly more than they could be now. Consequently, the more mature the company becomes, and the more difficult it becomes to capture the market, the more likely it is that soon it will begin to share most of its profits with shareholders.

I have no right to advise you which shares should be purchased if you want to save or, conversely, increase your capital. I can only express my personal opinion, which of course is not a recommendation or a plan for action for you. And all this is a topic for a separate conversation, and is not included in the scope of this article. Now I want to talk about protection.

After all, protecting the rights of minority shareholders and increasing confidence in the stock market is one of the main economic tasks of the state. This ensures the development of the economy, which means an increase in the standard of living of people.

By increasing confidence in the stock market, the state achieves amazing synergy: on the one hand, it increases business activity and develops the economy, which means it increases the standard of living of the population, on the other hand, it gives people the opportunity to take care of their own well-being and future pensions, which means to be financially protected and independent [6].

That's why the American market is so highly developed. Because the American government has provided everything necessary for this. And instead of investing our money in our domestic business and developing our economy, therefore, raising our own standard of living, we prefer to invest in American stocks, improving their economy and their standard of living. Because we consider it more financially reliable and secure, and possibly more profitable for ourselves personally. And this is a huge flaw in our state. I hope that in the coming decades the state will realize its role and the situation will gradually change for the better.

How and when is it better to buy stocks?

It seems to be simple, the cheaper you bought and the more expensive you sold, the more you earned. But, firstly, it makes no sense to look for the

maximum and minimum points in individual stocks, since on the long-term horizon, you still won't succeed. Most likely, you will turn into a speculator who plays on the fluctuations of the exchange rate, and thus feeds the broker. I will not give an analogy here about shovel sellers who made excellent money during the boom of gold prospectors.

Investing in stocks is an investment in a business. For example, an entrepreneur may consider investing in three different businesses: a restaurant, a store, or an entertainment center. At the same time, he analyzes business plans, estimates the volume of required investments and possible income streams, after which he chooses the most profitable business and invests money in it. If, over time, the expected profitability of one business decreases and the other increases, the entrepreneur will not be able to technologically exit a less profitable business and invest money in another, more profitable one. If the shares of a store, restaurant and entertainment center were traded on the market and had good liquidity, then an entrepreneur would be able to do it easily and technologically.

A liquid (stock exchange) stock market is, first of all, an opportunity for technological entry into and exit from a business, and not a mechanism for playing on market fluctuations in exchange value.

The cost of each business is determined by two main factors: the ability of this business to generate income for shareholders and the minimum required profitability with which investors are willing to invest in it, taking into account all its risks.

Potential profitability is the main criterion for investing. The future value of shares is determined based on the forecast of cash flows (profits) generated by the business for shareholders and the forecast of the minimum required profitability with which investors are ready to invest in this business in the future. For each asset traded on the market, analysts calculate its future value [7].

The future value of the bonds is determined by the size and schedule of coupon payments, and the forecast of the yield with which investors will be ready to purchase these bonds in the future. This yield also depends on the forecast of the issuer’s credit quality, maturity and liquidity of a particular issue, as well as the level of interest rates in the country.

The future value of real estate is determined by the amount of funds that will be directed to this market and the volume of supply in the real estate market.

The current value of the asset, the forecast of the future value, as well as the forecast period determine the potential return on ownership of the asset. The forecast of potential profitability for all assets traded on the market allows you

to evaluate the entire field of investment opportunities and invest only in the most potentially profitable assets.

If investors plan to invest in a business with a 50 % annual return (that is, they want the business to pay off in two years), then they will be ready to buy a business that brings in $100,000 a year for $200,000. If investors plan to invest in a business with a yield of 20 % per annum (that is, they want the business to pay off in five years), then they will be ready to buy a business that brings in $100,000 per year for $ 500,000.

What happens? The business still generates an income of $100,000, but its valuation has changed 2,5 times. This difference is explained by the different profitability that investors demand from investing in a business, and it, in turn, depends on the level of interest rates in the economy.

This is a vivid illustration of how the forecast of interest rates directly affects the success of investing!

The level of interest rates is the most important macroeconomic indicator.

Each group of assets, depending on the risk measure, corresponds to a certain range of profitability with which investors are ready to purchase them. The profitability of the most reliable assets determines the base level of interest rates. Investors expect higher returns from riskier assets. Changes in the base level of interest rates affect the profitability of all asset groups [8].

As a rule, the potential yield of stocks is higher than that of bonds, since stocks are an asset with a higher measure of risk. Risk and profitability are “two sides of the same coin”. At the same time, each investor strives to get maximum profitability with a minimum level of risk. Very often, current quotes are subject to fluctuations in the market. These momentary market sentiments do not always give grounds for revising future asset prices based on the fundamental economic performance of companies.

As you have already understood, the company’s financial statements are of interest to me from the perspective of forecasting specific future economic indicators and their transformation into the future exchange rate value of the stock. I want to understand what the company plans to become in the future, what profit it will generate for its shareholders and what the value of the stock will be from the perspective of a rational investor. Therefore, I believe that the financial annual and quarterly reports form the basis of the issuer’s reporting.

In the long term, it is impossible to get a stable profit from playing on fluctuations in the value of assets (speculation). In addition, the value of assets that create added value, as a rule, grows faster than the value of assets that do not create added value. The purchase or sale of derivative financial instruments (futures, options, etc.) is equivalent to making a bet, the result of which depends on the change in the underlying asset. Since I do not have the competence in

guessing the price of an asset on a specific date, and I also believe that this is in principle impossible on a permanent basis, I do not include this list of assets in my investment portfolio, but invest only in assets that involve the creation of added value.

It has been scientifically proven that regular and uniform purchase of shares is not “another new ideal trading system”. This is the use of the stock market for its intended purpose and in accordance with its physical meaning. This is a convenient and technological way to invest your money in a working business. This is a way to exchange your money, that is, the results of your work in the present for the work of other people in the future. Of course, not all stocks give the same result, but portfolio diversification will help here, that is, you do not need to put all your eggs in one basket.

There is also a useful mental technique: to abandon the measurement of your well-being in money and switch to its measurement in stocks. It is necessary to save not money (which depreciates), but stocks – as part of a business aimed at profit and value creation. Remember that according to statistics, stocks are growing in the long run, and money is getting cheaper.

The potential return on money is zero, and cash can end up in the portfolio as an asset only if all other assets have a negative potential return (if you predict a fall in future prices for all assets without exception). It is unlikely that such a situation is possible in practice, since there are always at least short-term bonds or savings accounts / deposits with a minimum yield that will simply be repaid in the near future [9].

In my opinion, such popularity of deposits is due to the low financial literacy of the population. The school does not teach how else you can effectively manage the results of your work. People keep all their savings in the bank, where they are “eaten up” by inflation from time to time. When a person decides to take money to the bank, he keeps the following in mind:

“The bank will return the deposit to me anyway”;

“Money will start working in the bank, bringing a stable income”;

“Most likely, I will not need money during the term of the deposit, so I do not risk much interest”.

But! The bank may go bankrupt and not return your deposit back. In case of revocation of the license from the bank (or its liquidation), the deposit is returned to you by the deposit insurance agency (DIA), and only in the amount not exceeding 1,4 million rubles in one bank. That is, if Vasya Pupkin, who is already familiar to us, opens a deposit in one bank and puts all the family savings there – 2 million rubles, and the bank’s license is revoked, Vasya will get back only 1,4 million rubles – because the DIA no longer returns. At the same time, Olya, who has accumulated 2 million rubles, but put them in two

banks – one million each, is in a more favorable position. Even if the license is revoked from both of these banks, Ole will be compensated for the entire accumulated amount. Because the limit is set based on one bank, and not on all the depositor's money.

At the same time, it makes no sense to compare the reliability of stocks and deposits and choose between them – it is necessary to combine both types of investments. The advantages of a deposit are in stability, shares – in long-term profitability. A person should have a clear idea of how much money he will need now and in the near future, and what part he can safely and painlessly leave untouched and invest for a longer period to improve his well-being in the future. This is a way to exchange your earned money, that is, the results of your work now – for the work of other people in the future. That is, by buying shares of a conditional Lukoil or Sberbank, you acquire a piece of this company, that is, you become the recipient of part of the profit from the labor of all those employees who work there. Moreover, it no longer matters to you when they retire, and their working resource will be exhausted, because others will come in their place, and you will still receive a piece of profit from the pie that the company earns [10].

The key objective of this article was to create a correct understanding of investments and the stock market. After all, successful investments require an understanding of how to be an effective owner. The economy of our country will be developed, and the standard of living will be high only when the broad strata of the Russian population become owners of the future of their country. I hope that I was able to shed some light and raise the level of your financial literacy and think about your future and the future of your homeland.

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PHYSICO-CHEMICAL METHODS OF WATER PURIFICATION FOR HOUSEHOLD NEEDS

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Abstract. The article discusses the main methods of wastewater treatment, presents the basic requirements for water quality, describes the main types of pollution, and describes the types of coagulation in water treatment.

Keywords: chemical and physical methods, water treatment, coagulation, adsorption.

ФИЗИКО-ХИМИЧЕСКИЕ МЕТОДЫ ОЧИСТКИ ВОДЫ ДЛЯ БЫТОВЫХ НУЖД

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Аннотация. В статье рассматриваются основные методы очистки сточных вод, представлены основополагающие требования к качеству воды, описаны основные типы загрязнений, а также описаны виды коагуляции в водоочистке.

Ключевые слова: химико-физические методы, водоочистка, коагуляция, адсорбция.

Clean water occupies one of the most important places in human life. The existence of almost all living organisms depends on it. With the help of water, the body receives nutrients in the form of vitamins and mineral salts. With the development of industry, pollution of rivers, lakes and other water bodies with harmful substances occurs all over the world. Since natural sources of drinking water are gradually being depleted, water from rivers, lakes and even seas is increasingly being used today, so it must necessarily undergo certain types of treatment that can make it drinkable. In nature, the properties of these sources often do not coincide with the characteristics of drinking water and suitable for

domestic consumption. In the environment, water is rich in minerals and a variety of salts. Many of them in high concentrations are harmful to humans. When a person consumes water, certain difficulties arise. The use of water of poor quality negatively affects the functioning of vital systems of human organs, and also contributes to the breakdown of equipment. That is why water coming from any sources must be treated and disinfected.

The lack of fresh water is already becoming a global problem. The growing demands of industry and agriculture for water force us to look for various ways to solve this problem. A significant role in increasing water turnover can be provided by the introduction of innovative high-performance water treatment technologies, especially physico-chemical ones, of which one of the most effective is the use of the reagent method. The use of this method of wastewater treatment does not depend on the toxicity of the impurities present, and in comparison with the method of biochemical purification is important.

Accordingly, the protection and rational use of water resources is one of the links of the global problem of environmental protection. At the present stage, the areas of water resources management are being determined: wider use and reproduction of freshwater resources; development of new technological processes to prevent pollution of reservoirs and reduce freshwater consumption. Drinking water is an important factor for human health. Almost all of its sources are subject to anthropogenic and technogenic effects of varying intensity. The problem of drinking water quality affects many aspects of human society throughout its history. Among the many areas of modern technologies aimed at improving people's living standards, improving settlements and developing industry, water supply occupies a large place. After all, water is an integral part of all living organisms, whose vital activity is impossible without water. Pollution of oceans, seas, lakes, rivers is a huge danger for all living organisms, especially for humans. For the normal course of physiological processes in the human body and for creating favorable living conditions for people, the hygienic value of water is very important. Currently, providing the population with high-quality water has become a real problem.

1. *Types of pollution.* One of the most important problems of water supply is the creation and use of such methods that will give the greatest effect when cleaning surface waters used for drinking purposes. The most common impurities that impair the quality of drinking water are: suspended solids, organic substances of natural origin, organic substances of man-made origin, microorganisms, calcium and magnesium salts of carbonic, sulfuric, hydrochloric and nitric acids, iron and manganese compounds, nitrogen compounds, hydrogen sulfide, methane [1].

The large turbidity of the water indicates its significant contamination with suspended solids, water of this quality cannot be used for household and drinking purposes. Water containing organic substances causes unpleasant odors, increases color and has a negative effect on the human body. Microorganisms in the water can cause various diseases. The high concentration of magnesium and potassium salts make the water unsuitable for household needs. In hard water, the consumption of detergents increases during washing, dishes and water heaters fail. The content of iron and manganese give the water a reddish-brown or black color, lower the quality of taste and contribute to the development of iron bacteria. High iron content in the body increases the risk of cardiovascular diseases, as well as various liver diseases. Water containing manganese has an astringent taste, color, and has a toxic effect on the body. When using drinking water contaminated with nitrates, nitrosamines are formed in the human body, which have carcinogenic properties that contribute to the formation of malignant tumors.

The method of water purification is chosen according to several criteria: the properties and stock of the source water, the required amount of product and the receptivity of the sewage system to receive pollutants released from the water.

2. *Water quality requirements.* The sources of water supply of centralized water supply systems are ground and surface water, as well as precipitation. The quality of water from natural sources is determined by the presence of substances of inorganic and organic origin, as well as microorganisms and is characterized by various physical, chemical, bacteriological and biological indicators.

Physical indicators include temperature, smell, taste, turbidity, color, electrical conductivity.

Chemical indicators of water quality are the total amount of dissolved substances or dry residue, calcined residue, pH of water, oxidizability, alkalinity, gas content, presence of nitrogen-containing compounds, chlorides, sulfates, iron, manganese, calcium, magnesium, some toxic and radioactive substances [2].

Bacteriological or sanitary indicators characterize the total bacterial contamination of water.

Biological indicators determine the presence of aquatic organisms located on the surface and in the water column or located at the bottom of the reservoir, shores and on the surface of underwater objects.

3. *Coagulation of water. Types of coagulation in water treatment.* The particles of the dispersed phase resist sticking together due to different mechanisms. This ability is due to the formation of a double electric layer on the surface of the particles of the dispersed phase, which provides electrical

stabilization of the dispersed system. And the molecular adsorption mechanism of stabilization also works, which consists in the formation of adsorption layers around the particles, consisting of molecules of a dispersed medium and substances dissolved in it. There is a kinetic stability factor – a low frequency of collisions of dispersed particles.

Sols (colloidal solutions) differ from coarse-dispersed and molecular systems by aggregative instability, so they change both over time and with the addition of various substances [3].

The essence of the mechanism of water purification from suspended colloidal particles consists in disturbing the equilibrium state of the system – eliminating the balance of forces that do not allow particles to settle. To achieve this goal, the process of coagulation of colloidal impurities is used.

Coagulation is the process of coalescence of colloids into larger aggregates, which occurs as a result of their collisions during Brownian motion, mixing or directional movement in an external force field, the addition of coagulants. At the same time, precipitation – coagulate occurs.

Coagulants (most often soluble salts of iron or aluminum) enhance the coagulation process. The introduction of these substances into the water contributes to the formation of a new poorly soluble phase (as a result of hydrolysis). Thus, the coagulation process consists in the progressive enlargement of particles and a decrease in their number in the volume of the dispersion medium [4].

Coagulation can be slow and fast. With slow coagulation, only a small part of the collisions of colloid particles leads them to stick together, and the coagulate does not fall out. With rapid coagulation, each collision is effective and entails the adhesion of particles, and a precipitate is gradually formed in the colloidal solution.

The minimum concentration of the dosed substance initiating the coagulation process in a system with a liquid dispersion medium is called the coagulation threshold. Under certain conditions, coagulation is reversible. The process of transition of the coagulate back to sol is called peptization, and the substances provoking this process are peptisers. Peptizers, being stabilizers of dispersed systems, are adsorbed on the surface of particles, weakening the interaction between them, resulting in the disintegration of aggregates. The return to the primary state is especially effective when surfactants are introduced into the medium, which reduce the surface interfacial energy and facilitate fine grinding of solids or liquids [5].

Methods of water purification before drinking is the process of preparing natural water, which includes various methods of removing pollutants.

4. *Adsorption methods.* Adsorption methods of water purification are based on the phenomenon of adsorption from solutions – the process of

concentrating individual components of a solution on a solid surface of a porous material. Two types of adsorption are mainly used in water treatment:

– ion exchange – interfering ions are removed from the water during their exchange to neutral ions associated with functional groups on the surface of the adsorbent (most often to sodium ion in the case of cation exchange, and chloride ion in the case of anion exchange). Ion exchange adsorbents in water purification processes are most often porous spherical polymer granules containing special functional groups for the extraction of cations (cation exchangers) or anions (anion exchangers).

– physical adsorption (sorption) is interfering components are removed from the solution due to direct interaction with the surface of the adsorbent. Sorbents are used to remove organic substances, chlorine, taste and odor correction. The most famous sorbent of this type is activated carbon. In water treatment, granular activated carbon is most often used, which is granules of coal of various origins (anthracite, coal obtained from the shell coconut, wood, etc.), treated with hot water vapor under special conditions to create a developed pore system. Polymer sorbents are becoming increasingly popular for the removal of organic substances of natural origin.

An important characteristic of any adsorbent is its capacity. The capacity of the adsorbent characterizes the amount of impurities that can be removed from the water by one liter or kilogram of adsorbent. After filling the adsorbent with impurities, it loses its adsorption capacity. The adsorption capacity of polymer adsorbents can be completely restored with the help of special solutions. The regeneration of activated carbons can be carried out by steam, but if they are used to remove organic substances of natural origin, this process is ineffective. Based on the capacity of the adsorbents and the composition of the source water, the resource of the adsorption water purification plants is calculated, that is, the amount of water that the filter can purify before the loss of the adsorption capacity of the adsorbents. Thus, when water comes into contact with adsorbents of one type or another, the composition of water is adjusted, the nature and quantitative indicators of which can be calculated based on the composition of the treated water and the time of its contact with adsorbents. This contact is made when water passes through an adsorbent layer created in a cylindrical container, and its time is regulated by the rate of water flow through the adsorbent layer.

The diverse composition of pollutants provides for the use of different wastewater treatment technologies. Sewage treatment plants of various types of treatment are used to purify wastewater from pollution.

Mechanical water treatment is mainly used before further biological treatment to separate solid particles. With mechanical treatment of urban wastewater, about 60 % of insoluble pollutants can be stopped. Biological

methods of water treatment are based on the functioning of microorganisms that mineralize dissolved organic compounds. Chemical and physico-chemical cleaning methods are used in most cases for cleaning industrial wastewater. If necessary, deep cleaning may be necessary, when the concentration of suspended solids in the wastewater after complete biological purification before discharge into the reservoir needs to be reduced. The final stage of wastewater treatment is disinfection, the purpose of which is to remove pathogenic microorganisms present in the wastewater. After wastewater treatment, sediment appears, which must be treated to reduce its humidity and volume, after disposal.

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THEORETICAL ASPECTS OF ECOSYSTEM FORMATION ON TRANSPORT

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Abstract. The article considers theoretical aspects of ecosystem formation on transport, presents the interpretation of the concept of “ecosystem” by various scientists. It also characterizes the concept of “ecosystem” from the perspective of various approaches to its representation, describing its main features. In conclusion, the basics of the functioning of this concept are presented and the purpose of the economic system and the usefulness of being in it are described.

Keywords: ecosystem, transport, railway transport, transport company.

ТЕОРЕТИЧЕСКИЕ АСПЕКТЫ ФОРМИРОВАНИЯ ЭКОСИСТЕМ НА ТРАНСПОРТЕ

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Аннотация. В статье рассмотрены теоретические аспекты формирования экосистем на транспорте, представлена интерпретация понятия «экосистема» в понимании различных ученых, дана характеристика понятия «экосистема» с позиции разносторонних подходов ее представления, описаны основные его особенности. В заключении представлены выводы и предложения по использованию экосистемного подхода к управлению на транспорте.

Ключевые слова: экосистема, транспорт, железнодорожный транспорт, транспортная компания.

Nowadays ecosystem is described as a vibrant and constantly evolving community of companies that bring new value to the table through cooperation and collaboration. At the same time, the main priority of their development is to meet the growing demands of consumers.

In recent decades there has been an increasing emphasis on an evolutionary approach to the analysis of economic phenomena and processes. The essence of the evolutionary approach is the constant evolution of the business world, as well as the integration between market actors. This is due to the fact that the evolution of different types of systems in the economy is determined by the interaction, variability and adaptation of their parts to each other, as well as by the processes that arise from the accumulation of technical knowledge [1, p. 235].

The ecosystem approach to evolutionary development processes is based on interdisciplinary research, which has led to different interpretations of the concept of «ecosystem» in economic science. Thus, the ecosystem can be viewed from different angles (Fig. 1) [2, p. 212].

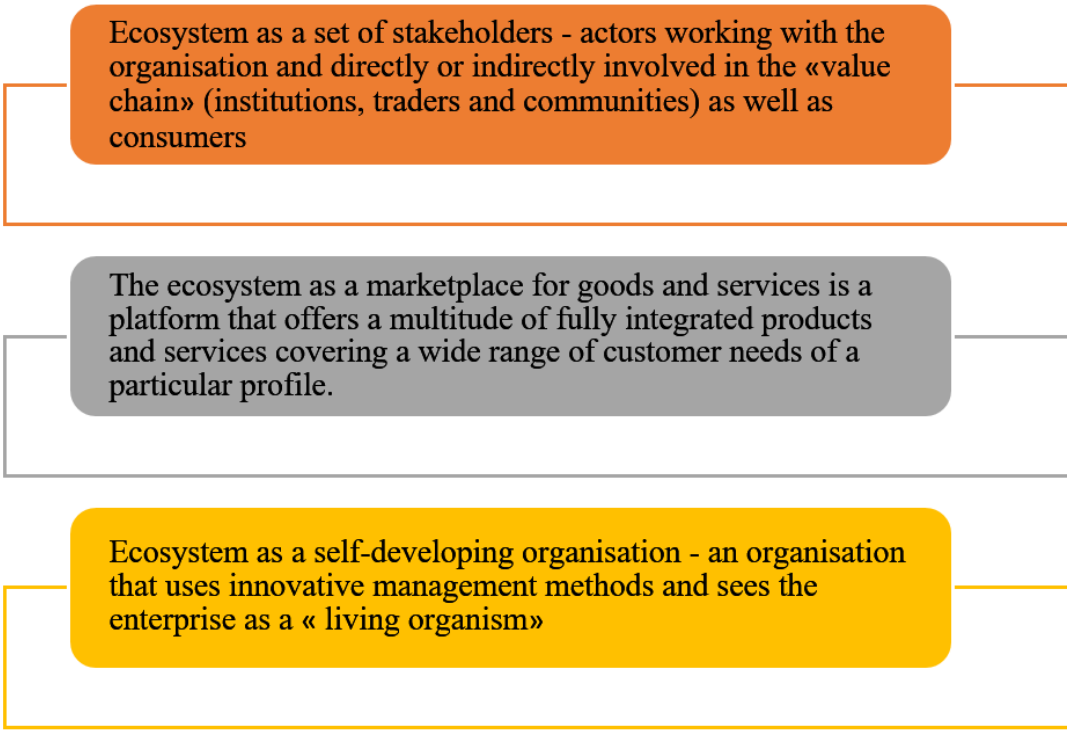

Figure 1. Characteristics of the concept of «ecosystem»

The first approach views the ecosystem as a group of organisations that are highly interdependent with respect to inputs and outputs.

The second approach views the ecosystem as a system of interconnected technologies for a multitude of goods and services to meet customer needs.

In the third approach, the ecosystem is a self-developing organisation with innovative management practices.

Table 1 shows the approaches to the interpretation of the concept of «ecosystem» as understood by various scholars. Innovation ecosystems are seen as collaborative arrangements in which firms combine their individual offerings into holistic, customer-centric arrangements [3, p. 5].

The business ecosystem is analysed as a community of organisations, institutions and individuals that influence the business, its customers and its offerings [4, p. 2].

A technology ecosystem is a system of interconnected technologies and interrelated technological developments that influence development.

Table 1 – Interpretation of the concept of «ecosystem»

Scientist	Interpretation of the concept of «ecosystem»
Dzhejms Mur	A network made up of organisations and individuals from the business community that together form a form of mutual support and evolve together.
Vul'f i Butel'	Focuses on how knowledge sharing between participants is dressed up, examining its fundamental impact on participants' decision-making.
YAnsiti i Levajen	The business ecosystem includes resource providers, consumers and the various firms that influence a firm's operations.
Kapur i Agarval	A structure in which a platform company coordinates the operation of a business system by providing a platform for firms producing complementary products.
Li s soavtorami	The role of the business ecosystem in the context of the start-up lifecycle, considering the system as a whole as a driving force for developing the environment and launching start-ups based on it.
ZHo s soavtorami	Ecosystem on the corporate responsibility side. The ecosystem is understood to be a system that is woven of the various members of the business ecosystem and the relationships between them.
Valkokari	An ecosystem refers to a main actor acting as a platform and providing shared resources to other actors in the network in order to create customer value.

The following characteristics of ecosystems are intrinsic to ecosystems in business as economic entities that create value [5, p. 10].

1. Stability is the ability of ecosystems to resist or adapt to changes in the environment and to maintain equilibrium. An ecosystem is a self-regulating system. Adaptation and self-regulation take place directly at the ecosystem level – feedback mechanisms, exchange of information, energy and other types of resources.

2. Dynamism and maturity. The dynamics of an ecosystem is reflected in the changes that occur as a result of external forces or internal contradictions in its development. An ecosystem goes through several phases during its life, with successive phases succeeding one another. Factors influencing changes in the structure of an ecosystem include exogenous (external) and endogenous (internal) factors. However, it is only at the stage of ecosystem maturity that it is common to distinguish patterns aimed at uniting and integrating communities. Otherwise, the ecosystem may collapse and end in degradation.

3. An effective resource sharing scheme. In general, the ideas of creating ecosystems have focused on creating a business community or even a network of suppliers, companies (product creators or developers) and customers in any economic sphere. A company has to create an ecosystem, develop it and update it with innovation, otherwise the ecosystem will simply cease to exist. The participants in the ecosystem are consumers, market intermediaries, suppliers and the company itself. It may also include owners and other stakeholders (government, competitors, etc.).

4. Adaptation. The presence of ecological niches characterises an ecosystem characteristic such as resilience, i.e. the ability to adapt to any changes in external conditions. An indicator of ecosystem resilience is the level of survival of ecosystem members.

An ecosystem can function based on the components below (Fig. 2).

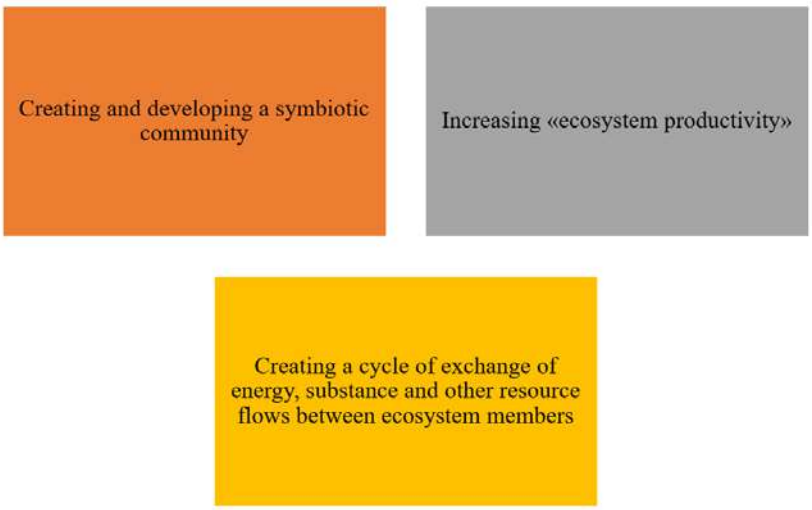

Figure 2. Basis of ecosystem function

The creation and development of a society in which there is active interaction between all its actors. Without the cooperation of all actors amongst themselves, an ecosystem cannot exist [6, p. 3].

The improvement of an ecosystem's productivity refers to dynamic work aimed at the development of the company and its organisational units. With this, all components add new value through cooperation and delegation of responsibilities [7, p. 1].

Sharing resources will help the company to function adequately in a dynamic society. Creating a continuous cycle of interaction between all stakeholders will facilitate the company’s growth in the ecosystem [8, p. 4].

The purpose of the economic system and the effectiveness of participation in it are evidenced by the following benefits:

– Communication. Once you have an idea, you can start a discussion with like-minded people who may be interested in the idea itself or know someone who might be interested in it.

– Being at the forefront of new knowledge: the ecosystem is a melting pot of ideas from which new information can be drawn.

– Desire and the opportunity to put it into practice. The ecosystem is an opportunity to create ideas and develop a passion for creating new ideas. Once a critical mass of ideas has been gathered, one expresses the desire to start a business.

– Equity participation. The start-up ecosystem can attract qualified help (e.g. experts, consultants, etc.) who have a stake in the future company.

– Joint effort. With different levels of ownership, company members will work together to promote the start-up, which increases the likelihood of success.

– Options for finding an investor. There are many investors competing in the ecosystem.

From the above reasoning, the following becomes clear. As a scientific category used in economics, ecosystems are mainly characterized by their internal dynamics and evolution under the influence of internal and external factors. An ecosystem is seen as a network of elements, some of which are the largest and determine the health of the ecosystem. Ecosystems can be distinguished at different levels – national and regional.

As conclusions and suggestions, the following should be noted:

1. The ecosystem approach to evolutionary development processes is based on interdisciplinary research, which has led to different interpretations of the concept of “ecosystem” in economic science. The versatile characterization of the concept of “ecosystem” enables a clear understanding of the representation of this object.

2. The main features of an ecosystem are based on 4 points: adaptation, stability, dynamic development, exchange of resources. Their effective development contributes to the development of ecosystems.

3. By taking advantage of being in the ecosystem, member companies are able to exploit communication channels, enter a new market for goods and services, and adopt progressive methods for further development.

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УДК 745

THE ROLE OF COMMUNICATION DESIGN IN THE URBAN ENVIRONMENT

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Abstract. The purpose of the article is to reveal concept of "communicative design in an urban environment" and with the help of specific examples, arguments and conclusions show its significance for the city, its residents and guests. The relevance of this issue is undeniable, because it is directly related to the standard of living, the atmosphere of the city and its general reputation.

Keywords: communication (communicative) design, information noise, conciseness, ergonomics, aesthetics, image (integral image), urban identity, urban space.

РОЛЬ КОММУНИКАЦИОННОГО ДИЗАЙНА В ГОРОДСКОЙ СРЕДЕ

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Аннотация. Цель статьи – раскрыть понятие «коммуникативный дизайн в городской среде» и с помощью конкретных примеров, рассуждений и умозаключений показать его значимость для города, его жителей и гостей. Актуальность данного вопроса несомненна, поскольку он напрямую связан с уровнем жизни, настроением в городе и его общей репутацией.

Ключевые слова: коммуникационный **(**коммуникативный) дизайн, информационный шум, лаконичность, эргономичность, эстетичность, образ (цельный образ), городская идентичность, городское пространство.

Communication or communicative design in an urban environment is more important than it may seem at first glance. In order to fully cover this topic, it is necessary to turn to the origins and understand what this concept means.

The word “communication” originates from Latin *communicare*, meaning “to share” or “to be in relation with” [1]. Communication design is a field of design, the main task of which is to transmit information of any nature to a person using visual graphics. In an urban environment, it can be an advertisement, a sign, a pointer, an information plate or a road sign.

The main task of communication design is to allow the user to navigate easily and quickly as well as get some useful information [2].

The problem of an overabundance of information is becoming more acute. The world is mired in information noise, and it becomes difficult for a person to hear and perceive what is important for him or her (Fig. 1). Therefore, there is a need for the qualitative transformation of information into the most understandable form.

Figure 1. Information noise

A person gets tired of the subconscious analysis of a large flow of information, which has a negative impact on his or her general condition and performance. The task of communicative design is, on the one hand, to rid a person of unnecessary work, thereby preserving the psyche, strength and energy for the things, which are important. On the other hand, it is aimed at the achievement of a more effective perception of information by the audience and a higher percentage of understanding of the message.

It is easier to perceive the concept when considering specific situations. A vivid and practical example is the signs with the addresses of houses in the city. Previously, they were small, and it was possible to read them only after coming closer (Fig. 2a). With the advent of a large number of cars, and therefore the need to perceive information at speed, such signage has become inconvenient for users. It is much easier to get the necessary information when it is depicted clearly, in a concise large font, without unnecessary details (Fig. 2b).

a) Inconvenient sign b) Convenient sign

Figure 2. The signs with the addresses of houses in the city

Another example of an information carrier in an urban environment is outdoor advertising, which has noticeably changed the appearance of cities in recent decades.

The reason for the “noise” is information fragmentation, which makes it difficult for a person to grasp the essence in the modern fast pace of life (Fig. 3a). Therefore, there should be balance in everything (Fig. 3b).

a) Inconvenient sign b) Convenient sign

Figure 3. The outdoor advertising

Thus, we can conclude that the information given to a person in an urban environment should be clear and understandable, not overloaded with details and without fragmentation. However, if the designer thinks exclusively about this function, the world will look like a “robot world” they like to show in modern cinema. The design of information should also perform the function of aesthetic comfort. This can be achieved with the help of color, light, shape and a single style, while maintaining conciseness and ergonomics (Fig. 4).

Figure 4. Application of the principles of communicative design

In the design of modern urban spaces, indoors and outdoors, these principles are increasingly being applied. With a successful selection of colors and shapes, it is possible to set the right mood, with the right distribution of accents, the user will find the necessary information faster. Integral images are perceived best (Fig. 5). Images are a very successful move for conveying information, since they are perceived the fastest and, as a rule, translation for foreigners is not needed.

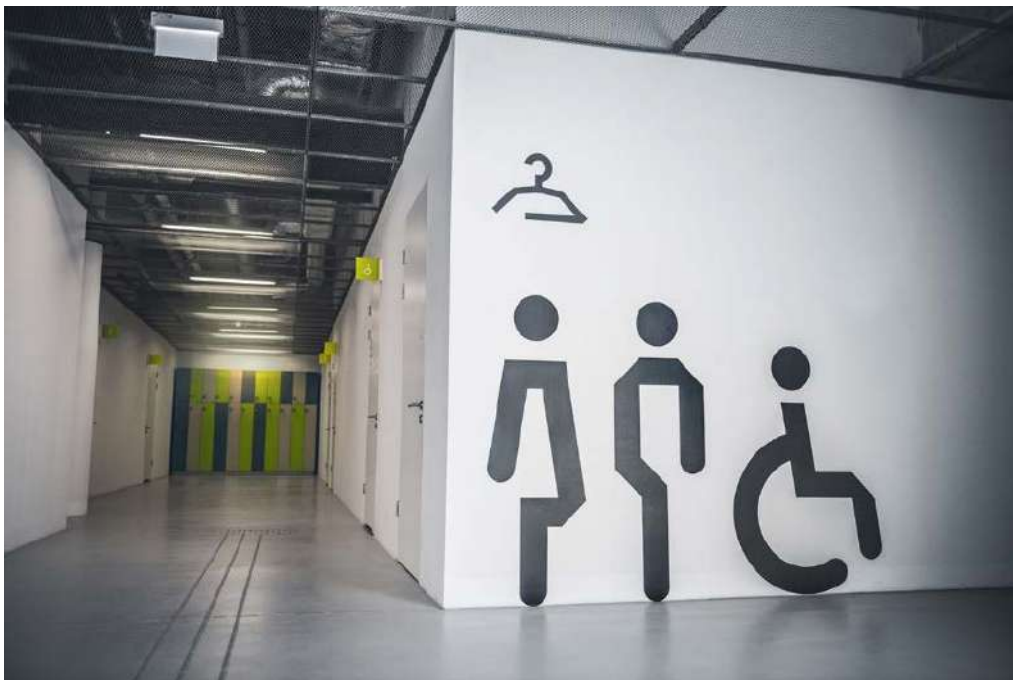

Figure 5. Application of the principles of communicative design

If you look deeper, at present the problem caused by globalization is growing with increasing force. Cities become similar to one another; a person loses a sense of belonging to a particular place and no longer seeks to invest in it, but works purely in personal interests. As Charles Landry says in his book “The Creative City”: “What kind of future of the city are we striving for? Which city will be proudly called “theirs”? What image of the future will become a motivating factor for the active involvement of citizens in the development of the city?” [3].

We have come to another important problem that communication design should solve in the urban environment, which is the preservation of authenticity, individuality and urban identity.

It is necessary that the residents feel their inclusion in the urban space, and the visitors feel comfortable and can sensate the special atmosphere of the city. The space should be properly organized, intuitive and at the same time correspond to the stylistic concept of the city’s image [4]. This is the creation of a convenient and comfortable environment for a person to stay, for example, parks, playgrounds, cafes, as well as convenience in such everyday places as transport or a store. The form of the embodiment of this comfort should be well-designed taking into account the character and “image” of a particular city, especially if it is a city of cultural and historical significance.

Summing up, we will highlight the main properties that the communication design of the urban environment should have.

Firstly, it is informative value, since the main goal is to effectively convey the meaning of the message to the audience.

Secondly, it is aesthetics, which allows one to feel comfortable.

Thirdly, it is maintaining the “image” of the city as a place that its residents can be proud of and which attracts tourists, investors, and businesses.

It can be concluded that communication design is quite important, as it sets a special mood and pace of life of the city and its inhabitants.

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УДК 620.92

EFFICIENCY OF THE CONDENSATION ECONOMIZER IN RESOURCE SAVINGS IN PRODUCTION

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Abstract. The effectiveness of the use of condensation equipment in the production process in order to increase efficiency by heating the replenishing water is considered in the article. The annual economic benefit is calculated.

Keywords: condensing economizer, efficiency, heat exchanger, boiler room.

ЭФФЕКТИВНОСТЬ КОНДЕНСАЦИОННОГО ЭКОНОМАЙЗЕРА В ЭКОНОМИИ РЕСУРСОВ НА ПРОИЗВОДСТВЕ

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Аннотация. В статье рассмотрена эффективность применения конденсационного оборудования в производственном процессе с целью увеличения КПД за счет нагрева подпиточной воды. Рассчитана ежегодная экономическая выгода.

Ключевые слова: конденсационный экономайзер, КПД, теплообменник, котельная.

The Russian Federation has long begun to move towards the efficient use of energy resources, in this regard, on November 23, 2009, federal law No. 261-FZ was signed “On energy saving and energy efficiency and on amendments to certain legislative acts of the Russian Federation” [1]. The law obliges to take the necessary measures aimed at reducing the level of energy consumption and ensuring gradual modernization at industrial facilities. At enterprises, this issue becomes especially relevant, since the cost of energy supply in manufacturing companies reaches 50 % of the total mass of costs.

Waste heat recovery is an effective technology to reduce energy costs. The key to a successful project to return waste heat back to the production cycle is the installation of a condensing economizer, schematically shown in Fig. 1, with which businesses can increase the overall heat recovery and steam system efficiency by up to 10 %.

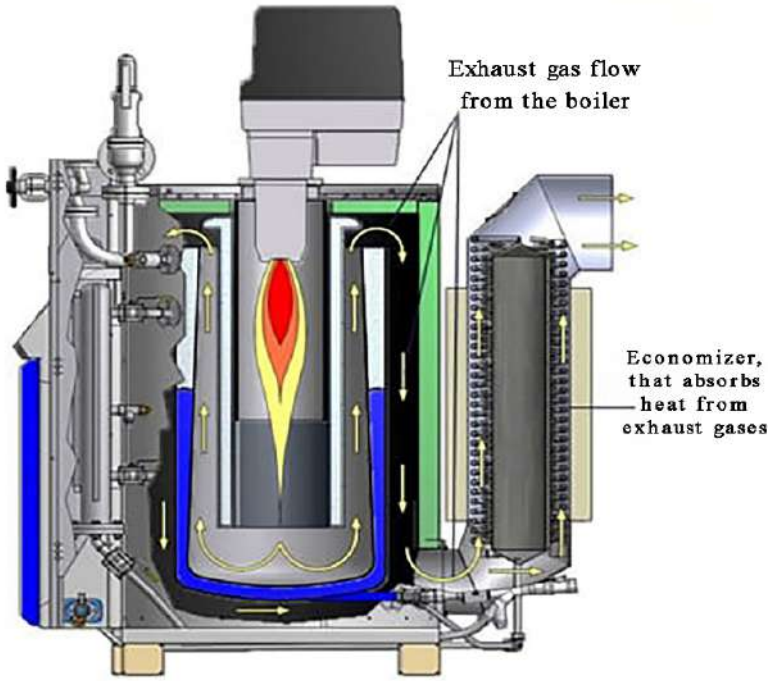

Figure 1. Installing a condensing economizer

A condensing economizer is a flue gas heat exchanger that converts energy by condensing the water vapor contained in them, as well as reducing the temperature of other components. The unit reduces losses during utilization of waste heat by cooling the flue gas below the dew point [2].

The main advantage of the economizer is the reduced fuel consumption for the steam boiler, since the heat from the flue gases is transferred to the feed water. For boilers using natural gas as fuel, the lowest temperature to which the flue gases can be cooled is approximately 120 °C. This avoids condensation and possible corrosion of the chimney and its inner lining. In addition, the condensing economizer improves waste heat recovery by cooling the flue gases to a temperature below the dew point, which is about 55 °C for natural gas combustion products. The unit also utilizes both useful heat from flue gases and latent heat of condensation of vapors contained in flue gases. In order to analyze in detail, the efficiency of a boiler with a condensing economizer installed on it, it is necessary to consider the equation for the stoichiometric combustion of methane (CH4) in air, which is the main component of natural gas.

$$CH_4 + 2O_2 + 7.5N_2 \rightarrow CO_2 + 2H_2O + 7.5N_2$$

When one molecule of methane is burned, it produces two molecules of water vapor. When moles are converted to pound/mole, we find that every pound of methane fuel combusted produces 2,25 lb. of water vapor, which is about 12 % of the total exhaust by weight [3]. Since the gross calorific value of methane is 55,5 MJ/kg, 19 kg of methane is required to produce 1 J/g of energy, resulting in 42 kg of high-temperature water vapor. The latent heat of vaporization of water at atmospheric pressure is 2,257 MJ/kg.

94 MJ (0.09 MWh) of the heat of vaporization of water vapor (42 kg x 2,257 MJ/kg) is discharged into the boiler chimney. This latent heat is approximately 9 % of the original energy content of the fuel. Most of this latent heat can be recovered by cooling the exhaust gas to below the dew point using a direct or indirect condensing economizer. It is possible to heat water up to about 90 °C with an indirect economizer or up to 60 °C with a direct economizer. Knowing these indicators, you can calculate the economic efficiency of this installation. The available heat in the boiler flue gas depends on the hydrogen content in the fuel, the fuel burning rate, the percentage of excess oxygen in the fuel mixture with air, and the flue gas temperature. Consider a natural gas boiler that produces 40 t/h of saturated steam at a pressure of 7 bar and an efficiency of 83 %; the total heat output of the boiler is about 30 MW. At its maximum thermal power, the boiler consumes more than 1945 kg (or approximately 2,5 thousand Nm^3) of natural gas per hour (density 0,781 kg/m^3), while releasing 4374 kg of high-temperature water vapor per hour [4]. The water vapor in the flue gas contains more than 2,7 MWh of latent heat. As shown in Table 1, the total amount of heat actually available for recovery is highly dependent on the temperature of the flue gases leaving the condenser economizer.

Table 1 – Dependence of the heating capacity on the temperatureof the exhaust flue gases

Initial flue gas temperature, °C	**The amount of heat available for utilization, MWh**			
	Heating capacity of the boiler, MWh			
	7,5	**15**	**30**	**60**
200	0,4	0,8	1,6	3,1
250	0,7	1,3	2,7	5,4
300	1,0	1,9	3,8	7,6

The data indicated in the Table 1 are given under the following conditions:

– fuel – natural gas,

– excess air 15 %,

– final temperature in the chimney 120 ºC

Let us assume that an indirect condensing economizer is installed on this steam boiler with a capacity of 40 t/h. The boiler is used to heat 50 % of the replenishing water from 15 °C to 95 °C, and flue gases to 40 °C. Under these conditions, the exhaust gases contain a total energy of 3,3 MWh, of which 1,95 MWh will be recovered to heat the replenishing water in the condensing economizer. More energy can be recovered if additional radiators are available.

Assuming 8000 operating hours per year of the boiler and the cost of natural gas 5 rubles/nm³ (density 0,781 kg/m³), the annual energy savings will be:

Saving natural gas consumption

= 1,95 MWh x 3600 / 55.5 MJ/kg / 0.781 kg/m³ / 0.83 (efficiency) = 196 nm³/h,

Economic effect in monetary terms

= 196 nm³/h x 8000 h/year x 5 rubles/nm³ = 7840000 rubles/year [5].

The cost of the economizer together with the installation is 3737500 rubles [6]. Under these operating conditions, it pays for itself within six months, and then there is a net economic profit. Which indicates a high economic benefit of the installation. Also, the main advantages of this installation are a long service life, calculated for 20 years, and the possibility of installation in new and existing boiler plants. One economizer can be installed on several boilers, moreover, the installation helps to reduce the level of thermal pollution of the environment.

From the above, we can conclude that the installation of a condensing economizer in production contributes not only to an increase in the efficiency of power boilers, but also to a reduction in financial costs.

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DEVELOPMENT OF CHINESE ELECTRIC POWER

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Abstract. After 70 years of development, especially the 18th National Congress of the China, the development of China's electric power industry has entered a critical stage of transformation, adjustment and transformation. The qualitative development of the electric power industry is a development that reflects a new development concept, which must be implemented through qualitative changes in efficiency and capacity changes. It is necessary to deepen the reform of the electricity market and improve systems and mechanisms for the qualitative development of the electric power industry, scientifically resolve contradictions in the development of the electric power industry.

Keywords: electric power industry; quality development; electricity efficiency; power system reform.

РАЗВИТИЕ КИТАЙСКОЙ ЭЛЕКТРОЭНЕРГЕТИКИ

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Аннотация. После 70 лет развития, особенно 18-го Национального Конгресса КПК, развитие электроэнергетики Китая вступило в критическую стадию трансформации и корректировки. Качественное развитие электроэнергетики отражает новую концепцию развития, реализованную через качественные изменения эффективности и мощности. Необходимо углублять реформу рынка электроэнергии и совершенствовать системы и механизмы для качественного развития электроэнергетики, с научной точки зрения разрешать противоречия в развитии электроэнергетики.

Ключевые слова: электроэнергетика, качественная разработка, эффективность электроэнергетики, реформа энергосистемы.

Introduction.

Since the founding of the People's Republic of China 70 years ago, especially after the 18th National Congress of the Communist Party of China, China’s electric power industry has achieved rapid development and continuous breakthroughs, as well as great achievements that attract the attention of the whole world. These achievements underpin China’s economic development and the continuous improvement of people’s living standards. China’s energy industry ranks first in the world in terms of installed capacity, generated capacity, network scale, voltage class, clean energy production capacity and market transaction capacity [1].

Opportunities and challenges facing the qualitative development of the electric power industry.

The development of China’s electric power industry has entered a key stage of changing the development regime, adjusting the structure and changing the driving force. The features of new forces, green structures and intelligent systems are becoming more and more visible, presenting both opportunities and challenges. The electricity substitution policy represents important opportunities for the development of China's electric power industry. The development of China’s electric power industry is facing problems such as slowing demand growth, excess coal capacity, long-term pressure of clean transformation of the electric power industry, improving the efficiency of the energy system, as well as problems with the energy system and mechanisms. China’s energy industry is still unbalanced and underdeveloped in all aspects of electricity generation, transmission, conversion and distribution. There are weaknesses in the construction and management of electrical networks. The imbalance in the development of the main marketing network, retail network and agricultural network is obvious.

The pressure of China’s large-scale net transformation is enormous. Under the influence of coal stocks, the state of resources and the level of energy technology, coal energy will occupy a dominant position in China’s power structure for a long time to come. Coal has been dominating China’s power structure for a long time. Control over the development of coal-fired power contributes to the development of renewable energy sources, nuclear power and natural gas electricity generation [2].

Compared to most industrialized countries of the world, China's electric power industry is characterized by large scale and high share of coal-fired electricity generation, while small scale and low share of gas, electricity and nuclear energy, which leads to difficulties in providing environmentally friendly technologies. transformation of China's electric power industry. The structure of a country's energy supply may reflect to some extent the complexity of converting clean energy. The share of coal-fired power units may reflect the complexity of electricity conversion in the country. The higher the proportion, the greater the transformation pressure. In 2018, coal-fired electricity generation in China was still 66,5 %, which is much higher than the global average (38,0 %) and much higher than in the United States (27,9 %), the European Union (20,0 %), Russia (16,0 %) and other countries.

The share of gas-fired electricity generation may also reflect the complexity of electricity conversion in the country, that is, the lower this share, the higher the conversion pressure. In 2018, natural gas electricity production in China is only 3,2 %, which is lower than the level of gas electricity production in the world (23,2 %), lower than in the USA (35,4 %), Russia (46.9 %) and the UK (39,4 %), and the European Union (18,9 %), Germany (12,8 %), Japan (36,8 %) and India (4,8 %) depend on gas imports.

The development of waterless renewable energy sources is a trend of transformation of the global energy sector. The share of waterless renewable energy sources in electricity production may also reflect the complexity of electricity conversion in a country. The lower the ratio, the higher the conversion pressure. With 9,1 %, China is close to the global average (9.3 percent), slightly below the United States (10.3 percent) and well below the United Kingdom (31,6 %). China's nuclear power industry is 4,1 % lower than the global average (10,2 %), much lower than in the USA (19.0 %), the European Union (25,2 %), the UK (19,5 %) and Russia (18,4 %). This is also lower than in Germany, which plans to abandon nuclear power (11,7 %) [3].

The coal-rich structure of electricity production in China is directly related to the long-term growth model of energy supply. The expansion of China's production capacity, with the largest increase (72 %) in the period from 1949 to 2012 accounted for coal-fired power plants; Despite the fact that clean energy accounts for most (57 %) of new energy generation from 2013 to 2018, the growth of coal-fired power units was significant. This is different from the United States, which between 1949 and 1983 relied on coal-fired power plants for most of its economic growth; In the next four years, nuclear power will be one of the main factors in the growth of U.S. generating capacity; since then,

natural gas-fired electricity generation has become dominant, and almost all new generating capacity in the United States from 1990 to 2005 came from gas-fired power plants. Recently, wind energy has been a major factor in the growth of electricity production in the United States. years. As of 2018, the United States generates 7,1 times more electricity from natural gas and 3.0 times more from nuclear power. The reasons lie not only in the objective reality of the availability of energy resources, but also in subjective factors, such as the emphasis in China's energy development strategy and energy conversion policy. In addition, there is a large amount of sewage and problems with the landscape. In 2018, China will give up about 69,1 billion kWh of water, or 5 % of water. The rejection of wind load was about 27,7 billion kWh, while the rejection rate of wind load was 7 %; the rejection of light lighting is about 5,49 billion kWh, and the rejection rate of light equipment is 3 %.

Increasing the efficiency of the power system.

The qualitative development of the electric power industry is primarily reflected in the high efficiency of the power system. The efficiency of the power system can be measured by load and other indicators. The level of utilization of the Chinese power grid is low. Network load speed and line power factor are important indicators of efficiency on the part of the power supply. Currently, the problem of low-load transmission lines in China is quite acute, most lines have been in a low-load state for a long time. (1) The average load of transmission lines in China is only 8 %, while the reasonable average load of transmission lines in the conservative case should be about 40 %. (2) China's power transmission line capacity factor of 9,72 million kWh/km is lower than that of the USA (14,86 million kWh/km) and Japan (3,08 million kWh/km) [4].

The load level of the power grid decreases from year to year, and the difference between peak and minimum values becomes more and more. Download speed is an important indicator for measuring the effectiveness of demand management. The load rate is the ratio of the average annual load to the maximum annual load. The lower the load level, the greater the difference between the average and maximum load, the greater the difference between the peak and minimum values, the worse the efficiency and efficiency of the power system will be. In China, the difference between peaks and troughs is still huge. With the exception of the power grid of Northern China (32,5 %) and the Northwestern Power Grid (29,4 %), the difference between the peak and minimum values of other power systems exceeds 35 %.

Currently, the efficiency of data transmission in China still has something to work on. The network loss ratio is an important indicator for measuring

transmission efficiency. In 2018, the level of losses in China's power transmission lines was 6,21 %, which is the highest level in the world with the same load power density. However, there is a gap compared to the countries with the lowest net loss rates.

The system and mechanism of qualitative development of the electric power industry.

The existing pricing mechanism for transmission and distribution may cause an increase in investments in the energy system and lead to excessive investments. The reform of electricity transmission and distribution prices in China is still at an early stage, there are many problems in the supervision of costs and evaluation of electricity transmission and distribution, and the separation of transmission and distribution is not affected.

The reform of prices for transmission and distribution of electricity is the main content of the qualitative development of the electric power industry and an important means of improving the efficiency of the energy system. By increasing the efficiency of pricing in the transmission and distribution of electricity, it can direct the development of investments in electricity in a reasonable and efficient direction. At present, the price of transmission and distribution of electricity in China is based on the pricing method "permitted income = permitted costs + income", which to some extent leads to the transformation of investments of electric grid enterprises, effective investment, but also causes the enterprise's energy system to increase investment, expand the scale of assets, which leads to excessive investment. The data show that after a new round of electricity market reform, investments in the energy system continue to remain at a historical maximum. Since 2014, investments in electric networks have started to exceed investments in electricity supply, and their share has been increasing annually. The share of investments in the electric grid complex in the electric power industry was 52,77 %, 52,94 %, 61,44 %, 64,8 % and 66,4 %, respectively. Investments in the energy system have been increasing from year to year. In 2018, China's investments in electric grid projects reached a record level of 537,3 billion yuan. This phenomenon of high investment growth rates reflects the fact that the problem of distorted resource allocation in the current energy construction has not been solved and even tends to worsen. It also reveals internal contradictions in the existing mechanism of electricity pricing, indicating that the possibilities of state supervision are insufficient, and the level of monopoly enterprises is low [5].

The experience of building a spot electricity market is insufficient, and the standardization of electricity trading institutions has not yet been resolved. The

market reform of electricity sales is a full-fledged game of the market mechanism and an efficient electricity market, as well as the main content of high-quality electricity development. The lack of experience in the construction of the wholesale electricity market, the implementation of the transformation of the capital of the electricity trading center, the reform of the marketing of retail electricity supply were not on the agenda.

The purpose of creating a spot electricity market is to optimize the allocation of resources using a scientific mechanism for managing reasonable prices, which is an important part of the qualitative development of the electric power industry. However, due to this round of reforms, such phenomena arise as the seizure by electric grid enterprises of the creation of electricity trading institutions and the prevention of the creation of regional electric grid companies, as well as the delay in the trial operation of pilot areas of energy flow. Market and energy trading institutions of the unfavorable situation of reforming non-tradable stocks. All this shows that the promotion of the spot electricity market is very difficult.

Implementation of the path of qualitative development of the electric power industry. Stimulating the development of the electric power industry through technological innovations and institutional innovations.

Strengthening the basic technology of the electric power industry and investing in the research and development of key technologies, energy storage technology, ultraviolet radiation technology, nuclear equipment, gas power generation equipment technology, renewable energy generation technology, electric vehicles and basic technologies in the field of electric power, such as applied technologies of the highlands, can turn technical innovation into the basis of China’s energy development in the future.

It is necessary to break the monopoly and weaken the supervision of the electric power industry. It is necessary to standardize the energy system by reforming transmission and distribution prices and improve the efficiency of investments in the energy system. Creation and improvement of the electricity market, creation of a market pricing mechanism for electricity and creation of an electricity market system, including a wholesale electricity market, a capacity market and an interregional electricity trading market.

Improving the efficiency of the electric power industry.

Thanks to technological innovation and openness, technical efficiency, resource allocation efficiency and the overall factor productivity of electricity production, transmission and distribution and electricity consumption are

constantly improving. The efficiency of the electric power industry is one of the important indicators for measuring the quality of growth of the electric power industry of a country or region. On the one hand, compared to developed countries, technical efficiency, aggregate factor productivity and resource allocation efficiency in China's electric power industry are low. A large number of studies have shown that the ownership structure, the price of electricity, the price of coal and environmental regulation have a significant impact on the technical efficiency of China's electric power industry. The share of state capital in the electric power industry and the price of thermal coal negatively correlate with technical efficiency, while the price of electricity positively correlates with technical efficiency, and environmental regulation has an inverted U-shape. Technological progress, changes in technical efficiency, economies of scale and distribution efficiency are important factors affecting the overall factor productivity in China's electric power industry. On the other hand, due to the influence of the intensity of investments, the level of economic development and the conditions of placement, the technical efficiency of China's electric power industry demonstrates an obvious imbalance in regional development. Therefore, it is necessary to promote the reform of the energy system, technological innovations and openness to the outside world, as well as to constantly improve the efficiency of the electric power industry [6].

Establishment of a scheme for the coordinated development of various energy sources, coordinated development of urban and rural areas, balanced development of regions.

At present, efforts must be made to solve the structural problems of unbalanced development in all aspects of "distribution, transportation, transformation and distribution". In the electricity generation link, it is necessary to reasonably control the installed capacity of coal-fired power, as well as optimize and adjust the structure of power supply. As for the power system, it is necessary to optimize the structure of the power system, increase the level of intelligence and efficiency of the power system, as well as solve the problem of "unbearable" ultra-high voltage power lines. It is necessary to strengthen planning and reasonable assessment of construction needs, as well as coordinate the development of large electric networks, distribution networks and rural power grids. It is necessary to reform the electricity pricing policy, formulate the science of electricity transmission and distribution prices, create a reasonable and scientific pricing mechanism in the electricity market, fully use the price

lever for the supply of thermal energy, gold, silver, copper, promote the mechanism of load aggregation and other aspects of response measures.

Construction of an industrial system of environmentally friendly energy.

Continuing to increase the level of final energy and electricity consumption, contributing to the development of vehicles using new energy sources and the conversion of coal into electricity. The vigorous development of clean energy production, such as wind, photovoltaic, hydropower, nuclear energy and gas, and the constant increase in the share of environmentally friendly and low-carbon energy contributes to the development of the global energy Internet, the creation of a market mechanism to promote environmentally friendly electricity exports and increase the level of interregional and transnational electricity trade.

Conclusions.

Achieving the qualitative development of China's electric power industry is not only a matter of the development of the electric power industry itself, but also an important issue of China's economic transformation and modernization, as well as qualitative development. The qualitative development of the electric power industry is intensive and efficient development, innovative development, balanced development, green and ecological development. The overall goal of the qualitative development of the electric power industry is to make the transition from large-scale expansion to improving the quality of the power system, characterized by the establishment of clean, low-carbon and high efficiency.

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REVIEW AND COMPARATIVE ANALYSIS OF AUTOCAD AND REVIT SOFTWARE

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Abstract. The article is devoted to the actual for today problem of computational complexes for calculation and designing of building structures in design organizations. At present there are hundreds of specialized and universal program products, the comparison of AutoCAD and Revit software packages has been presented in the given article. The main differences between the software packages, the advantages and disadvantages have been determined, and conclusions have been drawn about the possibility of joint use.

Keywords: software, digital drawing tool, information modeling, intelligent building models.

ОБЗОР И СРАВНИТЕЛЬНЫЙ АНАЛИЗ ПРОГРАММНЫХ ПРОДУКТОВ AUTOCAD И REVIT

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Аннотация. Статья посвящена актуальной на сегодняшний день проблеме проектно-вычислительных комплексов для расчета и проектирования строительных конструкций в проектных организациях. В настоящее время существуют сотни специализированных и универсальных программных продуктов, в данной статье представлено сравнение программных сред AutoCAD и Revit. Были определены основные отличия программных пакетов, достоинства и недостатки, сделаны выводы о возможности совместного использования.

Ключевые слова: программное обеспечение, инструмент цифрового рисования, информационное моделирование, интеллектуальные модели зданий.

At the present time when designing building structures in design organizations a significant part of calculations is performed on personal computers with the help of special design-computer complexes, which reflect and use the most modern achievements in calculation and design of structures. The market of computer-aided design systems (CAD) software has actually formed and continues to develop steadily. There are hundreds of CAD software products, both specialized and universal. In this review, AutoCAD and Revit software environments are presented.

The first version of AutoCAD was released by Autodesk in 1982. Since then, AutoCAD has been updated regularly, and recent versions include cloud storage and compatibility with mobile devices. After nearly four decades, AutoCAD has positioned itself as the market leader in drafting software.

The first version of Revit software was released in 2000 by Revit Technology Corporation, and its name is short for “refine”. The Revit software environment goes beyond simple drafting by allowing you to create intelligent building models in a virtual environment. Autodesk acquired Revit Technology Corporation in 2002, realizing the potential of this software package [1].

The main difference between these software packages is that AutoCAD is a conventional computer-aided design and project development software used to create accurate 2D and 3D drawings, while Revit is a software with tools for creating intelligent 3D building models. While AutoCAD is a general purpose drawing tool with broad applications, Revit is a building-specific design and documentation solution that supports all the steps involved in a building project.

Also, the difference between these programs is that AutoCAD is a drawing tool that represents buildings based on their geometry (Fig. 1).

On the other hand, Revit is a modeling tool in which the building components are identified by their functions, and the model can include technical specifications and pricing data. Because of these features, Revit can be used as a BIM tool, which is not possible in the AutoCAD software environment (Fig. 2).

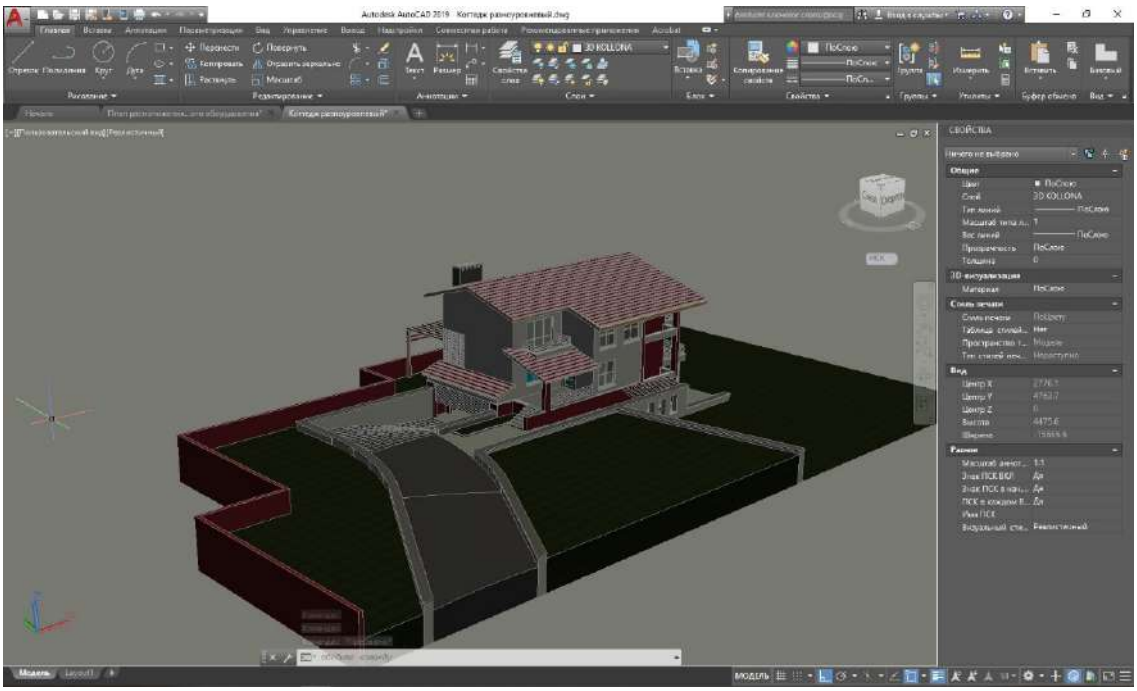

Figure 1. AutoCAD software interface

AutoCAD can be described as a digital drawing tool, which means that projects are depicted geometrically. For the program, all building components are geometric shapes, and there is no data about their physical properties or how they interact. For this reason, AutoCAD is effective for 2D drawing and accurate lines, but strictly speaking, it is not a building modeling tool. AutoCAD can also create 3D models and renderings, but they are still geometric models without component information.

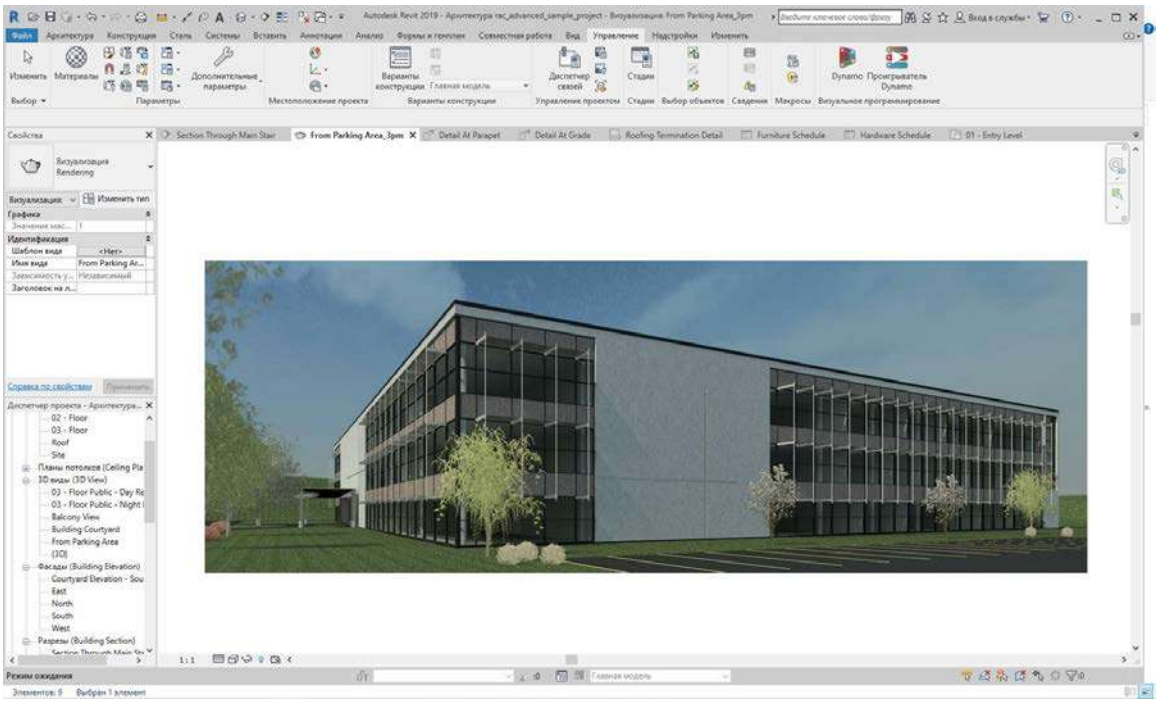

Figure 2. Revit software interface

Revit is more powerful software that can create 3D models of buildings. They are not limited to geometry, including the physical properties of components and their interactions.

Revit also makes it easier to make changes because all design teams work on the same model. Revit is also useful for material selection or when preparing a project proposal. Because the model contains specifications and prices for components, it can automatically generate cost schedules.

Because Revit is a BIM tool, it is useful in the planning, design, construction, and operation of new buildings. Even after a project is complete, having a Revit model makes maintenance and future updates easy [2].

Because AutoCAD is almost 20 years older than Revit, it is more popular, and many engineering firms use it as their default drawing tool. However, the commercial construction industry is rapidly evolving, and firms that ignore trends like BIM are doing so at their own peril.

AutoCAD remains a key part of the design engineer's toolbox because of its versatility and compatibility with older DWG files. Engineering firms tend to accumulate a large volume of project files, and converting them all to Revit can be excessively labor intensive. Ideally, Revit should be used as a new design tool, not as a complete replacement for AutoCAD.

When deploying drawings in Revit, you need to make sure that your networking capabilities are working at the proper level. Revit as a tool with BIM capabilities requires more data than AutoCAD.

The main differences between the AutoCAD and Revit software environments [3, 4]:

- AutoCAD uses the geometric way of CAD, while Revit uses the three-dimensional modeling way of CAD.

- AutoCAD covers many manufacturing functions, while Revit is focused on the building design industry.

- AutoCAD is considered best for 2D drawings, while Revit is better for modeling and getting cost estimates.

- AutoCAD is more flexible to use, while the Revit platform is more intractable to change.

- AutoCAD is available on both Windows and Mac computers as well as mobile devices, whereas Revit is only available on Windows operating systems.

- AutoCAD is more complex and time-consuming to modify projects, whereas Revit makes it easier.

AutoCAD and Revit are compatible and can be used together. Firms can use AutoCAD in some projects or design details and use Revit to create Building Information Modeling (BIM).

AutoCAD and Revit are widely used by architectural and engineering firms when designing buildings. These software packages can be used to create building plans. AutoCAD and Revit are often seen as competing products, but in fact they complement each other.

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УДК 004

DEVELOPMENT OF GIS ENVIRONMENTAL CONTROL BASED ON THE YANDEX MAPS API

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Abstract. The work is concerned with the methods of using GIS maps, ways to implement GIS maps on web-pages with Java-Script libraries and API Yandex map.

Keywords: GIS, maps, web-page, service.

РАЗРАБОТКА ГИС ЭКОЛОГИЧЕСКОГО КОНТРОЛЯ НА БАЗЕ API ЯНДЕКС-КАРТ

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Аннотация. В данной работе рассмотрены способы применения интерактивных ГИС-карт, способы внедрения ГИС-карт на web-страницы с помощью библиотек Java Script, API Яндекс-карт.

Ключевые слова: ГИС, карты, web-страница, сервис.

For several years a digital revolution has been taking place. Capabilities of modern devices are growing and users' needs are growing. GIS technologies are improving as well. In recent years a lot of tools have appeared to create GIS-maps and improve existing. In 2021 modern technologies help people to master the basic functionality of the API Yandex-map and experienced developers can use this service to solve various more complex tasks.

In this paper was considered several modern web services related to geographic information system.

Radio Garden is a non-profit Dutch radio and digital research project (Fig. 1) [1].

Figure 1. Radio Garden

The website presents a globe map of the whole Earth with many cities. Project objective is that everyone can listen any radio station, which located on any distance from the listener. Advantages of the service: modern and understandable design, the service is free of charge. The disadvantages are reduced to the content of the web service. Service has a little information about the radio stations. Users can't contact to developers. To create a web page, the developers used HyperText Markup Language (HTMl), Cascading Style Sheets (CSS), Java Script programming language, various Java Script language libraries.

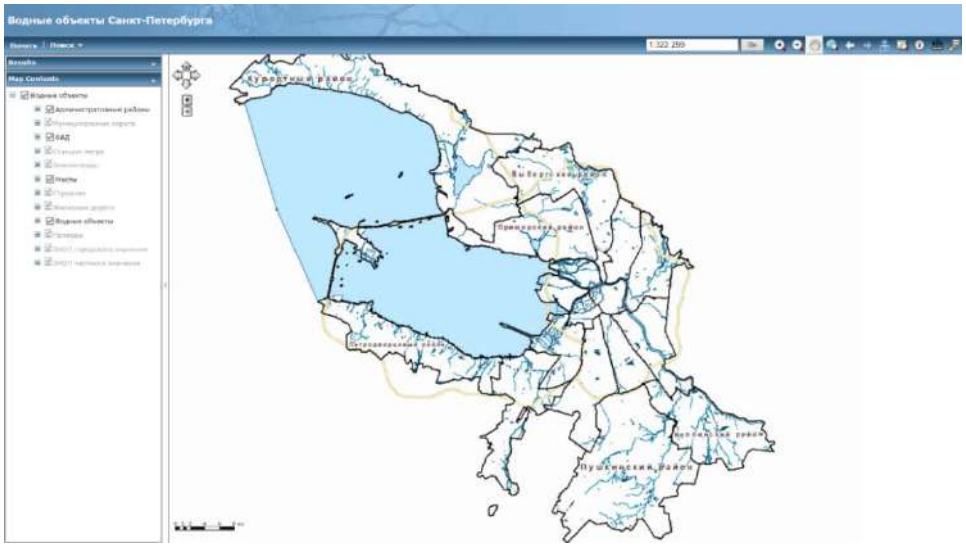

Figure 2. Service "Water objects of St. Petersburg"

Web service "Water objects of St. Petersburg" (Fig. 2) allows you to get information about the spatial boundaries, type, name, identification number,

length (area) of water bodies located on the area of the city [2]. Information about water bodies provided by the service was obtained as a result of works on the inventory of water bodies of the city, commissioned by the Committee for Nature Management, Environmental Protection and Environmental Safety from 2003 to 2008. Data on water bodies updates every month based on the results of topogeodesic surveys carried out on the territory of the city and hydrological surveys. The disadvantages are reduced to the old age of the service, for example outdated design, long loading time. To create a web page, the developers used HyperText Markup Language (HTMl), Cascading Style Sheets (CSS), Java Script programming language.

In total, more than twenty web services were analyzed, positive and negative sides were identified, and development tools for each of them were considered. Each service has its own distinctive features that can be used to create new projects.

Specially for geologists and ecologists of St. Petersburg and the Leningrad region, a web service was created which can monitor water bodies of the Leningrad region.

An empty web page was created, in which the GIS map was placed, and styles for this web page were also written. The map is added by writing part of the finished function code from the Yandex map API service [3]. After that, the coordinates of the map center and the approach to it were changed. The village of Tsvelodubovo was chosen as the center. Then the labels of water objects were added, and the water objects themselves are highlighted with a translucent red circle. In total, more than 30 water bodies were applied, information about which can be added and changed by a user who has access to the web service (Fig. 3).

Figure 3. New web service

The web service is a map with marked reservoirs, points showing information about this reservoir [4]. Currently, web service continues to be developed. This service can already be implemented in the tool of any company engaged in environmental monitoring of St. Petersburg and the Leningrad region. Cooperation with various organizations will improve the service, the service will become more thoughtful, later it will be possible to reach the All-Russian and world level.

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УДК 620.9

TECHNICAL BARRIES TO POWER GENERATION BY SOLAR INSTALLATIONS

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Abstract. The article deals with the different ways of obtaining thermal and electrical energy. It the reasons for the popularization of green energy, in solar energy particular describes. The principle of operation of solar thermal and photovoltaic power plants is considered. On the basis of the work of the given stations the conclusion about competitiveness in relation to traditional types of energy is made.

Keywords: alternative energy, solar panels, thermal power plant, power plant.

ТЕХНИЧЕСКИЕ БАРЬЕРЫ ГЕНЕРАЦИИ ЭЛЕКТРОЭНЕРГИИ СОЛНЕЧНЫМИ УСТАНОВКАМИ

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Аннотация. В статье рассказывается о различных способах получения тепловой и электрической энергии. Описываются причины популяризации зеленой энергетики, в частности солнечной. Рассматривается принцип работы солнечных теплостанций и фотоэлектрической станции. На основании работы данных станций делается вывод о конкурентоспособности по отношению к традиционным видам энергетики.

Ключевые слова: альтернативная энергетика, солнечные панели, тепловая электростанция, электростанция.

At present, it is a quite acute issue, devoted to the consumption of fuel and energy resources. In connection with the technical and scientific-technological development the humankind needs for energy is increasing annually and there is a need to increase the production sources for its generation. Basically, the priority of electricity and heat generation is given to non-renewable energy resources, which include oil, natural gas and coal [1].

Society has recently begun to pay considerable attention to environmental safety. Because of unfavorable changes in the world, namely global warming, pollution of the world ocean, destruction of the ozone layer, reduction of air and soil quality interest in green energy is increasing every year. There are various types of renewable resources including solar, wind, hydroelectric, geothermal and tidal energy, and biomass. The interest in these types of energy is primarily due to the fact that they are inexhaustible, unlike oil, gas or coal, and when using alternative resources, we do not observe negative emissions of harmful substances into the environment [2].

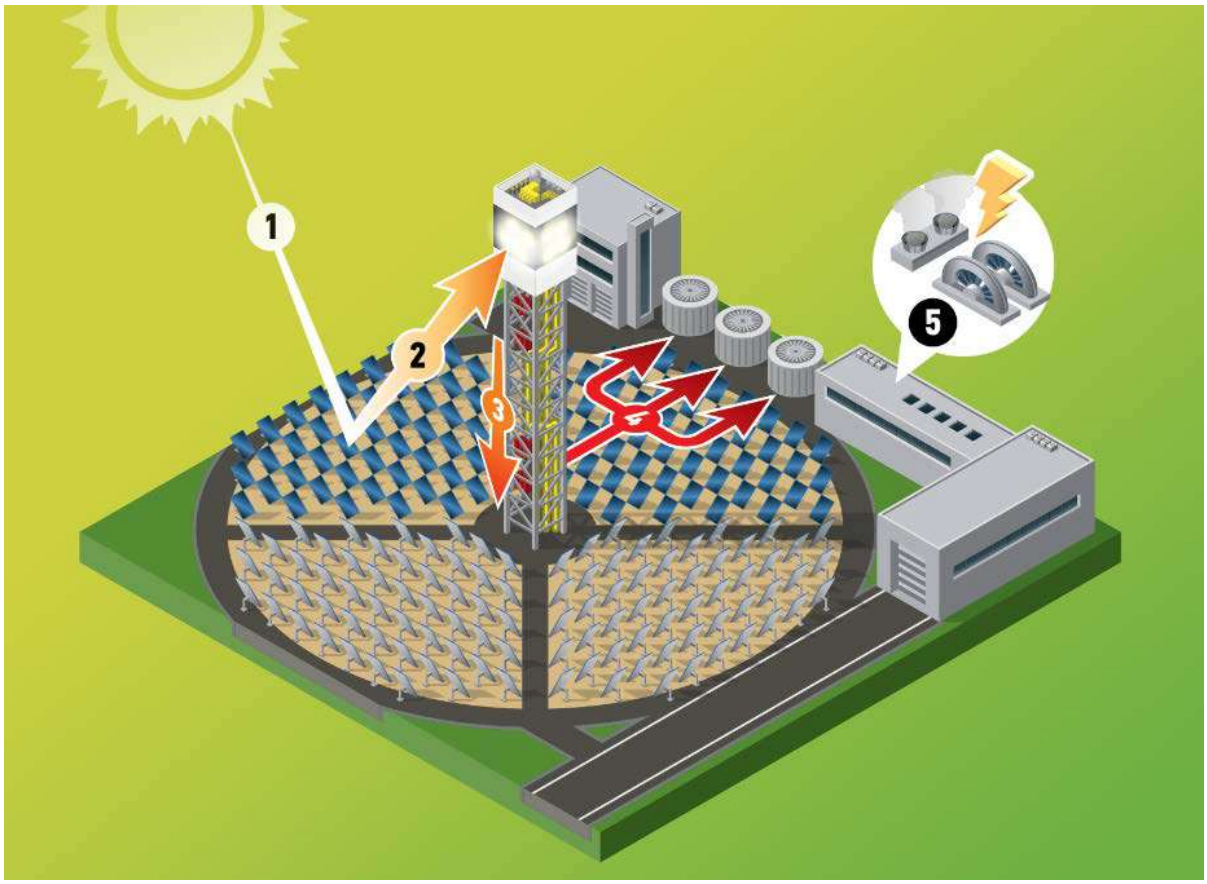

Figure 1. Schematic diagram of a solar thermal power plant

One of the most popular areas of alternative energy is the use of solar energy to generate heat and electricity. However, many people forget that generating energy with solar power plants or solar collectors and the absence of

harmful emissions directly during production are far from the whole picture. If we look in detail at the life cycle of installations at which the conversion of alternative forms of energy is produced (using solar as an example) some questions may arise: is this technology harmless to the environment and is it so effective to be able to compete with traditional thermal or electric power plants?

Fig. 1 shows a schematic diagram of a solar thermal power plant. Fig. 2 shows a schematic diagram of a photovoltaic power plant.

The process of the sunrays hitting the array of mirrors, called heliostats, is shown below number 1. The heliostats then direct the sunrays to the top of the central tower (2). The concentrated rays heat the working medium, liquid salt, to a temperature of about half a thousand degrees (3). The heated working body flows into special reservoirs where the heat is stored (4). To heat the final target – water, which will later become the steam that drives the turbine, salt enters the steam generator as a result of the process depicted by number 5 [3].

We can thus point out that the operation principle of such a plant is just the same as that of conventional heat and power plants, but for the solar radiation as an energy source. Electricity is generated by a steam turbine.

The main disadvantage of such power plants is their dependence on the time of a day and the weather conditions. At night, in the absence of sunlight, photovoltaic modules do not produce energy. And a cloudy sky significantly reduces the level of generation. For the correct operation of the plant, various expensive automatic control systems are required, which include sensors and servomotors that help change the position of the mirrors depending on the position of the sun above the plant. The station also requires periodic maintenance. Although the station is automated, its equipment needs to be maintained. To ensure that the efficiency of the solar panels does not decline, they need to be cleaned of dust and dirt, and in winter, sweep away the snow from them. It is worth noting that the location of the solar power plant requires large areas. As for the negative impact on the environment, despite the fact that we do not have any outgoing gases and at first glance do not harm the atmosphere in any way, solar power plants cause changes in climatic conditions in the surrounding areas due to changes in natural thermal balances and humidity – we shall discuss it later in this paper. At the same time, thermal pollution from cooling condensate remains, just like in conventional power plants.

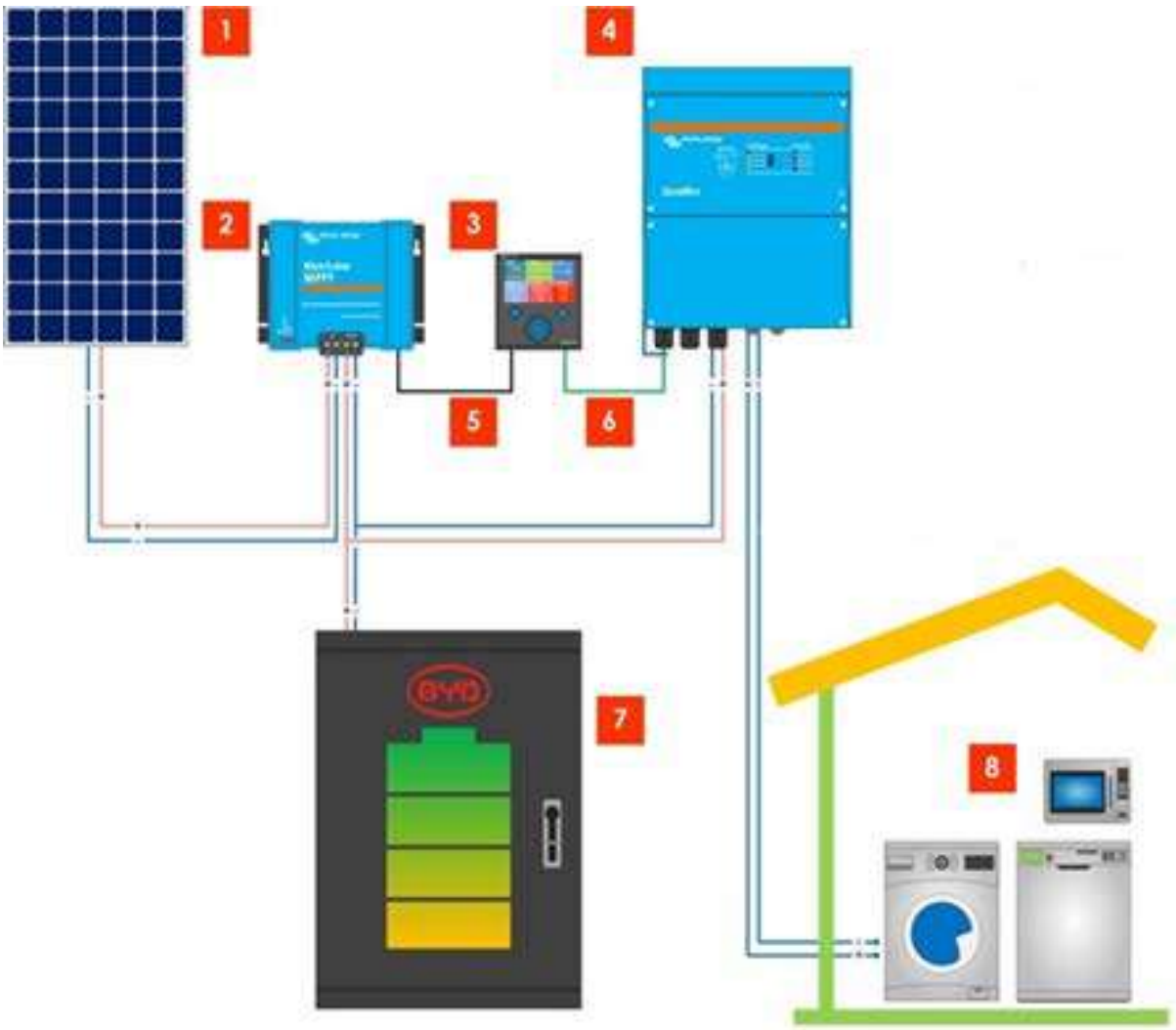

Figure 2. Schematic diagram of a photovoltaic power plant

Under number 1 the photovoltaic field is shown, which is designed to convert solar radiation into direct current electrical energy. Further, it is necessary to charge the battery (7) correctly and correctly, in which the generated energy from the photovoltaic modules is stored, which is ensured by the charge controller (2). The conversion of direct current into alternating current to power the electrical devices at 220 V (8) is carried out by an autonomous inverter (4). A control panel (3) is connected to the charge controller and the autonomous inverter by means of cables (5, 6) [4].

The described method of generating electrical energy belongs to solar photovoltaic power plants. The principle of their work is the generation of electric current when light hits the silicon elements. Such plants are considered the most environmentally friendly way of generating energy. If you do not count the large to be area that is required for the location of solar panels, and artificial creation of shading, which will not allow the normal existence of living organisms, it can be recognized as environmentally friendly. The need for large

areas is taken because of the low density-power, which is measured in W/m2 and characterizes the amount of energy that can be obtained from a unit area.

It is worth noting that it takes 600 kWh to create 1 m^2 of solar panel. This energy will be enough for 5000 light bulbs 12 watts, which are now very common in everyday life, would work for 10 hours. From this it follows that the solar panel will pay for itself only in a few years [5].

Due to the heating of the panels themselves in the process of generating electricity, there is an increase in air temperature in their surroundings. After some time, this increase in temperature leads to a change in the microclimate for living organisms and plants living in and around the area. Continuous long-term use of solar panels results in desertification of the area where the station is located. At the same time, the area around the solar power plant is negatively affected. For this reason, the use of large, most efficient solar power plants in the city and its region becomes impossible.

Similarly, the use of large plants is not possible in farms, due to changing climatic conditions, and the installation of weak units does not allow to obtain the necessary amount of energy.

If we install a large power plant, then we need to think about how to transmit electricity over the necessary distance, and, just as in the case of traditional plants, we can't do without transformers. In this case, we will need to translate the direct current generated by solar panels into alternating current, which creates certain specifics. It is worth noting that solar power plants, as well as traditional ones, require energy consumption for their own needs, which complicates the system as a whole.

But that's not all. The production of solar panels requires the use of many hazardous chemicals such as arsenic, chromium and mercury. These chemicals can cause serious damage to the environment if not properly disposed of, which makes it even more difficult to produce, and any accident on it can cause enormous damage to the environment.

From all of the mentioned above we can conclude: solar energy has a place to exist and can be used to generate electrical and thermal energy. Nevertheless, this type of plants is characterized by:

1. The irreparable damage to the environment in the process of production and disposal of exhausted components.
2. Impermanence, due to the natural solar cycles.
3. Low density-capacity, which requires a large area for the station
4. High cost of components and accumulation

Because of the complex technology, which includes many components that are hazardous to human health and the environment, any accident in

production would cause irreparable damage to the environment. The use of traditional sources of electric power generation is more efficient and does not depend on weather conditions, occupies a smaller area, which makes solar energy less competitive compared to traditional energy.

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УДК 620.9

INVESTOR FRIENDLINESS OF BIOENERGY: GENERAL ASPECTS

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Abstract. In this article, the authors analyze the types of bioenergy, describe their advantages in comparison with other methods of energy production. They consider in detail the economic advantages of biofuels, which in the future can ensure the prosperity and further development of bioenergy.

Keywords: bioenergy, renewable resources, waste recycling, biofuels.

ИНВЕСТИЦИОННАЯ БЛАГОЖЕЛАТЕЛЬНОСТЬ БИОЭНЕРГЕТИКИ: ОСНОВНЫЕ АСПЕКТЫ

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Аннотация. В данной статье авторы анализируют виды биоэнергетики, описывают их достоинства по сравнению с другими методами получения энергии. Подробно рассматривают экономические преимущества биотоплива, которое в будущем способно обеспечить процветание и дальнейшее развитие биоэнергетики.

Ключевые слова: биоэнергетика, возобновляемые ресурсы, переработка отходов, биотопливо.

Bioenergy is one of the youngest branches of the energy sector, however, a number of advantages in relation to other methods of electricity generation have ensured it the status of one of the most innovative and promising areas of energy development. Over the past decade, the bioenergy market has grown steadily. At the same time, Russia, despite its significant raw material base, was

by no means a market leader in this field. According to the report of the Finnish company “Pöyry”, which specializes in energy engineering, in 2015 the share of Russian exports in the market of pellets (one of the forms of biofuel) was about 8 % of the world volume [1]. However, from 2015 to 2020, Russia was able to enter the top five world leaders in the export of this type of biofuel products. Export volumes grew steadily by about 20 % over the year. If this growth is retained in the future, Russia will be able to take the second place in the world in the export of pellets by 2022 [2].

Despite a significant increase in the production of solid biofuels, the percentage of energy consumption generated by bioenergy in Russia is quite small. Solid biofuel is mainly produced for export, while the production of liquid biofuel and biogas remains undeveloped. Recycling is no better, as many types of waste are not used as secondary raw materials [3]. This lie of the land opens up an opportunity for the implementation of developments in the field of bioenergy aimed at the domestic market. Right now, when bioenergy in Russia is experiencing such an unprecedented rise, investments in this industry have a great chance of paying off and bringing significant profits to investors. One should not forget that the bioenergy industry is actively supported by the state. The Russian government is currently trying to financially stimulate the use of renewable energy sources in the interests of the electric power industry.

Bioenergy is considered to be the production of various types of energy from solid biofuels, biogas and liquid biofuels of various origins.

It would be reasonable to compare biofuel with traditional types of fuel in economic terms.

The market price of biofuel is approximately the same as the price of gasoline, nevertheless, biofuel offers more advantages. This fuel is better for engines, it reduces the overall cost of controlling engine pollution and therefore requires less maintenance. As the demand for biofuels increases, it is likely that it will become cheaper in the future. Thus, the use of biofuels will be less burdensome for the wallet. Gasoline is obtained from crude oil, which is not a renewable resource. Although today’s fossil fuel reserves will last for many more years, they will eventually run out. At the same time, biofuels are made from a variety of raw materials such as manure, crop residues and plants grown specifically for fuel. Not every country has large oil reserves. Oil imports leave a significant gap in the country’s economy. If a country begins to lean towards the use of biofuels, then dependence on imports will decrease [4].

This brings us to the analyses of existing biofuels and their benefits.

Biofuel is generally classified into solid, liquid and gaseous one.

Solid biofuel mainly includes firewood, wood chips, pellets, as well as peat. Pellets are solid granules made from agricultural waste. Pellets gained popularity due to their low cost. At the same time, in terms of heat release, they are not inferior to coal and other types of fuel. In addition, pellets also have a minimum ash content, which reduces the need for maintenance of furnaces and boilers. Furthermore, they have the lowest price compared to other types of biofuels [5].

Relative carbon savings from pellet-derived electricity ranged from 79 to 85 percent compared to coal power and 59 to 70 percent compared to natural gas. Across rotation ages, relative savings from pellet-derived were 83 percent and 68 percent, compared to coal and natural gas respectively [6].

Liquid fuels serve as an alternative to gasoline or as an additive to traditional automotive fuels. it is easier and cheaper to transport, store and use. For example, bioethanol is used for stoking fireplaces, since it has a high heat value and does not form combustion by-products. It can be used as an additive to automotive fuels as it protects the engine and reduces emissions.

Another type of liquid biofuel is biomethanol. Unicellular algae are used as raw materials for its production. The cultivation of such algae does not require either fresh water or land areas, and therefore it is one of the most promising directions for the development of biotechnology [7].

Biodiesel can be produced from any vegetable oil or animal fat. Rapeseed oilis the cheapest, so it is used most often. The advantages of biodiesel include the availability and low cost of raw materials, as waste from any agriculture can be used in its production [8]. The production of biodiesel in Europe is growing by 40 % annually. Pure biodiesel costs about $1,95 per gallon.

Gas biofuel is represented by biohydrogen and biogas.

The advantage of biohydrogen is its renewability. Organic waste is used for the raw material; the bacteria involved in the processing of raw materials can be used repeatedly [7].

Talking about biogas, firstly itis one of the most affordable types of alternative fuel (in particular for farmers), since the raw material base for its production is always available and always at hand. Secondly, biogas can be derived from a wide variety of organic waste, which means it can be produced in any region or country in the world, regardless of climatic conditions orgeography [9]. The US has over 2,200 operational sites producing biogas in all 50 states – 250 anaerobic digesters on farms; 1,269 water resource recovery facilities using an anaerobic digester; 66 stand-alone systems that digest food

waste; and, 652 landfill gas projects – according to the American Biogas Council.

They believe the potential for growth in the US biogas industry is huge, calculating that 103 trillion kilowatt hours of electricity could be produced each year; while reducing the emissions equivalent of removing 117 million passenger vehicles from the road [10].

Another type of biofuel is straw biofuel. The production of biofuels from straw is economical. About a third of the processed straw forms waste, which is burned. The process of burning releases enough energy to make sugar from the remaining two-thirds of the straw. Moreover, burning straw produces more energy than is required for the formation of sugars. It is quite possible to use this energy for other purposes [4].

Thus, economic benefits of biofuels are as follows:

Resource renewability. Fossil fuels are an inexhaustible source of energy that will eventually run out. Since biofuels are produced from plant substances, they are theoretically renewable. It allows to reduce production costs, as the necessary resources are quickly restored.

Economic security. Biofuels can be produced locally, creating jobs in the same region where they will be consumed, thereby reducing transportation costs and emissions. In addition, the production of its own biofuels reduces the country's dependence on oil supplies from other states. This makes it possible to obtain fuels from a wide range of raw materials

The durability of the engine. Since biofuels contain fewer impurities compared to traditional fuels, engines will also be polluted less and fail less often. With large-scale use, maintenance costs are significantly reduced.

Summing up, it is sensible to say that bioenergy is confidently coming to the fore in the energy industry. In the very near future, it is unlikely to be able to completely replace the energy of non-renewable resources; however, a huge number of advantages over other methods of obtaining energy will ensure prosperity and further development of bioenergy. Well thought out investment can help unleash the full potential of this industry and make the energy environment cleaner.

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УДК 62-521

IMPLEMENTATION OF PRODUCTION AUTOMATION SYSTEMS IN THE INDUSTRY

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Abstract. This article discusses the concept of automation of technological processes, the history of its appearance and development, the functions that are performed by automated control systems at a manufacturing enterprise. Also, the text contains specific examples of automation systems that are used in modern industrial complexes.

Keywords: automation, industry, production, functions, enterprise, system, technology.

ВНЕДРЕНИЕ СИСТЕМ АВТОМАТИЗАЦИИ ПРОИЗВОДСТВА В СФЕРУ ПРОМЫШЛЕННОСТИ

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Аннотация. В данной статье рассматривается понятие автоматизации технологических процессов, история ее появления и развития, функции, которые выполняют АСУ на производственном предприятии. Также в тексте приведены конкретные примеры систем автоматизации, которые используются в современных промышленных комплексах.

Ключевые слова: автоматизация, промышленность, производство, функции, предприятие, система, технологии.

In modern society, any company strives to maximize its performance and become more competitive, as well as to increase the efficiency and quality of the labor process. In addition, if earlier all this was achieved at the expense of

human labor, then today automated systems and high-tech equipment play an important role in achieving these goals. Let us try to understand the concept of automation of technological processes and production, consider its goals and means, and consider examples of the use of such systems.

Automation is a complex of methods and technical means, including computer technology, that allow you to control technological processes and entire industries without direct human participation or with his partial intervention. Its basis is the redistribution of energy, information and material flows in accordance with the accepted management criterion [1, p. 97]. In accordance with the degree or level of automation, the following types are distinguished [2, p. 45]:

– Partial – automation of individual devices, technological operations and machines. It is performed when the control of processes is practically inaccessible to a person, due to their complexity or other factors. As a rule, operating equipment is partially automated;

– Integrated – provides for the automation of a separate technological section, the entire shop or the whole enterprise, functioning as a single complex;

– Full – the highest stage of the level of automation, in which all the functions of control and management of production are transferred to technical means. At the current level of development, full automation is practically not used, since the control functions remain with the person. The organization of the work of atomic energy enterprises is as close as possible to this type of automation.

In each of these stages, various specially designed devices and devices are used, which can be used individually or as an element of a software and hardware complex and perform a number of tasks without human intervention. They are called automation tools.

They are usually classified according to the functions they perform. So, for example, automatic control means provide continuous or periodic monitoring of the values of technological parameters, means of automatic control realize stabilization or change according to the given laws of technological parameters without human intervention, means of protection keep the equipment in off-design or emergency modes, and control means are responsible for various commands, for example, turn it on and off.

Let us look at the history of the emergence of automation. This is necessary in order to better understand what path of development it has gone through over the long centuries of technological progress, as well as to find out the names of the great engineers who became pioneers in this area.

Self-acting devices, which were the ancestors of modern automation, appeared in distant antiquity, but did not receive wide distribution. A sharp leap in the level and scale of production took place in the 18-19th centuries and was called the industrial revolution. It was at this time that active work began on the introduction of machines and mechanisms into production to replace human labor. Mechanization was carried out in a wide variety of areas, be it metallurgy, woodworking or weaving. One of the most important inventions was made by the Russian mechanic I. I. Polzunov in 1765 – he developed an automatic regulator for the power supply of a steam boiler, as well as the English scientist J. Watt, who in 1784 created a centrifugal regulator for the speed of a steam engine. These inventions became the basis for many future projects [3, p. 45].

After that, already in the 19th century, mechanization and automation began to be integrated into the most diverse spheres of human life. Therefore, for example, with the active development of railway transport, automatic speed control devices appeared which ensured the safety of train traffic, as well as devices for recording the speed, arrival and departure times of trains. Therefore, already in the 20th century, all these processes are taking on colossal proportions and, according to the programs for the development of the national economy and industry, automation systems are beginning to be actively implemented in the energy, chemical and oil industries, as well as in mining enterprises.

All of this today is already commonplace for us, but then these were truly unique inventions that allow not only to improve the efficiency of the processes in which they will be used, but also to make them safe for humans, and much more.

This leads to the logical question of why production automation is needed and what goals are pursued by enterprises by introducing such systems into their workflow. APCS have the following functions [4, p. 74]:

– Heavy physical labor is performed by a machine, not a person;
– Reducing the number of defective products, which appeared due to human errors and shortcomings;
– Increase in labor productivity and production rates;
– Improving the safety of the work process;
– Reducing the number of service personnel;
– Decrease in raw material consumption;
– Improving environmental friendliness.

Having found out what automation is for and what functions it performs, we will consider some examples of those ACS systems and devices that are used in modern enterprises:

1. Robots “KUKA”. The German company “KUKA” offers many options for industrial robots with different load capacities and ranges. By using such a technique in production, you can successfully solve the problems of handling and stacking loads and parts of large mass and volume [5]. KUKA industrial robotic manipulators are successfully integrated into work processes, and thanks to their extremely wide operating radius, they can handle large-scale equipment maintenance and perform operations over a wide range of areas (Fig. 1).

Figure 1. KUKA robots

2. CNC machines AMADA. The Japanese company AMADA offers the best automation solutions, designed and manufactured individually for each enterprise. Their systems are compact and modular, and can also adapt to all production needs to get the most out of their turret press.

3. Industrial robots “FANUC”. FANUC offers the widest range of robots in the world with over 100 models [6]. FANUC equipment covers a wide range of applications and industries, is easy to operate and offers the widest operational flexibility with a range of task-specific custom solutions, ease of integration, lifting capacities up to 1,7 tonnes, and maximum reach up to 4,7 m (Fig. 2).

Figure 2. FANUC robots

4. Multifunctional controllers for communication with the “Emikon” object. MKSO are designed to work as communication devices with a USO facility in distributed or local automation systems, including facilities with explosive zones. Scope of MKSO – automated control systems for technological processes of objects for various purposes, including objects with explosive zones of classes 0, 1 and 2.

Thus, we can conclude that due to the automation of various production processes, the speed of the tasks performed increases. In addition, this way it is possible to exclude the human factor, the number of common errors is significantly reduced, which makes it possible to improve the quality of the process. Thanks to the development of new technologies, production automation contributes to the storage and processing of more data than with a manual method. This method of organizing production allows you to perform several tasks in parallel without sacrificing the quality and accuracy of work.

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УДК 730

THE MAIN TRENDS OF MODERN SCULPTURE

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Abstract. Modern forms of sculpture are so diverse that they no longer fully comply with any canons. In this regard, the article is devoted to the following main trends of modern sculpture: the destruction of any framework and the acquisition of new meanings, dynamism, the introduction of new materials into sculpture, as well as revised masses and spaces.

Keywords: modernity, sculpture, art, trend, development.

ОСНОВНЫЕ ТЕНДЕНЦИИ СОВРЕМЕННОЙ СКУЛЬПТУРЫ

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Аннотация: Современные формы скульптуры настолько разнообразны, что больше не соответствуют в полной мере каким-либо канонам. В связи с этим статья посвящена рассмотрению следующих основных тенденций современной скульптуры: разрушение каких-либо рамок и приобретение новых значений, динамичность, внедрение в скульптуру новых материалов, а также пересмотренные массы и пространства.

Ключевые слова: современность, скульптура, искусство, тенденция, развитие.

This article will consider a topical topic concerning modern trends in sculpture. Sculpture is a reproduction in three-dimensional space of a figurative or abstract image. Previously, sculpture was perceived as an ancient art form, as an addition to architecture. But during the 20th century, it experienced a real

revolution and acquired a new meaning, destroying the old foundations. Various leaps in culture, industry and society have contributed to the development of creative thought in a new direction. Renaissance masters created sculptures of the ideal human body. A man at that time was considered the crown of creation. Modern sculptors, on the other hand, express actual concepts and meanings in the form and rarely resort to realistic images of a person, looking for deeper meanings. Gradually, human consciousness moves to unraveling the laws of existence and, consciously or unconsciously, searching for the meaning of life [1].

Architecture has played a significant role in the development of sculpture. Its principles, namely the management of free space and light with the help of new technologies, tools and materials, have been adopted by modern sculpture. Spatial sculpture is currently the most dynamically developing art form.

Next, we will look at the main trends of modern sculpture.

Lack of frames. It is worth noting that the most pronounced feature of modern art, from which, in turn, other revolutionary moments of its development will come, is complete freedom. The sculptor decides for himself what his creation will embody, how it will be made. He can both build a sculpture in the environment and modify the landscape for sculpture. A very striking example of the sculptor's creative freedom is the “Column without End” (1938) in the sculpture complex on Heroes Street in the city of Targu-Jiu, created by Konstantin Brancusi (Fig. 1). He is considered the founder of abstract sculpture. Almost a thirty-meter tower of seventeen diamond-shaped blocks stands literally in an open field. It symbolizes the path by which souls go to another world. It is worth noting the symbolism that modern artists emphasize. The symbol is an integral part of modern creativity in general.

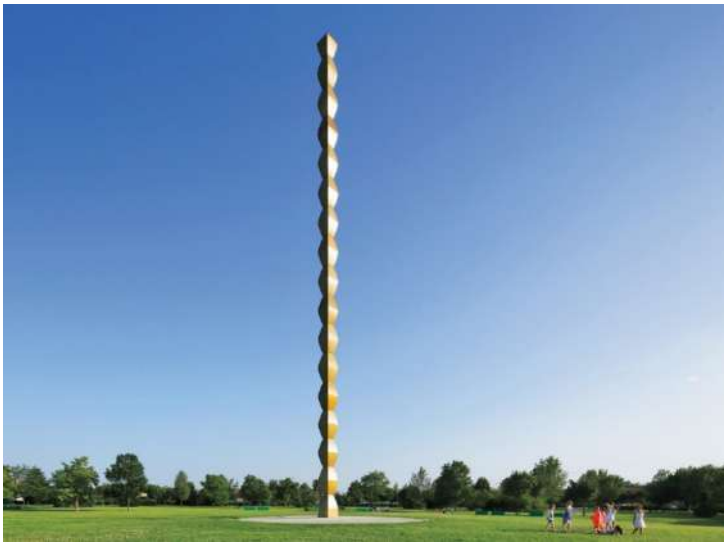

Figure 1. Konstantin Brancusi “Column without end”

Dynamism. Also, modern sculpture is characterized by dynamism. In addition, due to modern technologies and new materials, it has ceased to be associated with any special technical skills of the sculptor. Futurists from Italy tried to portray this dynamic of life. For example, the modern sculptor Umberto Boccioni conveyed in sculpture the speed of modern life, forward movement and rapid changes in forms over time. This is clearly seen in his famous sculpture “Unique Forms of Continuity in Space” (Fig. 2). It depicts a moving human figure. The sculpture has an aerodynamic and smooth shape. Like a pedestal, two blocks at the feet connect the figure to the ground. The figure is also armless and without a noticeable real face. Initially, this form was inspired by the sight of a football player moving to a perfectly weighted pass.

Figure 2. Umberto Boccioni “Unique forms of continuity in space”

New materials. It can be noticed that over the years people attach more and more importance to the surrounding space, namely its beautiful surroundings. Such attention, for example, of the customer to the interior of the house requires even more attention of the sculptor to his work, to the materials from which he will create it. Materials such as clay, glass, porcelain, resin, gypsum, metal, wax and even wire are used [2]. Previously, sculptures were

created only from stone, wood, bronze and marble, but now the list can be called countless. The main thing is that the sculpture fits into the exterior. Even the ways of creating this kind of art are numerous. Sculptures can be sculpted, modeled, cast, forged, mixed and combined to give the image a certain shape / small architectural form (bas-relief, free-standing object or element of the natural landscape). Taking into account the trends of the late 20th century, it is no longer possible to talk about specific "materials for sculpture". Modern sculpture has no frames. Art historians predict that any material, natural or artificial, will probably continue to be used, including polyethylene, foam rubber, polystyrene foam, fabrics and neon tubes. Moreover, real objects can be included in the sculpture, for example, as in the composition of a mixed medium by Edward Kienholz "History as a planter" (Fig. 3) [3].

Figure 3. Edward Kienholz "History as a planter"

Mass and space. Historically, any sculpture is defined by its two main elements – mass and space. In the sculpture of the modern style, these elements lose their former meaning. Monolithic forms give way to light and transparent structures made of various materials that allow the sculptor to capture the effect of movement in space [4]. A good example is Rodin White's sculpture "Fairy with Dandelion" (Fig. 4). It is made of wire and reflects the moment when the dandelion develops in the wind [5].

Figure 4. Rodin White “Fairy with dandelion”

General conclusion. Modern sculpture has gone through many transformations and has become what we can see it all over the world in completely different places, be it the city center or some private territory. Sculpture can become a part of any interior, landscape or landscape. The possibilities of the master have become so limitless that some previously important canons go into the background or lose their meaning altogether. She leaves the external pretentious effects in the past, moves on to the realization of the innermost that is hidden in the form, sculpture is increasingly becoming an expression of higher meanings. For example, a figure does not have to be made of plaster, stone or marble, it can even be made of garbage, and at the same time it will be considered a work of art, another new approach to its understanding. Someone will say that art, including sculpture, has come to a dead end, and someone will say that on the contrary it becomes more multifaceted and more complex. Everyone can find their own answer to this question, but one thing is clear for sure: modern sculpture breaks all the once existing frames, takes new forms and adapts to an endlessly changing world.

Culture flourishes only when the lifestyle of a certain era is so clear and obvious that it can be directly expressed. Therefore, no matter how the sculpture changes, no matter how it seems similar to its own past, its essence remains unchanged. It always shows an attempt to organize a person’s space, it is an attempt to bring into the spiritless physical world what is inherent in human nature – reason and feeling, logic and beauty. Art reflects the actual state of time.

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УДК 94

CONTRADICTIONS IN THE SOCIO-ECONOMIC DEVELOPMENT OF CENTRAL ASIA

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Abstract. The article examines the trends and imbalances in the socio-economic development of the Central Asian countries that restrain the deep integration of production, commodity and material exchange, financial and labor spheres; the factors hindering the cooperation of the countries of the Central Asian region are described; the positive impact and threats of globalization processes on regional security in medium term. The article substantiates the promising directions of economic integration of the Central Asian countries, within the framework of favorable conditions for doing business in each of them.

Keywords: globalization, integration processes, regional cooperation, regional security, labor migration.

ПРОТИВОРЕЧИЯ СОЦИАЛЬНО-ЭКОНОМИЧЕСКОГО РАЗВИТИЯ ЦЕНТРАЛЬНОЙ АЗИИ

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Аннотация. В статье рассмотрены тенденции и диспропорции в социально-экономическом развитии стран Центральной Азии, сдерживающие глубокую интеграцию производства, товарно-материального обмена, финансовой и трудовой сфер; описаны факторы, препятствующие сотрудничеству стран центрально-азиатского региона; выявлены позитивное влияние и угрозы процессов глобализации на региональную безопасность в среднесрочной перспективе. В статье обоснованы перспективные направления экономической интеграции стран ЦА, в рамках существующих в каждой из них благоприятных условий для ведения бизнеса.

Ключевые слова: глобализация, интеграционные процессы, региональное сотрудничество, региональная безопасность, трудовая миграция.

The collapse of the Soviet Union in 1991 led to the creation of five new states in Central Asia: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. During the Soviet period, these territories were called “Central Asia” and Kazakhstan, which corresponded to the geographical location and economic zoning of a single country. In 1993, at the Ashgabat meeting of the heads of Central Asian states, the term “Central Asia and Kazakhstan” was replaced by “Central Asia”. This was primarily due to an attempt to identify a new subregion in the post-Soviet space. Secondly, it was a definite attempt to distance himself from Russia.Central Asia is a very heterogeneous region in terms of socio-economic processes. It is rapidly fragmenting in terms of living standards, economic growth rates, environmental conditions, quality of social services and access to infrastructure. Therefore, it is difficult to find common socio-economic problems that would equally concern a resident of a megalopolis and a native of a small village [1].

On the other hand, the region is still characterized by numerous contradictions that pose serious problems for the socio-economic development of the entire Central Asia. Therefore, it is worth looking at it through the prism of a combination of very contradictory processes.

Firstly, population growth continues in Central Asia, and the acute problem of employment is combined with a shortage of qualified personnel and low quality of human capital. Despite the strong migration outflow, the population of the region has grown by 47 % over the past 30 years, or more than 23 million people. Against the background of a young population structure (the average age, according to 2015 data, ranges from 22 years in Tajikistan to 29 years in Kazakhstan) and a large number of children in the family (for example, in Tajikistan there are an average of 3,8 children per woman), it is obvious that growth, although slower than before, will continue.

For all countries of the region, the problem of employment of the population, especially young people, remains extremely relevant. According to official data, unemployment in Central Asia ranges from 2,3 % in Tajikistan to 9,3 % in Uzbekistan, and the total number of officially unemployed in the countries of the region exceeds 2 million people. However, experts speak of a more serious scale of the problem, when a significant part of the unemployed are not registered, belong to the categories of seasonal workers or self-employed, and also go into labor migration abroad. Hundreds of thousands of Central

Asians are not registered as unemployed for several reasons: because of the complicated and lengthy bureaucratic registration procedure with social security agencies, because of their legal illiteracy or because they are officially employed in agriculture or in the service sector. part-time employment and extremely low labor productivity [2].

It is estimated that the share of unemployed in large cities is 10 – 15 %, and in rural areas – from 40 to 60 %. Thus, Mardikor bazaars – spontaneous markets for day laborers – are an integral part of the landscape of regions with an excess of labor in Central Asia, and more than five million people are abroad as labor migrants.

At the same time, the countries of the region are experiencing an acute shortage of qualified specialists in the field of healthcare, education, industry, transport and housing. That is why Central Asian countries annually attract tens of thousands of foreign workers and specialists from China, Turkey, Russia, India and other countries to implement new projects in the field of industry and construction.

Secondly, Central Asia is characterized by rapid economic growth, accompanied over the past 20 years by a significant increase in the standard of living of the population and significant successes in the fight against poverty. At the same time, poorly diversified local economies depend on external economic conditions, a small domestic market, weakened by the wave of devaluation of national currencies in 2014 – 2019, cannot provide the necessary volume of demand, and new projects are technologically completely dependent for foreign companies.

Economic growth in Central Asia over the past 15 years has been higher than that of many of its neighbors: the EU, Russia, Iran or Turkey. In the poorest country in the region, Tajikistan, the poverty rate decreased from 73 % in 2003 to 31 % in 2015. There have also been major changes in the structure of GDP, where the share of agriculture has significantly decreased. However, the economies of the countries of the region still depend either on the export of minerals (Kazakhstan, Turkmenistan, Uzbekistan), or on the export of labor (Tajikistan, Kyrgyzstan) [3].

Thirdly, the region occupies a unique geographical position in the center of the Eurasian continent, but its transit potential is poorly realized due to undeveloped infrastructure, customs and technical restrictions and a high level of corruption. For example, in Kazakhstan, the volume of rail transit cargo in 2018 amounted to just over 17 million tons, which is several times less than the volume of transit cargo of the Trans-Siberian Railway [4].

There are many reasons for the low level of infrastructure development. So, at the time of the collapse of the Soviet Union, only Kazakhstan had a relatively full-fledged railway network connecting all regions of the country. In the rest of the Central Asian states, movement from one region to another was tied to transit through the territory of neighbors. For example, in Uzbekistan, it was possible to get from Tashkent to Termez by rail only through the territory of Turkmenistan.

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УДК 620.95

THE RELEVANCE AND ADVANTAGE OF BIOFUEL IN THE ECOLOGICAL COMPONENT

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Abstract. Biofuel is considered in this article. Its types, advantages with an ecological component and trends in its development are discussed.

Keywords: biofuel, ecology, relevance and advantages of biofuels.

АКТУАЛЬНОСТЬ И ПРЕИМУЩЕСТВО БИОТОПЛИВА В ЭКОЛОГИЧЕСКОЙ СОСТАВЛЯЮЩЕЙ

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Аннотация. В данной статье рассматривается биотопливо, его виды, преимущества в экологической составляющей и тенденции развития.

Ключевые слова: биотопливо, экология, актуальность и преимущества биотоплива.

In the 21st century, humanity is faced with a number of environmental problems that can not only make adjustments to our life, but also end the existence of us as a species. Now we see climate change, which is pushing us to develop in the field of ecology.

Since it is almost impossible to reduce our needs, people are looking for other ways to obtain energy, which will be unlimited and less hazardous to the environment. Biofuels help with this. Since the fuel we use is depleted and may run out at any time, we need an alternative that will give us energy and not do much harm to the environment.

Bioenergy

This power industry specializes in the production of energy from biofuels. Biofuels are obtained from raw materials as a result of processing biological waste. There are also projects of varying degrees of sophistication aimed at obtaining biofuels from cellulose and various types of organic waste, but these technologies are in an early stage of development or commercialization.

Biofuel is an alternative type of fuel obtained as a result of processing biological waste or biological raw materials. Today, waste from the agricultural and food industries can produce biofuel. Raw materials can be: animal manure, agaric waste and others.

It is divided into several types, namely: liquid, solid and gaseous.

Solid biofuels are the most common in our lives. The most striking example is firewood, wood pellets, pellets, etc. are also on the list of solid biofuels, which are made from sawdust, bark, straw, manure and other agricultural waste.

Liquid biofuel is typically used in cars. It includes bioethanol, biomethanol, diesel fuel, second generation biofuels, biobutanol.

The last one is gaseous biofuel, which includes biogas, biohydrogen and methane. These types appear during the fermentation of biomass.

Second generation biofuels

These are fuels made from straw, sawdust and other biomass that are affordable and renewable with little maintenance and fertilizers. For example, biofuel made from algae, which have a simple chemical composition, is amenable to splitting and processing, and absolutely any water and sunlight are needed for growth. This makes this fuel one of the ways to solve the energy crisis.

Advantages of biofuel

1. Biomass is a renewable energy source. Millions of reserves have already been created by nature itself and are formed as a result of human activity. It can be processed correctly without polluting the atmosphere and converts carbon dioxide into energy. This is due to the fact that when new plants grow, this dioxide is absorbed, which is a consequence of fuel combustion. Carbon dioxide emissions are reduced by 60 – 65 % when burning biofuels, which helps to prevent global warming.

2. Many people, choosing a high-quality and full-fledged energy carrier – biogas in housekeeping, in medium and small enterprises, in heating residential and industrial premises, are the saviors of nature, because they do not pollute nature with a lot of garbage and various waste.

3 At the time of combustion of this type of fuel, a small amount of sulfur oxides is released. But compared to other types of fuel, there is one very important distinguishing feature – it is the minimum pollution of the environment.

4. It is very easy to get biofuels, because they can be produced not only from waste and garbage, but also from existing resources, for example, from algae. They have a simple chemical composition, amenable to splitting and processing, and also for their growth you just need sunlight and absolutely any water. It is used as a fuel for various types of transport, in the generation of various types of energy.

5. Biofuels have a positive effect on the fauna. There are plants that are sources of woody biomass (rod-shaped millet – sorghum, in particular). They create an environment that is favorable for animals and also has a positive effect in reducing erosion.

6. Methane and the energy that is produced from biogas can be used to replace the energy produced from fossil fuels, and therefore to reduce greenhouse gas emissions, since the carbon in biodegradable material is part of the carbon cycle.

7. An important advantage of biofuels is that it helps in solving problems associated with the correct disposal of organic waste. Technologies for processing such waste are a solution to the problems of environmentally safe disposal of organic waste. One of which is methane (anaerobic) digestion to produce biogas. This is the process of anaerobic decomposition of proteins, fats and carbohydrates contained in biomass, under the action of enzymatic hydrolysis into the simplest organic compounds.

The raw material is biodegradable waste (waste paper, food residues, grass trimmings, animal waste), which makes this method as organic as possible and can solve the problem not only in disposal, but also be used for wastewater treatment [1].

Prospects and trends in the development of biofuels

1. The development of agro-industrial regions consists in the search for optimal, as well as affordable technologies for processing organic waste, using integrated technologies for utilizing biomass through methane digestion with biogas production.

2. Technologies for generating heat and electricity from biomass can improve production efficiency.

3. Automation is expected to drive down the cost of bio-based raw materials, which improves economics and helps the industry grow [2].

Green energy has shown high growth rates for the last 20 years.

In 2019, global biofuel production exceeded 1.8 thousand barrels, with a market share of $ 136 billion [3].

Bioenergy pioneers such as Sweden, Finland and Denmark are successfully introducing capacities operating on biological raw materials into their energy systems. And the friendly policy of the European Union contributes to the further attraction of investments in the industry of bioenergy. It does not have high productivity, but it wins with its environmental friendliness.

The volume of generation of renewable energy sources is growing at a fast pace, as is its global energy consumption. Most bioelectricity is produced in North America, Europe, South America and Southeast Asia. Most of all bioelectricity is produced in such countries as:

1. South East Asia
2. Europe
3. North America
4. South America

According to forecasts of experts, the volume of investments in renewable energy is growing every year, in contrast to the extraction of oil and gas. In the next decade, green energy will become the largest energy sector in terms of investment [3].

Green energy companies

Foreign companies.

1. British Petroleum (BP) invests in renewable energy sources. BP Bunge Bioenergia is co-founded with Bunge to combine bioenergy and sugarcane ethanol efforts.

2. Total (TOT). This French company is seriously engaged in the development of green energy, increasing capacity indicators. They are increasingly increasing their attention in the field of photovoltaic solar energy, wind energy, bioenergy, hydropower [4].

Companies in Russia.

1. The Bioenergy Development Center of the All-Russian Research Institute of Agricultural Mechanization.

2. The Bioenergy Technology Platform at the Kurchatov Institute Research Center.

Russia, given its wide potential for the production of various types of biomass, may be a serious exporter of biofuels to the world market. These two organizations are developing in bioenergy. They create large-scale programs for the development of bioenergy in the country. Their projects are being implemented in an industrial biogas power plant in the Belgorod region (two biogas plants “Baitsury” and “Luchki”), the Kirov plant “Biochemzavod” and a plant for the production of pellets [5].

The development of bioenergy, which implies the production of biofuel, is one of the most important tasks for states in the near future. Green energy has many advantages, for example, affordability, since it does not often require additional investments in the extraction of raw materials; environmental friendliness, because it is not accompanied by carbon dioxide emissions, health of the population and the state of nature in general. Now humanity is at a stage when the relevance of this type of energy is high as never before. This requires the creation of targeted government programs and their funding. This investment will pay off, as nature will thank us, and as a result, future generations.

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УДК 681.5

SIMULATION MODELING OF A SUCKER-ROD PUMP SYSTEM

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Abstract. At present, it is important to increase the productivity of equipment in all areas of industry. The leading industry that generates most of the profits in the Russian Federation is the oil and gas industry. This report is intended to review and analyze the existing developments of the scientific community in the field of automation of sucker-rod pump system in terms of the basis - the model of the control object. As a result of modeling, the model that most accurately describes the control object, as well as taking into account all the features of the design and technological process was obtained.

Keywords: APCS, process modeling, sucker-rod pump system, oil and gas industry, automation.

ИМИТАЦИОННОЕ МОДЕЛИРОВАНИЕ УСТАНОВКИ ШТАНГОВОГО ГЛУБИННОГО НАСОСА

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Аннотация. В настоящее время актуальным является повышение производительности оборудования во всех сферах промышленности. Ведущая отрасль, приносящая достаточно большую часть прибыли в бюджете Российской Федерации, – нефтегазовая отрасль. В работе приведены обзор и анализ существующих разработок автоматизации УШГН с моделированием объекта управления. В результате моделирования была получена модель, наиболее точно описывающая объект управления, а также учитывающая все особенности конструкции и технологического процесса.

Ключевые слова: АСУТП, моделирование технологических процессов, установка штанговых глубинных насосов, нефтегазовая промышленность, автоматизация.

1. Introduction.

There are several types of installations and methods of oil production, for which different approaches in automation are used.

There are more than a million oil production wells worldwide, and artificial lift technologies are vital for crude oil production. 99 % of oil wells are not gravity flowing, so oil has to be brought to the surface by artificial methods, and in 88 % of cases, using specialized automation tools.

Let’s consider using a simulation system for the installation of a sucker-rod pumping system (SRPS).

2. Main part.

Simulation modeling of automated control systems is an important stage for the analysis of the control object [1 – 4]. A software package used for simulation modeling of control objects [5] was used in this work.

Let’s consider one of the options for modeling the LPGC [6]. Fig. 1 shows the structural diagram of the system. Fig. 2 shows the transfer functions of the links and the control loop diagram.

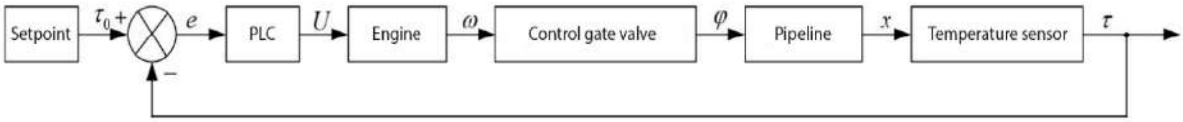

Figure 1. The structural diagram of the system

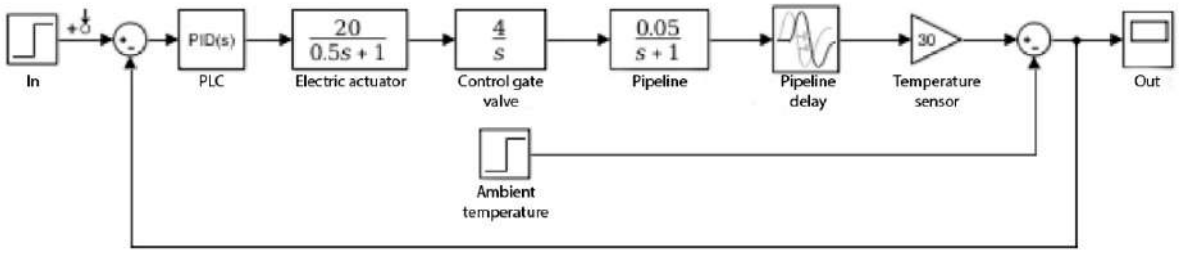

Figure 2. Control loop diagram

In the considered model, the control object is the pipeline section of the control unit. The system maintains oil temperature inside the oil-filled furnace above 25 °C. Transient process of the system is shown in Fig. 3.

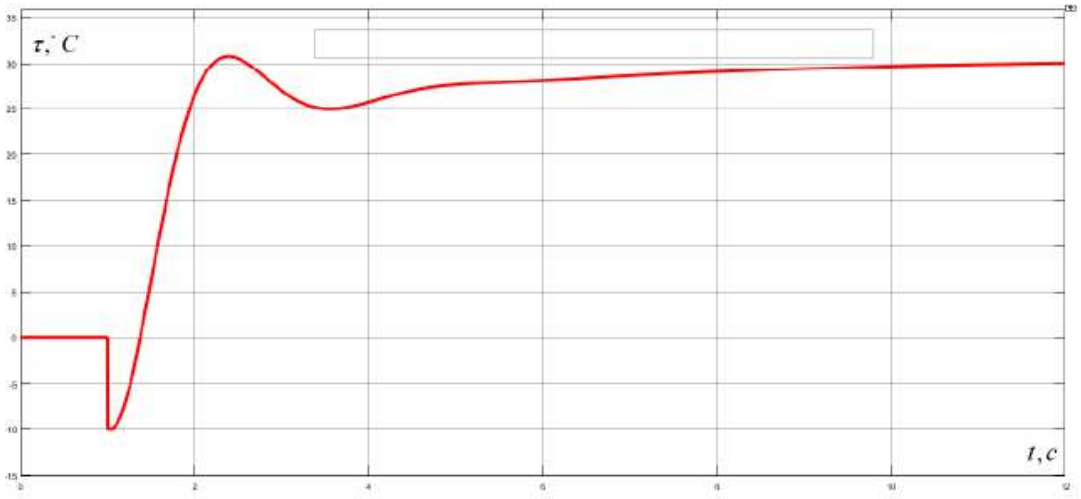

Figure 3. Transient response of the simulated system

The required value of the parameter 30 °C is reached in 12 seconds, the overshoot is about 3 %. There is a temperature sag at the beginning of the graph, due to the initial condition (ambient temperature is assumed to be –10 °C). The system takes into account the electric drive that drives the rocking machine, the pipeline through which the oil flows, the regulating gate valve and the temperature sensor. From the disadvantages it can be immediately noted that the influence of the crank installed on the rocking machine, which directly affects the load of the electric motor, is not taken into account, and at direct control of the electric motor it is necessary to consider this influence, otherwise the system can break down in a relatively short time [7].

The structural and functional diagram of the following variant of the simulation of the SPRS is shown in Fig. 4.

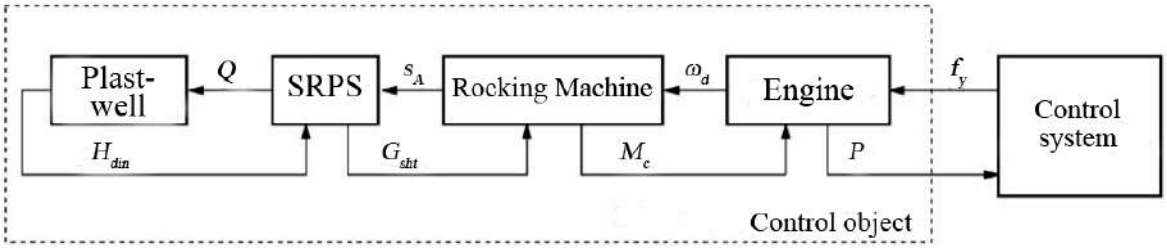

Figure 4. Structure-functional diagram of control object:
Q – supply of the sucker rod; s_A – law of motion of the polished rod; ω_d – angular velocity of the motor shaft rotation; fu – frequency of the control signal set by the control system; M_c – moment of resistance on the electric motor shaft; G_{sh} – forces on the polished rod; H_{din} – dynamic level of liquid in the annular space of the oil well; P – the value of average power consumed by the drive during the balancer rocking

The control object is a complex system consisting of separate subsystems: reservoir-well, sucker rod, pumping machine and electromechanical drive. Parameters of the subsystems are related to each other. Each subsystem in the work is considered separately to simplify the mathematical description. The general simulation model of SRPS is shown in Fig. 5.

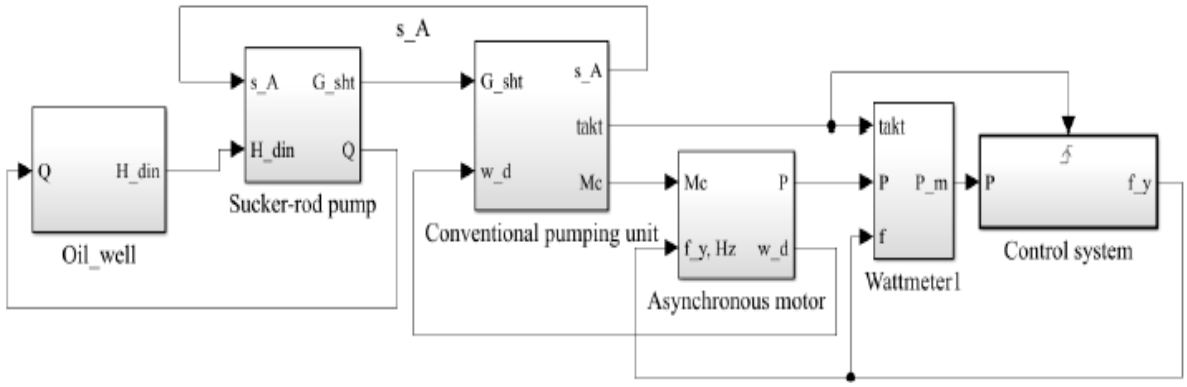

Figure 5. Simulation model of SDHC with subsystems:
Q – supply of SRPS (flow rate); H_din – dynamic liquid level;
s_A – position of the rod; G_sht – force on the rod, w_d – angle speed of motor shaft rotation; Mc – moment of resistance on the motor shaft;
f_y – frequency of control signal; P – instantaneous speed value

The model accurately describes each subsystem of the SRPS and allows the system to be studied under different parameters of the equipment used, taking into account the well.

3. Conclusion.

Application of simulation modeling systems for SRPS is a complex but relevant task, the solution of which makes it possible to analyze different modes of operation for real control objects.

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ELECTRIC MOBILITY AS A DIFFICULT WAY TO ENSURE ENVIRONMENTAL FRIENDLINESS

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Abstract. This article is devoted to the impact of motor transport on the natural environment since one of the main causes of air pollution is cars with internal combustion engines. One of the important measures for clean air is the gradual transition to environmentally safe transport. The article discusses issues related to electric vehicles, their main advantages and disadvantages in the context of climate change, as well as the difficulties of using electric vehicles into everyday life.

Keywords: electric vehicle, environmental pollution, emissions, motor vehicles, electric drive, eco-friendly cars.

ЭЛЕКТРОМОБИЛИЗАЦИЯ КАК ТРУДНЫЙ ПУТЬ К ОБЕСПЕЧЕНИЮ ЭКОЛОГИЧНОСТИ ОКРУЖАЮЩЕЙ СРЕДЫ

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Аннотация. Данная статья посвящена влиянию автотранспорта на природную окружающую среду, так как одной из основных причин загрязнения воздуха являются автомобили с двигателями внутреннего сгорания. Одной из важных мер по борьбе за чистый воздух считается постепенный переход на экологически безопасный транспорт. В статье рассмотрены вопросы, связанные с электромобилем, их основные достоинства и недостатки в контексте изменения климата, а также трудности внедрения электромобилей в повседневную жизнь.

Ключевые слова: электромобиль, загрязнение окружающей среды, выбросы, автотранспорт, электропривод, экологичные автомобили.

The transition from gasoline and diesel vehicles to electric cars is a key strategy for solving global warming issue. The specialists anticipate solid federal investment to charge stations development and tax concession for electric cars owners in the nearest future.

Electric drive is the main mover of an electric car. The key parameters of the vehicle depend on its work efficiency. The electric motor is considered to be absolutely eco-friendly. It does not emit any toxic substances while working. However, coal and other energy resources are used for energy production, so actually the environment suffers indirectly anyway. That is why some countries like Germany or Netherlands along with electric car program implant the system of “green” energy, increasing the number of wind and solar power stations.

In order to improve the efficiency and minimize energy loss, it is necessary to increase power supply voltage of electric motors. According to Ohm’s law, the current is decreasing proportionally, that is why brushless alternating current motors are used for electric cars. Eventually the emission from the whole vehicles pool – from the vehicles of all types and sizes – affects the extent of environmental pollution [1]. Inability to reduce the emission from gasoline vehicles burdens the atmosphere with CO_2 excess for many years ahead.

Electric cars emit less amount of hazardous substances that cause the climate change than the vehicles with gasoline motors. In addition, electric cars help to avoid environmental damage caused by oil drilling, refining and transportation to the gas stations.

Despite the fact that electric cars help to reduce CO_2 emissions, this does not affect the overall picture due to increasing popularity of pickups and off-roaders with high fuel consumption, which neutralize the potential reduction of CO_2 emissions from electric cars.

There are Federal Standards of clean air cars, which combine Corporate Average Fuel Economy (CAFE) standards with standards for greenhouse gas emission. Both of them are applied to the whole vehicles pool. This means that the sale of electric cars and other high-efficient vehicles allows the producers to sell more less eco-friendly vehicles without violation of average limitations of greenhouse gas emission.

As a result, not every newly sold electric car leads to the reduction of CO_2 emissions. Actually, electric cars even provide the producers with extra benefits without standard violation. Selling the electric cars nowadays increases average emissions from the whole vehicle pool to the amount that can be a bit smaller without electric cars [2].

The car producers should acknowledge the importance of electrification. The most part of car producers are committed to bring more electric cars to the

market. However, electric cars are still not fully convenient for wide usage because of high price and unavailability for many consumers.

Even if the price decreases, drive distance and the amount of charge stations increase, the charge time remains the problem. That is why it is still not clear if the world is ready for quick transition to the fully electric future.

More than 2 million of electric cars were sold in 2018. By 2025, this amount should be around 25 million. By the same year, the electric cars will take 20 – 22 % of the whole car market. In 2018 around 1,3 million of fully electric cars were bought and 60 % of the market comes on China. The main producer of the electric cars is Tesla, Inc. which produced and sold 245 249 electric cars in 2018 (Fig. 1). The top three largest producers also include Chinese companies Beijing Electric Vehicle (BJEV) and BYD. Seven biggest companies out of ten are located in China.

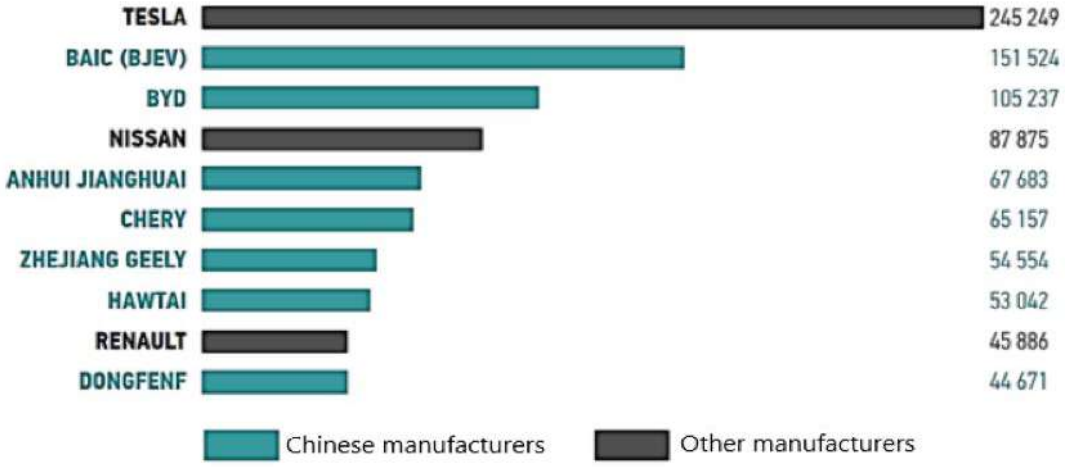

Figure 1. Global sales of electric vehicles, units

Huge development of Chinese market can be induced by governmental support. According to the Ministry of Industry and Information Technology of PRC, the government invested 6.64 billion of CNY (one billion of USD) to motivate consumers for electric car purchase. The province and city administrations also support the programs of additional financing to make electric cars more attractive for the population. However, despite this fact, Chinese government gradually decreases subsidy rates to stimulate car producers to spend more money for technological development, which can secure successful future of the field [3].

The Russian market of electric cars is also growing; however, the pace of growth is slower than in PRC or Europe countries. For example, in the last quarter of 2018 there were only 3000 electric cars in Russia. Most part of them are used cars sent from Asia, American or European countries.

Ecological standards that are getting harsh every year make car producers to reduce CO_2 emission from their car pools. Hopefully, this will turn the technological potential of electric cars to the actual improvements [4].

"Green" social organizations and politicians put many efforts to promote electric cars; however, these efforts are not enough to stimulate consumers for eco-friendly car purchase.

To reduce CO_2 emission as soon as possible it is very important to improve significantly the efficiency of gasoline cars in the near future. This is especially crucial for pickups and off-roaders with high fuel consumption. Eventually, the humanity will leap to the conclusion that electric car is necessary measure for environmental improvement.

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FORMATION OF SOCIETY'S ATTITUDE TO THE FEMALE IMAGE IN COMPUTER GAMES

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Abstract. In this paper, the female image in computer games is considered, how characters are created, how they are made attractive and interesting for users. The opinions of the creators and editors are also considered. Visually fixed female images not only reflect, but also form a social reality. Therefore, it is relevant and important to trace the situation of the construction of meanings in the visual argument, the dynamics of the representation of female images.

Keywords: computer games, society, opinion, female image, character.

ФОРМИРОВАНИЕ ОТНОШЕНИЯ ОБЩЕСТВА К ЖЕНСКОМУ ОБРАЗУ В КОМПЬЮТЕРНЫХ ИГРАХ

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Аннотация. В данной работе рассмотрен женский образ в компьютерных играх, каким способом создаются персонажи, как делают их привлекательными и интересными для пользователей. Рассматриваются также мнения создателей и редакторов. Визуально зафиксированные женские образы не только отражают, но и формируют социальную реальность. Поэтому актуально и важно проследить ситуацию построения смыслов в визуальном доводе, динамику представления женских образов.

Ключевые слова: компьютерные игры, общество, мнение, женский образ, персонаж.

The current society, becoming post-industrial as well as informative, transforming into a society of public culture, has “spoken” in the latest styles and has also seen itself in other visual places. The newest reality actualizes 1 from the concepts of “power” – a conditional, equivalent reality, in which visual signs and figures also carry out significant significance. Now the phenomena of visuality are not simply designated as a field of imaginative creativity, but also as an instrument of ideology, becoming one of the effective elements of influence on the people. The figures, without exception, more replace reality. This substitution is carried out in absolutely all areas of existence: in today’s auction, not real objects, but formed marketing figures, public institutions, in addition, without exception, include more figures in the fun.

In particular, often in the current visual culture, a statement is made to the ladies’ types. As well as an aesthetic object, as well as the owner of culture. Visually marked ladies’ figures in no way only reflect, but also form the social reality. For this reason, it is also important to track the situation of the construction of contents in the visual argument, the dynamics of the concept of ladies' figures.

Computer technological processes have firmly entered into our life activity with you. Computer-based forms of entertainment have started to become available as well. They use the maximum popularity about schoolchildren of the younger generation as well. The type of entertainment itself forms the community's approach to the ladies’ type.

The development of games proceeded at such a rapid pace, as well as the formation of computer technical. Because of 2 decades, the language of video games has developed, the concept of trends and genres has been formed, famous surnames have also emerged as a form of entertainment, gaming societies and clubs have appeared [1, p. 260].

The gaming industry is being formed at a rapid pace, and any creator also strives to bring something into it-in this case, the latest, recruiting the best experts in order to solve the problems of visual concept, animation, and video game events. During the study of games, software developers are of significant importance, but the basis of absolutely all plans is constantly represented by the category of artists and painters. In their hands lies a significant responsibility due to the complete formation procedure from the sketches up to the 1st release [2].

In the course of a whole review of academic, scientific-widespread, dilettante literature, a number of similar lessons of bard’s advice were selected.

The result of the search activity began with the basis of the organization of the Bardic councils in the general educational and methodical manual.

As well as the principle, sense-art is formed during the initial period of the plan study.

In the base of concept-art there is a theory, in this case there is a concept of work. The concept of the character as well as his appearance type directly depends on the local features of the real or fictional society in which someone “lives” [3].

Often, in the current amusements about any character, his chronicle is also thought out in detail, as is the general psychological image. This is expressed in no way only in the feelings of the character, but also in his action as an external version. This kind of process forces people to “believe” in what is happening, experience game actions together with him, enjoy or sympathize with the hero. Some creators publish short videos that tell the biography of the main characters, a kind of entertainment, a certain background. By this, most affecting our understanding, our understanding is also an understanding of the heroes. The fact that he is able to move also into real life.

Girls are traditionally unlucky in computer games. The artists focus on the teenage audience of the stronger sex – who sees attractive appearance in girls and is more interested in military-themed games. No one really bothered with the more complex parts of the wardrobe.

It often happens in this way that the representatives of the stronger sex prefer to perform because of the ladies' heroes, thus also on the contrary. Of course, in which place there is a character selection. Who exactly-in this case, creates in this way only because of what they like, for example, the appearance of the type or this protection after all?

The main technical editor of the RENDER portal. EN The book of Tsapik does not observe a rigid connection among the gender of the person also sunken character. What concerns the conditions, if an individual constantly selects only ladies’ heroes, the Book of Tsapik observes a number of factors, “starting with the fact that he just likes beautiful female characters, and ending with an unconscious identification with a female character. But if it’s not inconvenient in real life, there’s no problem.”

It is quite difficult to form an impeccable image of a woman in fun. The conversation is not about this in any way, in order for the beloved to exist faithful in absolutely everything, good and genuine. The heroines are obliged to look real, to have specific shortcomings, but at the same time, over time, to

attract every young person for themselves. Let women have charisma and attractiveness, but they do not cross the border of obscenity in any way. In conversations, such ladies have every chance to show erudition, but in difficult moments to stand up for themselves or, despite the fact, to assist the main hero. Emotions are formed, the fact that the conversation is about this or that-in this case, utopia. In fact, in real society it is extremely rare to meet such a lady, as well as a young man with an impeccable set of data. But look, in fun, this is completely feasible [4].

An example is the game Tomb Raider: Lara Croft. Initially, the main character of the Tomb Raider game, according to the developers from the Core Design studio, was supposed to be a man. A muscular macho man in a hat and with a whip. Of course, such an undisguised law under Indiana Jones would hardly cause any serious attitude to the game in the public, so it was decided to change the hero. Toby Gard, the main artist of the game, took advantage of this moment to push his idea – to make the main character a woman. The first option was Laura Cruz – a hot Latin American.

However, the idea had to be screwed on – in the USA, the attitude of the majority of the population towards Latinos is somewhat ... specific. They are associated primarily with street criminals, illegal migrants and dumping migrant workers, so the developers were afraid that such a heroine would reduce sales of the game in this market, the largest in the world. As a result, the heroine was transformed into a British Lara Croft. However, her face on the promo materials for the first part of the game still has noticeable Latin American features – dark skin, prominent cheekbones.

Although Toby Gard, when inventing Lara, emphasized that she should attract the player primarily with a strong character, and not with physical articles, concerned schoolchildren could not explain this.

Also, an example is Tifa Lockhart, the heroine of Final Fantasy VII and Advent Children, a non-player character. She is an excellent fist fighter; thanks to training from teacher Zangan Tifa, she is able to cope with almost any opponent with her bare hands. Thanks to her impressive appearance and provocative way of dressing, Tifa has had no end of fans almost since childhood.

The girl really amazes with the shapes of her body, but this is only a pleasant appendage. She is distinguished by kindness, tries to treat the actions of loved ones with understanding, is ready to support in difficult times. She is no stranger to negative emotions, such as anger and a desire for revenge. More

importantly, Tifa will never betray, on the contrary, he tries to repay the good with the same coin.

The founder of the computer game developer Stepgames, Yuri Matveev, is sure that the game is always an attempt to play a role: “A person wants to try himself as a football player, killer, special forces, interplanetary explorer, Sherlock Holmes, strategist. One of these roles can be a woman.”

Video games are a variation of the well-known art based on the numerous manufacture of a figurative product (there is no creator around the games – the beloved is constantly being formed by a creative team, a small factory).

The imaginative domain of computer games is dictated by aspects of the film genre as well as the standards of widespread culture. In addition, visual impersonation is the only one with more significant components of the trading attractiveness of computer games. The visual “beauty” of games stands out from the painting of cinematography as well (undoubtedly, to represent their heiress). Almost everything is drawn from the final one: the probability of replacing the project, compositional decisions, the use of effects, melodic maintenance (for example, in simulators, the probability of looking from the edge into your own aircraft is also taken into account the implementation of flight components).

In this way, an area aimed at fun as well as peace has transformed into a significant also large industry driving growth in the future.

The games are also ladies’ figures in their repetition of these negative plots, what are also other works of art. Such figures have an impact on global understanding and also fix malicious standards. For this reason, it is necessary to cause the reviewer, including in this case, what they like. Also, especially in this case, what you like.

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УДК 380

HIGHER EDUCATION: PARADIGM SHIFT

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Abstract. The paradigm of higher education has changed the long-established system of education. Education is a constant stage of human development. And even the usual traditional system has every right to succumb to changes. In 2019, there was a massive change in the world, it was time for a new one, which was facilitated by the strongest disease that took on a massive character, the COVID-19 pandemic. There was a paradigm of education, new striking differences from the previous system of education were introduced. This period influenced every stage in education, their goals, principles, strategies for the implementation of educational activities, and even more so, the methods of interaction of students with the educational program. A changed yesterday is a new tomorrow, behind which stands the future development of our country.

Keywords: higher education, training, system, sphere, specialty, university, pandemic.

ВЫСШЕЕ ОБРАЗОВАНИЕ: СМЕНА ПАРАДИГМЫ

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Аннотация. Новая парадигма высшего образования способстововала изменениям в давно устоявшейся системе обучения. Образование – постоянная ступень развития человека, но даже привычная система имеет все права поддаться изменениям. В связи с пандемией COVID-19 в 2020 году в традиционную парадигму образования были внесены новые яркие отличия. Этот период повлиял на каждый этап в образовании, на цели, принципы и стратегии осуществления учебной деятельности, а тем более методы взаимодействия учеников с образовательной программой. Измененное вчера – это новое завтра, за которым стоит будущее развитие нашей страны.

Ключевые слова: высшее образование, обучение, система, сфера, специальность, университет, пандемия.

In the age of modern technologies, development and new communications, nothing stands still, all the time there is a movement forward. This also applies to the field of education, which would seem to be the most permanent stage of a person. Higher education, as before, is considered a valuable and important stage in a person's life, but even without it there are many ways to implement and acquire skills.

The modernization of knowledge changes with the appearance of new circumstances in it. Training a couple of years ago had a completely different character. With the arrival of the COVID-19 pandemic, the mass closure of institutions, the teaching format had to be drastically changed. Higher education has shown its resistance to these conditions [1].

Education until 2020 had a stable, unshakable format. Full-time students, regardless of their specialty, went to classes, listened to lecture material, answered and prepared seminars. Teachers went to the university buildings every day and told the same material to different groups several times, based on the curriculum.

With the beginning of the 2nd semester of the 2020 academic year, all universities were transferred to the distance format. All classes were attended via a network, mobile device or PC Students and teachers studied the program without leaving home. For many, this has become a challenge. Many teachers took short courses on the study of digital devices. Students were not equipped with software, equipment, access to digital packages necessary for training.

There was a radical change in training, for that period of time it seemed that they were temporary. Having appreciated the risks and the quality of knowledge, many higher educational institutions now (as of October 2021) continue to use the distance format, but not for all disciplines, because there is no need, but only those where there is a possibility of mass congestion of people and the spread of viral infection. So, in universities, most lectures are held for students remotely, as well as teaching classes where technical equipment is required. The paradigm has caused controversy, someone approves of this system now, having felt its advantages, there are also those who speak out against it – these are mainly parents of students who, based on personal experience of twenty years ago, judge the system and the educational process now [2]. Universities provide a complete educational program, both within the walls of the educational institution and behind them – remotely, only here, as with a full-time visit, the student chooses whether to receive this knowledge or not. No one will monitor the performance of tasks, everyone is responsible for

himself, and makes a choice on the way to knowledge. The main, disturbing, issue today is communication with the teacher, but even here no one remains on the sidelines. Teachers are open to the interest of students, give their contact details, respond and conduct a dialogue during the lesson, many spend their extra-working time on additional information for students. All this concerns educational programs, where it is possible to partially or completely replace disciplines with a remote format. The combination of mixed learning was given the name HyFlex (hybrid flexible) since, based on experience, she is able to change and bend under forced conditions [3]. Only higher educational institutions have reached this level of the educational program, and this has not affected everyone.

Medical universities and military schools, after two quarantines, have not suffered any changes in training. The usual full-time format, visiting couples and practical work require personal presence in the study of this profession. Specialties where chemical and biological processes are studied try to attract students to personal study of the material as much as possible. In schools, in order to fence off and reduce the risks of morbidity, it was recommended that everyone be vaccinated without fail. They have a high risk of morbidity because cadets spend most of the time together, spending the night in barracks, and attending classes daily. For such educational institutions, they do not even consider changes in the training format, and the students themselves voted against changes in full-time classes in these areas.

A survey of their views on the paradigm of higher education in 2021 was conducted among students and graduates of the university this year, 42 students from different universities of Russia took part in it. To the question: “Has the format of education at your institution changed in the last 2 years?” 100 % voted: Yes.

Before trying out the remote format for 2019, most of the participants had a negative attitude to such a system. To date, when remote classes have already become familiar, only 22 % of the percent did not approve of this format; of which 12 % are students of the biology and chemistry department and 6 % are cadets of the flight school and 4 % of students in the direction of graphic design. Changes in the approach to education only sound scary at first glance, if the training takes place in a mixed mode, now it facilitates the work process, both for teachers and students, there is more time to do homework, time on the road can be spent on completing tasks or in-depth study of the material [4].

Changes are always scary, there is a step before the unknown, how these innovations will be perceived and spread, obstacles that prolong traditional foundations. And only certain conditions of a mass nature could become an impetus for transformation in educational institutions. The higher education

paradigm was gradually and very slowly moving towards the introduction of IT. Over the past two years, there has been a complete revolution towards the 21st century of information and innovative technologies. Having overcome the stage of changes, we can say that the education system has been ready for the new system for a long time, “insurmountable obstacles” have shown their flexibility and creativity. To keep up with the times, to get relevant knowledge for your era, and there is a developed future, behind which stands the abandoned yesterday and the new today.

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УДК 620.98

BOILER PLANT FUEL TRANSFERRING TO REDUCE THE NEGATIVE IMPACT ON THE ENVIRONMENT

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Abstract. The article deals with the ecological impact of the energy industry. It directly addresses the issue of air pollution by exhaust gases from thermal and electric power plants. As a solution to this environmental problem it is proposed to modernize the existing plants by transferring from coal to gaseous fuel combustion, which is a cleaner energy resource. To assess the effectiveness and feasibility of this proposal the results of calculations are given.

Keywords: alternative energy, solar panels, thermal power plant, power plant.

ПЕРЕВОД КОТЕЛЬНОЙ УСТАНОВКИ НА НЕПРОЕКТНОЕ ТОПЛИВО С ЦЕЛЬЮ СНИЖЕНИЯ НЕГАТИВНОГО ВОЗДЕЙСТВИЯ НА ОКРУЖАЮЩУЮ СРЕДУ

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Аннотация. В статье рассматривается воздействие энергетической отрасли на окружающую среду. Непосредственно затрагивается вопрос загрязнения воздушного бассейна уходящими газами от тепловых и электрических станций. В качестве решения данной экологической проблемы предлагается модернизация существующих станций, путем перевода угольных котлов на газообразное топливо, которое является более чистым энергетическим ресурсом. Для оценки эффективности и возможности данного перевода приводятся результаты расчетов.

Ключевые слова: загрязнение атмосферы, угольное топливо, газ, паровой котел, экология.

The environment is a generalized concept that characterizes the natural conditions of an area and its ecological state. Unfortunately, technological progress development and the constant desire of mankind to improve life conditions lead to negative environmental consequences, which are manifested in significant pollution of the atmosphere. If we take the energy industry as an example, it becomes difficult to imagine the life of a modern man without centralized water supply, heating and widespread electrification systems. But this industry causes significant and irrecoverable damage to the air basin. A large number of thermal power plants, combined heat and power plants and boilers, every second burning different fuel, emit into the atmosphere flue gases containing products of chemical underburying, carbon oxides, vanadium, sulfur, nitrogen, benzapyrene and ash [1].

But it worth noting that every year the awareness of the population increases, people begin to understand and sincerely accept the fact that it is necessary to protect our planet. An important principle of a modern society is a conscious consumption – a way to meet its needs in an environmentally friendly way, finding a balance between personal comfort and benefit for the planet.

About 25 % of electric power in Russia is generated by coal-fired thermal power plants. The predominance of this particular energy resource is primarily due to its abundance and high calorific value (which reaches 8000 kcal per kg)

One of the ways to save air basins is to convert operating plants (originally designed for solid fuel) to gas combustion.

In energy and environmental terms natural gas is a more profitable source of energy, which as an energy raw material has a low production cost and a fairly high calorific value (which can reach 10000 kcal per kg). Also, at the moment gas is the cleanest type of mineral fuel [2].

Also, the undeniable advantage of gas over coal is that gaseous fuel tends to burn easier and more efficiently. When a boiler is converted to use gaseous fuel, there is no dependence of the plant operation on the timing of coal supply, coal quality, quantity and assortment, as well as the need to store and deliver fuel stocks. While using gaseous fuel working conditions improve, the efficiency and productivity of plants increase and utilization of waste heat from exhaust gases is easier, as the flue gas is not polluted with solid particles and aggressive sulfur compounds.

To assess the efficiency and possibility of conversion from coal to gas, theoretical calculations were carried out for a two-drum steam boiler PK-10, U-shaped layout, vertical water-tube with natural circulation, steam capacity of

$230\,\frac{tons}{hour}$ with parameters of superheated steam 510 ℃ and pressure 100 bar. The furnace chamber of 1210 m^3 volume is fully shielded. The boiler design includes a two-stage steam superheater. In the convective shaft there is a tubular air heater made in a split with a water economizer.

To perform the calculations, 2 types of fuel have been selected. The first one – coal from the Kuznetsk basin with the lower heating value equal to $23{,}57\,\frac{MJ}{kg}$. Fig.1 shows the composition in % by mass of individual chemical elements. The second type of a fuel is natural gas from the Urengoy-Novopskovsk pipeline with the lower heating value of $35{,}59\ \frac{MJ}{m^3}$. Fig. 1 shows the % composition of volume fractions to the volume of a dry gas in the mixture under normal conditions [3].

In order to calculate the efficiency and the required fuel consumption, a thermal balance and a thermal calculation were made. For a solid fuel a constructive thermal calculation was made, the purpose of which was to determine the heat exchange surfaces (which should provide reliability, efficiency of the boiler, as well as the nominal steam capacity). In the case of a gaseous fuel, a verification calculation was carried out to assess the possibility of this conversion and determine the main indicators. For ecological assessment of the conversion efficiency, calculation of harmful emissions entering the atmosphere together with flue gases was carried out [4].

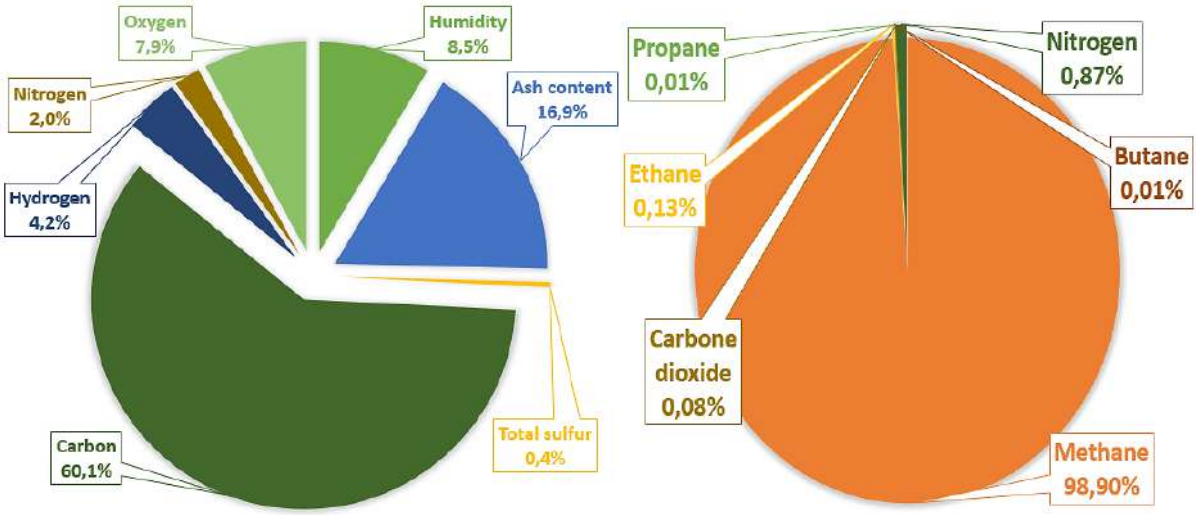

Figure 1. Composition of coal (left) and gas (right)

According to the results of thermal balances, it can be argued that the transfer from coal to gaseous fuel has a favorable effect. Firstly, at operation on gaseous fuel heat losses with flue gases and mechanical underburning are reduced that leads to the increase of boiler efficiency from 93,1 to 94,8 %. Secondly, due to the increase in efficiency and combustion heat the total fuel consumption is significantly reduced from 7,2 $\frac{kg}{\text{sec}}$ to 3,4 $\frac{kg}{\text{sec}}$.

The analysis of thermal calculations showed us the following changes when running on gaseous fuel: water temperature at the outlet of the 2-nd stage water economizer decreased from 296 to 267 ℃. The hot air temperature after the 2-nd stage air heater decreased from 300 to 255 ℃, the heat capacity of the furnace volume slightly decreased from 138,0 $\frac{kW}{\text{m}^3}$ to 137,4 $\frac{kW}{\text{m}^3}$, the adiabatic temperature increased from 1997 to 2036 ℃.

According to the results of verification calculations, in order to comply with the specified parameters, it is required to reduce the heating surfaces in the superheater and water economizer of the 2nd stage. This can be achieved by removing the rows along the flow path. Consequently, it is necessary to remove 8 rows in the 2nd stage of a superheater, 10 rows in the 1st stage of a superheater and 10 rows in the 2nd stage of water economizer. Also, it is required to dismantle ash collector and dust collection system and to install a gas control point.

Fig. 2 shows a graph of temperature distribution, which shows that when working on a gas, there is a decrease in temperatures throughout the gas path of the boiler.

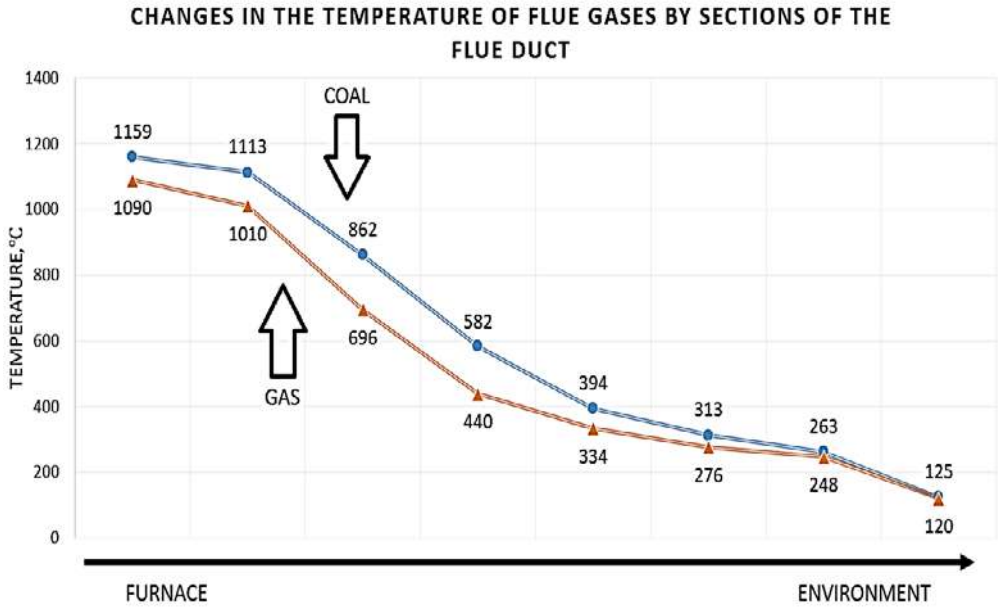

Figure 2. Gas temperature distribution along the gas path

To assess the environmentally friendly effectiveness of the transition process, calculations of harmful emissions were performed, which showed that emissions of nitrogen oxides and benzopyrene are reduced when switching to gaseous fuel. And due to the fact that the flue gas does not contain solid particles and aggressive sulfur compounds, it is obvious that the emissions of solid particles, unburned products and sulfur oxides will not pollute the environment.

Thus, it was proved that the conversion of the boiler PK10, designed for coal combustion, to combustion of the gas is a sustainable solution leading to the following main changes. One and for most, the amount of harmful substances emitted with flue gases into the environment is significantly reduced, which will lead to an ecological situation improvement. Also we obtain a reduction of the total fuel consumption by 3,8 $\frac{kg}{\text{sec}}$, therefore the annual fuel savings will be $\Delta B = 3{,}8 \cdot 3{,}6 \cdot 24 \cdot 360 = 118\,195\ ^{t}/_{year}$ with an increase of boiler efficiency by 1,7 %.

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УДК 316.612

REFLECTION: WHY IT IS IMPORTANT TO ANALYZE YOURSELF AND YOUR BEHAVIOR

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Abstract. The article discusses the concept of reflection. Its functions are presented. Its process, components, benefits and significance are described. It also tells how to reflect using the methods “Start, Stop, Continue”, “Quick Retrospective”, “Mad, Sad, Glad”.

Keywords: reflection, introspection, analysis.

РЕФЛЕКСИЯ: ПОЧЕМУ ТАК ВАЖНО АНАЛИЗИРОВАТЬ СЕБЯ И СВОЕ ПОВЕДЕНИЕ

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Аннотация. В статье рассматривается понятие рефлексия. Представлены ее функции. Описывается ее процесс, составляющие, польза и значение. Также рассказывается о том, как рефлексировать с помощью методов «Start, Stop, Continue», «Quick Retrospective», «Mad, Sad, Glad».

Ключевые слова: рефлексия, самоанализ, анализ.

Reflection is a person’s ability to turn inside himself and his thoughts, the ability to analyze his behavior.

All of you, for sure, one way or another, have encountered this condition when questions appeared in your head: “why did I do this?”, “what does upset me?”, “what do I feel right now?” You can not ignore these questions, it is important to answer them to yourself and answer honestly. By finding answers to such questions, we learn to see the connection between our actions and the results of these actions.

Reflection allows the brain to pause in the midst of the fuss, unravel its observations, sort them out and look at everything more meaningfully. This is a convenient tool that you need to learn how to use. Today we will talk about personal reflection, that is, one during which you yourself explore your personality. Also, reflection is the ability to competently evaluate other people, to make comparisons between them and yourself [1].

Reflection functions:

– Control of consciousness, which includes awareness of one's own thoughts and actions, actions. Formation of logical thinking.

– Understanding your strengths and weaknesses – self-criticism. The ability to recognize the relationship between events, successes, failures and actions performed.

– Finding the keys to solving complex problems and tasks. The ability to plan your steps to achieve goals.

– Getting rid of destructive, destructive attitudes.

– Finding opportunities to make thoughtful, correct, useful decisions.

– Identification of hidden abilities, talents and resources.

The process of reflection:

During the process of reflection, a person reflects on his inner world, compares himself with other people and looks at himself from the outside. This is an opportunity to accept yourself in the “here and now” state. The specialist encourages you to look at yourself “from the outside”, as if at the hero of the series from the TV screen.

Self-observation can be different: Ordinary reflection is when a person thinks about his actions, arranges a “debriefing” to himself, but does not dwell on it. Deep reflection is when a person analyzes his actions on the scale of society and the response of society. This includes reflections on the universe and the norms of morality.

Any human action can become reflexive. For example, feelings, actions, words, impulses, emotions. They become reflexive if a person turns to his consciousness and makes attempts at introspection. Thanks to reflection, a person feels like a part of reality, begins to feel like a certain person and acts in society according to their attitudes.

Reflection is the search for answers to all existing questions related to a person’s personality. With its help, you can solve all personal problems. Periodically considering his attitude to life and people, conducting introspection, a person sees his own shortcomings and can correct them, depending on moral values [2].

There are several forms of reflection, depending on the situation in which a person's reflections begin:

- Situational reflection is an analysis “right now”, a reaction to the situation that a person is facing at the moment. Can you give examples?

- Retrospective reflection – a look into the past, an analysis of events that occurred in the past. What situations can there be?

- Perspective reflection – thoughts about the future, a person builds, dreams and sets certain goals. Do you have any examples of such reflection [3]?

Benefit:

There are a lot of benefits in regular reflection that a person may not even realize. In the process of reflection, personal growth is observed. The habit of asking yourself questions at the end of the day positively affects a person's ability to be attentive in communication, with his confidence in his effectiveness and ability to quickly understand tasks, and also increases productivity.

Reflection is also useful because it helps to get rid of thoughtless surface reactions and take a step towards awareness. In other words, reflection is related to a person's ability to be in the current moment, to track their states and experiences. Reflexive activity opens up new opportunities for a person. Thinking over his actions and deeds, he learns to live correctly. It becomes possible to control your thinking. Reflection contributes to the emergence of healthy self-criticism, which allows you to see your own disadvantages, analyze them and work on mistakes. Introspection allows you to get rid of obsessive negative and oppressive thoughts that interfere with a person's life. The analysis of experienced life situations begins, with subsequent conclusions. Being aware of past mistakes, a person cultivates a strong personality and acquires his own position. A person changes and learns from his mistakes without repeating them in the future. But if a person lacks reflection, then he repeats similar mistakes and does not understand the reason for the recurring negative scenario.

The process of reflection helps to bring our conscious goals and unconscious motives closer together. We begin to take a closer look at ourselves, adjust our moral portrait and even the general course. And the German scientist Oliver Schultheis proved that the better our conscious goals and unconscious motives are connected, the happier we are [4].

What is reflection:

In the age of the ever-increasing pace of life, information noise and the tendency to continuous education, it is increasingly difficult for a person to slow down, exhale and be alone with himself. Performing automated mechanical movements has long been a habit. Therefore, most people are not inclined to constant or at least situational introspection. And, as we have already established, very much in vain.

There are several ways to develop reflection and look at the world differently. To analyze the day spent. The analysis must be done down to the

smallest details, up to random meetings, individual dialogues, unpleasant situations and joyful events. Read the relevant literature. Take a little time to think. Write a gratitude diary or a few important issues that need to be resolved. Try to think of a possible way out. Plan tomorrow, talk about yesterday, celebrate your achievements.

Nevertheless, one of the key ways to develop reflection is communication. By contacting the outside world, experiencing positive and negative moments, a person learns introspection. After a long and eventful day, you should think a little about what you have experienced, structure and benefit from it. Somewhere here lies the path to self-knowledge.

Parts of reflection:

We have divided reflection into three parts:

1. Self-knowledge.
2. Self-awareness.
3. Self-criticism.

Self-knowledge (how do you invent what it is?) – this is a search for our innate and acquired qualities, a regular analysis of our behavior in various life situations, a process when we try on various life roles, try to feel how close they are to us. In the process of self-knowledge, information accumulates. It cooks in our head for a long time and slowly it becomes clear what kind of people we are, self-awareness comes.

Self-awareness is an understanding of what I am, I am like this. And there are other people, and they are different, not like me. The development of self – awareness occurs in several stages:

By one year, there is a discovery of one's own "I".

At the age of two or three, a child has the opportunity to separate the results of his own actions from the actions of others and clearly realize himself as a doer.

The ability to self-esteem develops in the period from 7 to 8 years.

Self-criticism The more we understand ourselves, the more we realize that we are not perfect, we have both strengths and weaknesses. It's good when we can admit our weaknesses to ourselves. But it's even cooler when we can recognize them in front of others.

How can you develop reflection in yourself?

Reflection lends itself to independent training. One of the basic exercises for the development of reflection is to paint on a piece of paper the moments that cause special excitement and are of the greatest importance to you. After they are collected in one place, you can highlight the most important ones. Such an analysis helps to get rid of shortcomings and self-doubt, to become better, to adapt.

Practical recommendations:

After the decision has been finally made, it is necessary to analyze its consequences and effectiveness. You need to be able to see other ways out of the situation and learn to anticipate the final results.

At the end of each day, it is necessary to return mentally to the events that have occurred and analyze in detail the negative aspects that need to be corrected in the future.

It is necessary to analyze your opinion about others, try to draw objective conclusions. It is important to communicate with dissimilar people who share different beliefs and views on life. Thus, it will be possible to develop empathy, mobility of thinking and the ability to reflect.

How to reflect?

There is no universal approach to reflection – everyone is groping for the path that suits him, and there may be an uncountable number of them. You can start with:

- constructive mental conversations with yourself while walking or traveling in transport;
- sitting in a secluded place, preferably with your eyes closed;
- writing practices – keeping diaries and drawing mental maps;
- discussing the experience with a psychologist or mentor – in a word, with someone who is able to formulate the necessary questions.

Experts advise you to choose a time for classes when no one pulls you and you are as honest with yourself as possible.

The “Start, Stop, Continue” method

This method is based on three questions:

– What should I start doing?
– What should I stop doing?
– What should I keep doing?

After such an analysis, you can create a kind of checklist in which all the revealed facts will be spelled out. Next to each item, you can put a check mark after its completion, so it will be easy to track progress, and you will be able to understand exactly when your goal (to become more perfect) will be achieved.

The “Quick Retrospective” method

This quick way of reflection is perfect for analyzing any of your skills. It can be done several times a week. It is enough just to answer a few questions:

– What was good?
– What are the problems?
– How can we fix the problem?
– What ideas can I offer for future development?

Example:

Start	Stop	Continue
1. Running in the morning 2. Drink 2 liters of water a day 3. Eat healthy food	4. Eat sweet 5. Go to fast food restaurants 6. Skip workouts	7. Sleep 8 hours a day 8. Counting calories 9. Cook yourself

I want to learn how to draw and draw a house. After that I answer the questions:

10. What was good: smooth lines, harmoniously matched colors.

11. What are the problems: the perspective is broken.

12. How to fix the problem: look at the real house and understand how to keep the perspective.

13. What are the ideas for development: watch a video on the Internet about the varieties of paper and paints.

The "Mad, Sad, Glad" method.

The essence of this method is to distribute your observations (moments, events) into 3 groups: mad (mad), sad (sad), glad (joyful). Thus, you will be able to track how certain events affect your mood, and in the future, you can do everything possible to avoid "crazy" and "sad" moments and multiply your happiness with "joyful" events [5].

Examples of questions for analyzing a specific situation:

– What exactly made me feel this way and not otherwise?
– What did my act look like from the outside?
– What guided me in making such a decision?
– How did it affect other people/others?
– What do I need to do to prevent this from happening again? (if something turned out badly)
– How can I fix the situation?
– How do I convert my weaknesses into strengths?

The meaning of reflection:

Reflection allows a person to feel, think, analyze. It is the ability of a person to go beyond his own prejudices, to carry out a deep introspection, to draw appropriate conclusions from the experience. Unlike useless digging into the past and accumulating resentments, reflection allows you to rethink and improve your standard of living in general [6].

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УДК 620 745

COLLABORATION OF WIND ENERGY AND INDUSTRIAL DESIGN

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Abstract. The purpose of the article is to show the interaction of such industries as wind power and design. The relevance of this topic is dictated by the growing popularity of “green” wind energy, which requires more and more resources – territorial and human ones. Land alienation is one of the environmental disadvantages of wind power. However, there are some projects that make it possible to avoid this disadvantage and the task of this article is to consider these concepts.

Keywords: wind power industry, industrial design, ecology, new energy technologies.

КОЛЛАБОРАЦИЯ ЭНЕРГИИ ВЕТРА И ПРОМЫШЛЕННОГО ДИЗАЙНА

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Аннотация. Цель статьи – показать взаимодействие таких отраслей, как ветровая электроэнергетика и дизайн. Актуальность этой темы диктуется нарастающей популярностью «зеленой» ветроэнергетики, которая требует все больших ресурсов – территориальных и человеческих. Отчуждение земель – это один из экологических минусов ветроэнергетики. Однако есть некоторые проекты, которые позволяют избежать этого недостатка, и задача этой статьи – рассмотреть данные концепции.

Ключевые слова: ветровая электроэнергетика, промышленный дизайн, экология, новые технологии энергетики.

Nowadays, in comparison with the past 30 years, the problem of ecology is considerable, its solutions are at the peak of popularity. Any decision made related to construction, production or utilization is considered from the point of view of its environmental friendliness. This article will provide design proposals aimed at solving modern environmental problems as well as the ways of implementing these projects on an industrial scale for street lights, personal wind turbines, self-sufficient buildings from an energy point of view. In addition, another interesting point will be touched on which is kinetic art [1].

The current world leader in self-sustaining energy using WPPs (wind power plants) is Denmark. But they have decided to go further and combine wind energy, solar panels and architecture in the Dutch Windwheel project (Fig. 1).

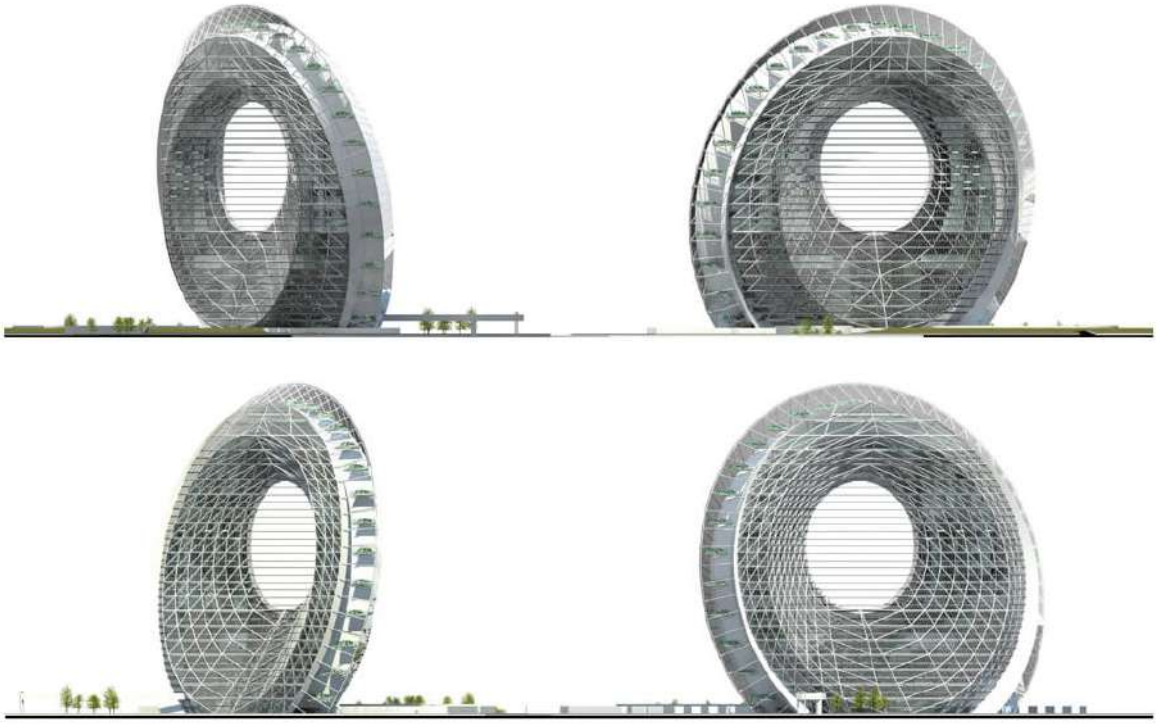

Figure 1. Dutch Windwheel

In 2015, the architects of Rotterdam proposed the concept of a wind turbine that uses the EWICON (electrostatic wind energy converter) technology developed by engineers at the Delft Institute of Technology in 2015. This method of generating energy works like this: a steel frame structure that holds horizontally arranged tubes, each tube containing several electrodes and nozzles (a nozzle is a channel of variable or constant cross-section of a circular, rectangular or other shape, designed to supply liquids or gases at a certain speed and in the required direction), which, under the influence of the wind, release positively charged water droplets into the air. When droplets fly out of the

turbine, the voltage changes in the device and it starts generating an electric field. The water needed for the turbines is taken from the reservoirs surrounding the building, as well as from sediments. It is planned to place solar panels on the surface of the wheel. The building will be residential, which means that we are no longer talking about the alienation of land. Also, unlike conventional wind turbines, the EWICON system does not make noise and will be able to fully provide itself with energy and several areas around it [2, 3].

Another interesting development in this field is O-Wind Turbine (Fig. 2) from the James Dyson Award winner for 2018, developed by students of the University of Lancaster in the UK, Nicolas Orellana and Yaseen Noorani. This miniature wind turbine is designed for dense urban environments. Unlike standard wind turbines tens of meters high, located in open areas where the wind flow is constant, O-Wind Turbine is able to use randomly directed wind, reflected from skyscrapers and located on the balcony.

Figure 2. O-Wind Turbine

The creators of the O-Wind Turbine claim that their development will help residents of high-rise buildings generate their own electricity for themselves, and therefore reduce the amount of utility bills. They also believe

that this way of generating electricity will help more people play a greater role in saving the planet and switching to green energy sources [4].

Berlin student designer Tobias Trübenbacher has developed the Papilio light (Fig. 3), a street lamp that generates electricity for street lighting using renewable wind energy.

Figure 3. Papilio light

Papilio light can be positioned either on the wall or on a free-standing post. Ideally, it should be located 3 – 6 meters above the ground, where the wind is strong enough to rotate the turbines. Diagonally inclined, complex turbines can exploit chaotic air currents in urban environments. “We urgently need to tackle light pollution and the loss of biodiversity coming along with it. This can only happen if cities generate energy themselves – through locally embedded, decentralised systems and ‘prosumer’ products in huge quantities spread all over urban spaces. In this context, wind represents an often underestimated yet constantly growing potential.” – says Tobias Trübenbacher [5].

Agreeing with the German student designer, we can only add that wind energy and its potential can and should be used in conjunction with such renewable energy sources as solar energy and biofuels, as was done in the Dutch Windwheel project. However, it is worth remembering that the transition from

conventional energy sources to alternative ones may take some time. And even when this starts to happen, the alternative clean energy may have opponents. For example, in wind power, these are bird watchers and Norwegian reindeer herders [6]. What does it mean? It is necessary to prepare the ground for large-scale “green” projects, using design to make them beautiful and interesting, include useful functionality, etc.

The idea of clean wind energy can be also promoted to the masses using contemporary art. So since 1990, the artist Theo Jansen has been creating Strandbeest – “beach animals” that can move under the influence of the wind on the sand. These creations are going through a kind of evolution, from simple mechanisms at the beginning of the artist's activity, to complex “organisms” today. Now Theo Jansen’s “Beasts” store wind energy by inflating their “stomach” consisting of plastic bottles, know how to determine the type of soil on which they walk, and drop anchors if the wind blows too hard. They succeed in all this without the involvement of complex electronics. “There are few people in any field today who are crossing art and science as beautifully as Jansen has been doing for nearly 30 years,” says Honor Harger, executive director of the Art Science Museum. And this certainly draws attention to wind energy (Fig. 4) [7].

Figure 4. “The Beast” on the beach of Holland

Summing up, we would like to note that industrial and landscape designers, architects and artists dealing with solving environmental problems presented in this article not only competently used wind energy and came up

with an interesting and functional concept, but also brought their idea (or are in the process of bringing it to fruition in case of Dutch Windwheel) to its logical conclusion, that is consumer use. Which means it's not just scientists, ecologists and inventors who can help our planet survive the transition from the centuries of fossil fuels use. An important part of this task – visuals, ergonomics, aesthetics and submission of the project for public approval – is the task of designers.

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УДК 681.58

AUTOMATED PROCESS CONTROL SYSTEM OF THE SOUTHWEST THERMAL POWER PLANT

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Abstract. Today, automation of technological processes is very widespread in absolutely all spheres and areas and is one of the decisive factors in increasing productivity and improving working conditions. The main problems in the operation of power equipment automation systems are the need to establish communication and determine the optimal and sufficient amount of information exchange between them, as well as the principles of control and management. In order to solve these problems a unified automated process control system for thermal and electrical equipment on the basis of a single software and hardware complex was created.

Keywords: software and hardware complex, process automation, diagnostic system, control system.

АВТОМАТИЗИРОВАННАЯ СИСТЕМА УПРАВЛЕНИЯ ТЕХНОЛОГИЧЕСКИМ ПРОЦЕССОМ ЮГО-ЗАПАДНОЙ ТЭЦ

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Аннотация. Автоматизация технологических процессов на сегодняшний день очень распространена абсолютно во всех сферах и областях и является одним из решающих факторов повышения производительности и улучшения условий труда. Основными проблемами при эксплуатации систем автоматизации энергетического оборудования являются необходимость создания связи и определения оптимального и достаточного объема обмена информацией между ними, а также

принципов контроля и управления. Для решения данных проблем была создана единая автоматизированная система управления технологическим процессом тепломеханического и электротехнического оборудования на базе единого программно-технического комплекса.

Ключевые слова: программно-технический комплекс, автоматизация технологических процессов, диагностическая система, система управления.

The main problems in operation of automation systems of heat-mechanical and electrical equipment (HMO and ETO) at South-West CHPP, implemented using different technical and software means, are the need to create communication and determine the optimal and sufficient amount of information exchange between them, principles of control and management. To solve these problems a unified automated process control system (APCS) of heat-mechanical and electrical equipment on the basis of a unified software and hardware complex (PTC) was created.

Proceeding from the set task, a set of necessary control and monitoring algorithms has been implemented in the APCS of the South-West CHPP, which includes:

– collection, primary processing and distribution of information received from various sources;
– providing information to operator stations electronically and in hard copy;
– automatic control systems ensuring equipment control in standard, transient and emergency operation modes;
– process protections and safety interlocks;
– monitoring and self-diagnostics of the software and hardware of the PTC;
– archiving of information;
– calculation of technical and economic indicators of CHPP operation [1].

Unified APCS of heat and mechanical and electrical equipment is based on software and hardware complex SPPA-T3000 company Siemens.

Control systems for power plants must provide control, display and documentation of all critical production processes. Failure of the control system or any of its components can lead to very costly downtime of power generating equipment. The use of fault-tolerant components in the control system increases the availability of the control system, which minimizes the risk of downtime. The use of redundant components guarantees the overall resilience of the system and thus a high availability of the control system. This means that all active

components of the critical process control system must have redundant / standby components in continuous operation that are simultaneously included in the process with the main components. In this case, if one of the components fails, the fail-safe standby component ensures that the control system continues to function correctly without impact. Switching over to the standby component must be automatic (user intervention must be excluded).

The diagnostic system must notify the operator of faulty/failed components in order to ensure a quick response by maintenance personnel. Such measures reduce equipment downtime. Siemens' support of the principles discussed above provides a high degree of fault tolerance for the SPPA-T3000 control system.

The archiving system in the SPPA-T3000 provides storage of analog and binary values, alarms, event sequence, protocols, and operator actions. All data are stored in a centralized real-time database. This ensures that all system users, both inside and outside the power plant, have access to the same data. The archive can continuously collect and store data over the entire life cycle of the power plant without data loss. The archived data is stored on the local hard drive of the application server in files with hourly, daily and monthly data sets.

The architecture of the South-West CHPP PTC represents the presence of three levels of hierarchy (Fig. 1).

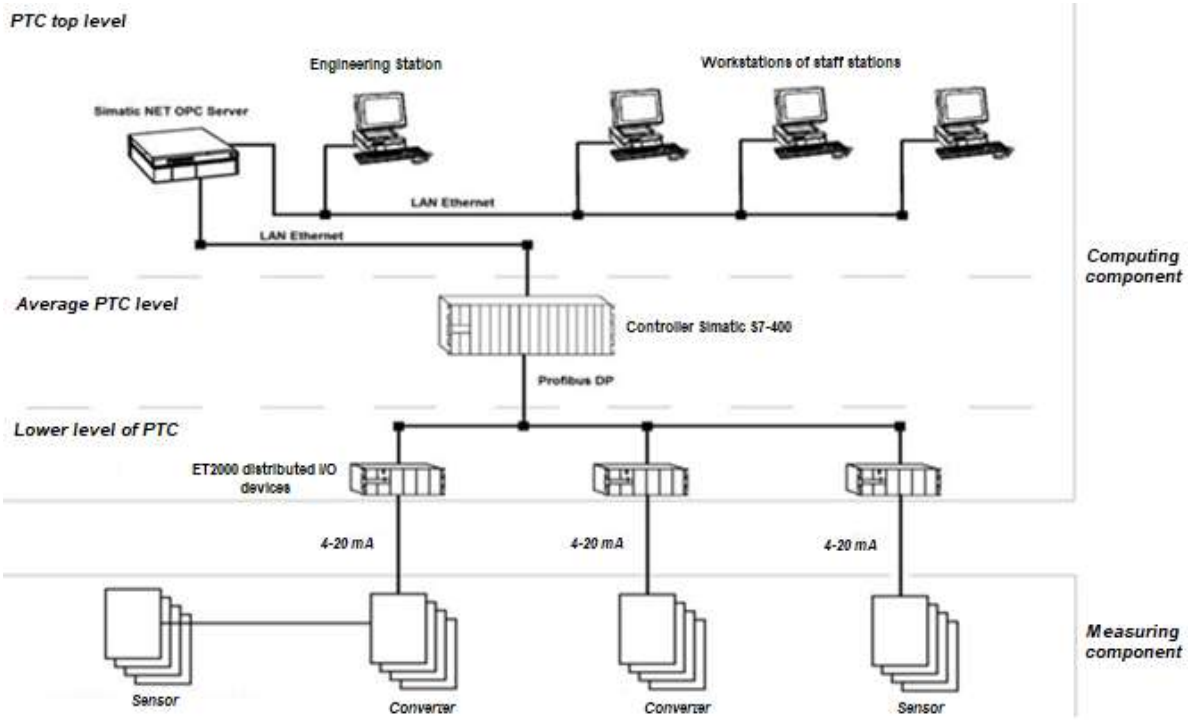

Figure 1. Architecture of the ACSPP software and hardware complex

The lower level (data acquisition level) ensures operation of measuring components, cyclic interrogation of primary measuring devices, reception, measurement and conversion of current signals from pressure, temperature and flow sensors into digital code, as well as transmission of the received measuring information by remote input method to the middle level in the software and hardware complex controller. This level is implemented on the basis of ET-200 input/output stations, intermediate relay cabinets and cross cabinets.

The middle level is the level consisting of redundant S7-400 automation servers, each controlling its technological zone, as well as two redundant application servers.

The automation servers level provides:

– performing collection, accumulation, calculation, processing, control, storage of measuring information about volume flow, temperature, pressure based on accurate and promptly received measuring information from primary measuring instruments;

– providing security of storage of measuring information.

– Upper level is responsible for provision of information, operational control and management, analysis of current and retrospective information.

Upper level PTC consists of [2, 3]:

– Simatic NET OPC Server, a redundant server for the collection of measurement and other information;

– Engineering station, providing loading and changing of theTC software during the setup and its engineering support;

– workstations, providing visualization of measurement information and operation of technological equipment of the power unit.

To enhance reliability of operation of the complex of technological protections and safety interlocks the following solutions have been applied:

– the main volume of monitored parameters, which take part in technological protections, is realized on analogue sensors;

– Input signals from primary measuring instruments are distributed to different modules, having independent electric power supply;

– Information from discrete sensors, involved in technological protections, is fed to independent input modules;

– degradation principle is realized – exclusion of faulty sensor from protection scheme and its transition to the lower level.

At the moment the South-West CHPP successfully operates the unified APCS of power equipment, implemented on the basis of PTC SPPA-T3000 with unified principles of monitoring and control, upper level, data archive and technical means. The implemented system provides reliable operation of equipment in the entire range of loads and in all modes due to the developed algorithms of automatic protections, interlocks and logical control programs, also a high degree of automation of technological processes, electrical equipment and maintenance procedures of the TPP APCS equipment was achieved.

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УДК 527

USING THE RANKINE CYCLE WITH ORGANIC BODIES

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Abstract. The use of low-potential heat is currently not widely used. The organic Rankine cycle will allow the most efficient use of fuel energy. Low-potential heat obtained in the form of solar energy, energy released during the combustion of biomass and energy from geothermal sources, will reduce the emission of harmful substances and increase the efficiency of using fuel energy.

Keywords: organic Rankine cycle, organic working fluid, solar energy, biomass, low-potential heat sources.

ИСПОЛЬЗОВАНИЕ ЦИКЛА РЕНКИНА С ОРГАНИЧЕСКИМИ ТЕЛАМИ

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Аннотация. Использование низкопотенциальной теплоты в настоящее время не находит широкого применения. Органический цикл Ренкина позволит максимально эффективно использовать энергию топлива. Низкопотенциальная теплота, полученная в виде солнечной энергии, энергии, выделившейся при сжигании биомассы, и энергии геотермальных источников, позволит снизить выброс вредных веществ и повысить эффективность использования энергии топлива.

Ключевые слова: органический цикл Ренкина, органическое рабочее тело, солнечная энергия, биомасса, низкопотенциальные источники тепла.

The process of the organic Rankine cycle differs from the classical Rankine cycle in that organic substances with a low boiling point are used as working agents. The use of organic working bodies provides a number of

advantages, such as: no risk of erosion of the blades, no supercritical pressure. This process allows us to reduce the level of enthalpy drop, remove the need for overheating. This will help us to use less costs for bringing the working fluid to the boiling point, as well as to make the energy environmentally friendly.

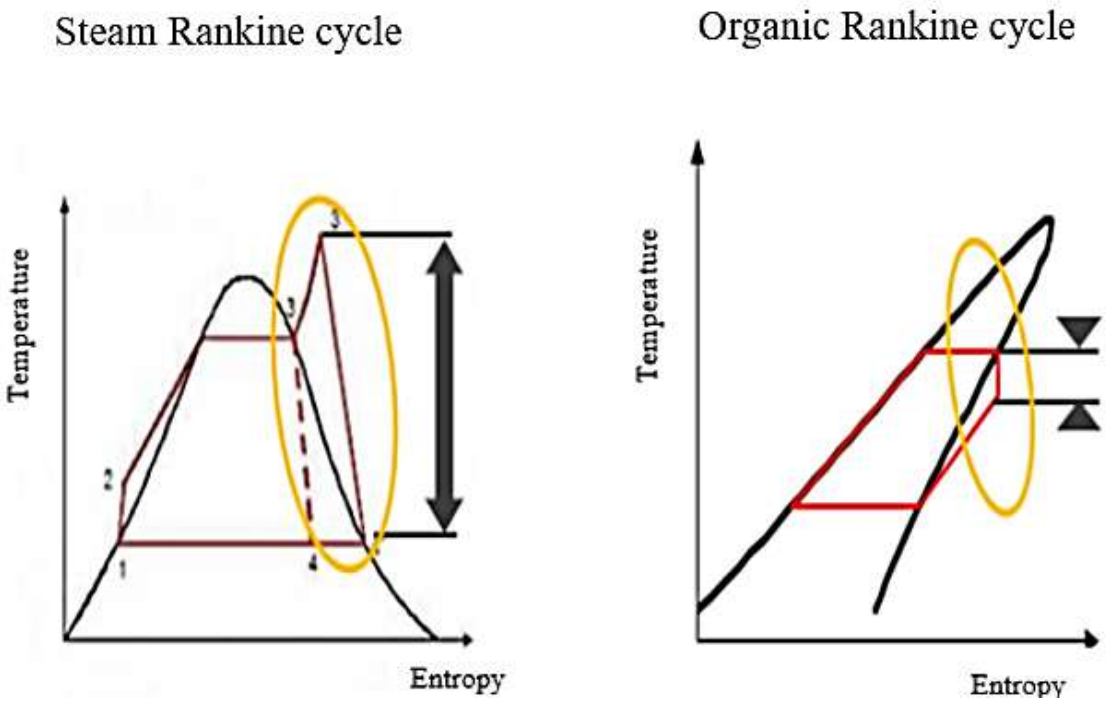

Figure 1. Comparison of Rankine steam cycle with organic

In this process, the organic working fluid is heated by an external heat source: steam, hot water, flue gases, air. That is, the energy that is inefficiently used in enterprises [1].

The organic working fluid, which is low-boiling, is heated through a heat exchanger from a low-potential heat source, evaporates, and then used to rotate turbine blades mounted on a shaft that is connected to an electric generator. Further, the spent steam of the organic agent is cooled by passing through the mains water or also giving heat to organic bodies, thereby being condensed and reused.

As a source of low-potential heat, solar energy, energy released during the burning of biomass, geothermal energy can be used.

To realize the maximum efficiency of obtaining heat from solar energy, it is possible by concentrating sunlight on the surface of the heat exchanger, which will directly heat the working fluid, and when it reaches a low boiling point, it will evaporate, driving the turbine into motion, thereby rotating the rotor of the electric motor to generate electricity [2].

The most interesting source of low-potential energy is the utilization of biomass. Since when it is burned, a small amount of heat is released, which does not turn into useful work and is most often not used. But when using low-boiling agents, that is, organic bodies, it will be possible to use effectively. The problem is the small density. What affects transportation costs, it is advantageous to burn it directly where it is obtained: at agricultural and industrial enterprises.

There are geothermal sources in Russia, some are used to source steam in a turbine. But sometimes the water temperature is not high enough and the organic Rankine cycle helps here. Water enters the heat exchanger-evaporator with the help of a pump, where it transfers heat to the organic body, it heats up and evaporates. And the water returns back to the ground [3].

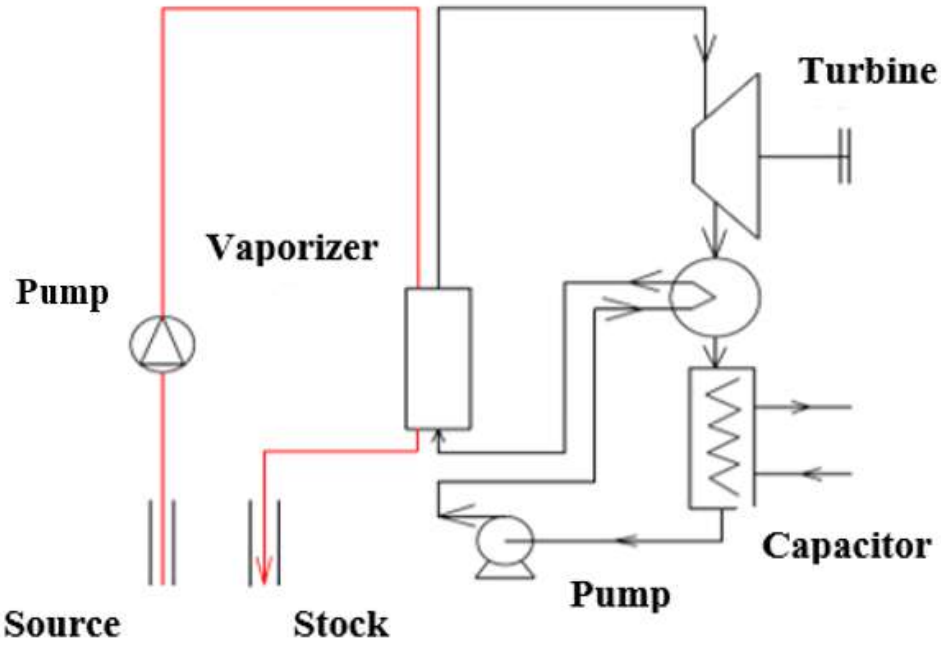

Figure 2. Diagram of an installation with a CRO using geothermal energy

To choose a working fluid, it is necessary to understand that it must be sufficiently liquid to minimize friction losses. It should also have a high thermal conductivity in order to maximize the heat energy to the heat exchanger. Therefore, do not forget about such a value as pressure, it must be of certain parameters. Due to the low pressure, the process will not start, and an excess of pressure can destroy or damage the fittings used and reduce the strength of the pipelines [4].

Since the process involves an organic product, it is important to understand that when heated, an organic compound can chemically change its properties, which should be taken into account.

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УДК 621

RESEARCH ON THE INTENSIFICATION OF WORK EVAPORATIVE BATTERIES

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Abstract. In order to study the intensification of the work of evaporation batteries, it is necessary to develop a new hardware and technological scheme for the evaporation of black liquor based on its reconstruction with output to a power of 1.5 times or more in comparison with the one achieved at the existing evaporation plant. The problem of import substitution is also being solved by mastering new competitive technical solutions and extending the service life of existing evaporation plants.

Keywords: evaporative batteries, black liquor, heat exchangers.

ИССЛЕДОВАНИЕ ПО ИНТЕНСИФИКАЦИИ РАБОТЫ ВЫПАРНЫХ БАТАРЕЙ

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Аннотация. Целью исследования по интенсификации работы выпарных батарей является разработка новой аппаратурно-технологической схемы упаривания черных щелоков на основе ее реконструкции с выводом на мощность в 1,5 раза и более в сравнении с достигнутой на существующей выпарной установке. Также решается проблема импортозамещения путем освоения новых конкурентоспособных технических решений и продления сроков службы действующих выпарных установок.

Ключевые слова: выпарные батареи, черный щелок, теплообменники.

Evaporation is the process of thickening a solution, in this case black liquor, by turning water into steam. The main sources of water in black liquor are: wood; vapors condensed during cooking; white liquor and water used for

washing pulp. The purpose of the residue is to increase the concentration of dry substances of the spent liquor to a level that ensures its effective use.

The evaporation of black liquor is carried out in a multi-body evaporation plant, the number of housings of which varies from 5 to 7. The evaporation apparatus is a heat exchanger in which heat is transferred to the solution through a metal surface heated by steam.

There are three types of evaporators:

- with a rising film;
- with falling film;
- with forced circulation.

Currently, evaporators with a falling film and forced circulation are used to achieve the final concentration of dry substances [1].

The configuration of the evaporator must meet the established requirements and have:

- simplicity of the device;
- reliable in use;
- high performance and activity of heat transfer with the smallest possible volumes of the device and the consumption of metal for its production;
- easy cleaning of the heat exchange surface;
- convenience of inspection, repair and replacement of individual parts.

The choice of the material of the evaporation device and its configuration is also determined in each individual case by the chemical and physical properties of the evaporated solution itself:

- crystallizability;
- temperature depression;
- thermal resistance;
- chemical aggressiveness;
- viscosity, etc.

High heat transfer coefficients and productivity are obtained by increasing the circulation rate of the solution, but as a side effect, the energy consumption for the evaporation process increases and the necessary temperature difference decreases, since with a constant temperature regime of the heating steam with a simultaneous increase in hydraulic resistance, the boiling point of the solution also increases. And these contradictions must necessarily be taken into account in the economic and technical comparison when choosing the type of device [2].

The most important problem in the production of cellulose is to increase the performance of evaporating batteries of black liquor. Currently, many domestic pulp mills operate up to 50 % of the design capacity when evaporating

black liquor. This forces us to make a decision on the purchase of new expensive equipment for the evaporation of black liquor.

The objective is to develop a new hardware and technological scheme for the evaporation of black liquor based on its reconstruction with output to a power of 1,5 times or more in comparison with the achieved on the existing evaporation plant.

Currently, mixing heat exchangers are widely used in industry, in which heat and mass transfer between heat carriers occurs without a dividing wall between them. According to the principle of operation, these are mostly continuous-acting devices [3].

The essence of the proposed heat technology is that the process is a mixed evaporation scheme consisting of evaporation from weak to medium liquor (countercurrent branch) and a branch consisting of evaporation to strong liquor (direct-flow branch). This approach allows, on the one hand, to reduce the physico-chemical depression of strong liquors, on the other hand, to reduce the intensity of scale formation on the boilers of evaporators. Surface solution heaters, which are equipped with existing evaporation plants, are replaced by mixing heat exchangers of the original design. Heat exchangers operate on the principle of controlled cavitation erosion [4]. This allows these heat exchangers to work without overgrowing, suck out part of the steam-gas mixture from the boilers of the evaporation apparatus housings and stably heat the solution with low underheating to the temperature of the steam heating the liquor. Despite the dilution of the solution with heating steam condensate, the efficiency of the circuit as a whole compensates for this disadvantage. Another feature of the scheme is the transfer of evaporators to a falling film, with the circulation of the solution providing optimal speed. As studies have shown, this rate is 1,5 – 2,0 times higher than accepted in foreign schemes. Distribution devices of the solution in devices with a falling film other than in foreign schemes are also accepted. All these technical solutions provide a higher KTP, and consequently, the performance of the evaporating battery.

The proposed technology of heat in the process of evaporation of solutions of black sulfate liquors of cellulose production makes it possible to increase the productivity of the evaporation plant by 1.5 – 2.0 times in comparison with the achieved productivity of evaporated water at the Arkhangelsk Pulp and Paper Mill.

The achieved effect is ensured by increasing the evaporation performance by reconstructing the evaporation equipment unit: heaters, evaporators and their strapping scheme. To a large extent, on the basis of the development of new technical solutions, the problem of import substitution is solved by mastering

new competitive technical solutions and extending the service life of existing evaporation plants.

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УДК 629.4

BASICS OF APPLICATION AND DESIGN OF SYSTEMS WITH PNEUMATIC EQUIPMENT

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Abstract. This article discusses the advantages and disadvantages of pneumatic automatic control systems, their main components, standards and rules for drawing up basic pneumatic circuits. The classification of types of converters and their designations according to accepted standards, description and principle of operation of pneumatic cylinders are also given.

Keywords: pneumatic systems, pneumatic distributor, pneumatic cylinder, fundamental scheme.

ОСНОВЫ ПРИМЕНЕНИЯ И ПРОЕКТИРОВАНИЯ СИСТЕМ С ПНЕВМАТИЧЕСКИМ ОБОРУДОВАНИЕМ

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Аннотация. В данной статье рассматриваются преимущества и недостатки пневматических систем автоматического управления, их основные компоненты, стандарты и правила составления принципиальных пневматических схем. Также приводится классификация видов преобразователей и их обозначения согласно принятым стандартам, описание и принцип действия пневматических цилиндров.

Ключевые слова: пневматические системы, пневматический распределитель, пневматический цилиндр, принципиальная схема.

It is impossible for a modern person to imagine his life without automated control systems. They are found everywhere, from residential buildings to large-scale industries. Depending on the set of requirements for the system, its operating conditions, requirements for the manufactured product, etc., one or

another type of automatic control system is selected. One of these classification features is the type of energy used. In accordance with this feature, automatic control systems are divided into: electric, hydraulic, pneumatic, electrohydraulic and electropneumatic.

Currently, pneumatic systems occupy a strong place among other automation tools [1]. The most popular pneumatic devices are SMC (Japan), FESTO (Austria) and CAMOZZI (Italy).

Pneumatic systems are systems in which gas under a certain pressure is used as an energy carrier [1].

The properties of pneumatic systems include:

– high ratio of the developed power of pneumatic actuators to their own weight;
– simplicity of the equipment, its reliability and durability;
– the possibility of achieving various types and high speeds of movement of actuators;
– resistance to adverse effects and insensitivity to overload;
– fire and explosion safety;
– environmental friendliness;
– availability of atmospheric air, the possibility of accumulation and ease of storage of compressed air;
– cost.

The latter advantage is somewhat conditional. This is due to the fact that the pneumatic equipment itself is relatively inexpensive and does not require special maintenance for a long time. However, when compressing air, preparing it and transporting it, there is a need for large energy costs. So, for example, when air is compressed, a significant part of the energy passes into heat and then dissipates.

Other, already unambiguous, disadvantages of pneumatics include:

– uneven movement at low speeds;
– complexity of regulation;
– the need to constantly maintain the tightness of the system;
– noise.

All the advantages and disadvantages of pneumatic systems stem from the properties of gas compressibility. Therefore, it should be borne in mind that for the same reason, pneumatics is competitive at a pressure of up to 10 bar.

Pneumatic automation systems are widely used in various industries, from food to heavy, as well as in special automatic systems, such as medical devices and mobile robotics. It is difficult to imagine the modern construction and mining industry without pneumatic automation tools [1].

The main components of pneumatic systems are:

1) compressor;
2) drive;
3) pipe contour between compressor and drive;
4) check valve (one or more);
5) air collector (receiver, reservoir);
6) pipeline (main line);
7) steam trap;
8) compressed air preparation unit;
9) the consumer.

The first five points relate to the subsystem of compressed air production and its transportation to the consumer. The remaining items relate to the subsystem of compressed air consumption.

The compressor takes air from the atmosphere and compresses it to the required pressure in order to further supply air to the pneumatic system. Then, along the contour of the pipes, the air is directed to the drive. With the help of a check valve, air flows from the compressor to the air collector necessary for storing compressed air. Next, the air enters the main line, arranged in the form of a pipeline with a slope of 1 – 2 %, from which there are pipeline branches. At the bottom point of each such diverted pipeline, a condensate trap is installed, usually automatic, in order to remove condensate. And immediately before the air supply to the consumer, special compressed air preparation units are installed, which purifies the air and, if necessary, can add oil to the air.

In addition to the listed components, pneumatic systems must also have various filters for air purification, dehumidifiers and other technical means necessary to ensure the proper operation of the main equipment.

The main elements of pneumatics for the end user are pneumatic distributors, actuators and speed control devices.

A pneumatic distributor (pneumatic distributor) is a device that distributes compressed air flows from sources to actuators [2], usually by an electrical signal from the controller.

There are a large number of types of pneumatic valves. Classification is made according to the following parameters:

- by the number of lines (line – distributor port): two-, three-, four- and five-line;
- by the number of positions: two-, three- and four-position;
- by the number of basic positions (positions in which the distributor can remain indefinitely in the absence of a control signal): monostable (one basic position) and bistable (all basic positions);

- according to the basic position (for monostable, two-three-line): normally closed (air does not enter the outlet in the main position) and normally open (air enters the outlet in the main position);
- by type of control: pneumatic, mechanical, electromagnetic (electric);
- by type of control: direct (mechanical switching of the distributor) and indirect (action by the control body on the pilot air line, which should switch the distributor);
- by central position (only for three-position): with an open center, with a closed center, with a center under pressure;
- by design: spool, valve and crane.

The actuators are designed to convert the potential energy of compressed air into mechanical work. These are pneumatic cylinders, grippers, rotary actuators, pneumatic tools.

The most commonly used pneumatic cylinders. They can be two-sided and one-sided, two-position (have two extreme fixed positions) and multi-position (can fix the position in the intermediate between the extreme positions). The design of a one-way pneumatic cylinder is shown in Fig. 1.

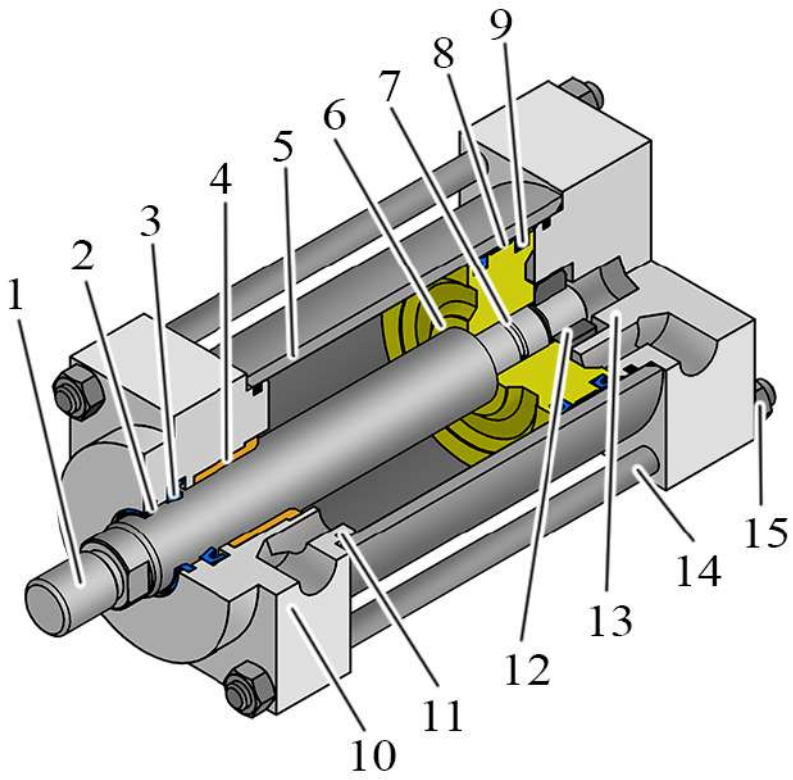


Figure 1. Design of a one-way pneumatic cylinder [3]:
1 – rod; 2 – dirt-removing ring; 3 – rod cuff; 4 – guide sleeve; 5 – sleeve; 6 – piston; 7 – rubber ring; 8 – piston ring; 9 – piston cuffs; 10 – pneumatic cylinder caps; 11 – rubber rings; 12 – nut; 13 – back cover; 14 – stud; 15 – nut

The principle of operation of a pneumatic cylinder can be described as follows. The piston performs a pushing or pulling motion, moving together with the rod when compressed air is supplied to one of the cylinder cavities and the other cavity is connected to the atmosphere [4].

Speed control devices in pneumatics are chokes and quick exhaust valves that allow you to smoothly change the speed of movement of actuators.

When developing an automatic control system using pneumatic equipment, as in the development of any other automated system, schematic diagrams must first be constructed.

The schematic diagram defines the complete composition of the elements in the system and the relationships between them. There are certain rules for drawing up basic pneumatic circuits, which are set out in:

GOST 2.701 – 2008. Schemes. Types and types. General requirements for implementation;

GOST 2.704 – 2011. Rules for the implementation of hydraulic and pneumatic circuits.

The elements in the diagrams are designated by special graphical symbols. The rules for composing these designations are given in:

GOST 2.780 – 96. Conventional graphic designations. Working environment air conditioners, hydraulic and pneumatic tanks;

GOST 2.781 – 96. Conventional graphic designations. Hydraulic and pneumatic devices, control devices and instrumentation;

GOST 2.782 – 96. Conventional graphic designations. Hydraulic and pneumatic machines

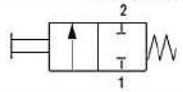
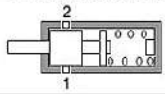
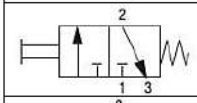
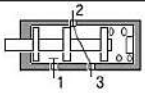
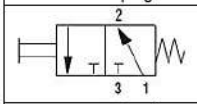
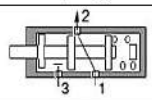
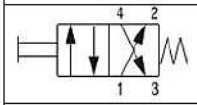
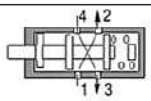
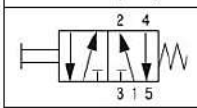
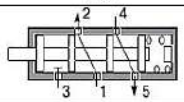
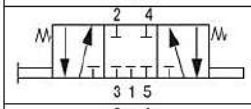
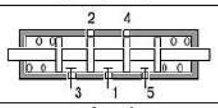
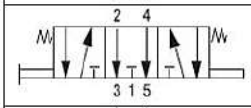
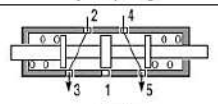
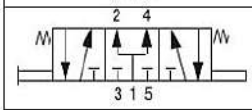
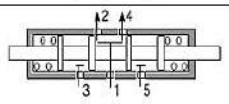
ISO 1219. Hydraulic and pneumatic actuators and their elements. Graphic designations and schematic diagrams.

Taking into account these standards, Table 1 has been compiled, which shows the most commonly used pneumatic valves [5].

The elements in the diagrams must necessarily have alphanumeric designations (in accordance with GOST 2.704 – 2011). The scale and spatial arrangement when performing schematic diagrams is not required to be observed. The main thing is that the graphic elements and the connections between them are arranged so that the diagram is readable and visual.

Fig. 2 shows an example of a schematic pneumatic circuit [6]. It is divided into subsystems in order to further improve readability.

Table 1 – “Conditional graphic designations of pneumatic valves”

Designation	Constructive scheme	Function
		Pneumatic distributor 2/2 (two-line, two-position, without exhaust). To turn on and off.
		Pneumatic distributor 3/2 (NC) (three-line, two-position, normally closed). To supply or release air through the outlet «2».
		Pneumatic distributor 3/2 (NO) (three-line, two-position, normally open). To supply or release air through the outlet «2».
		Pneumatic distributor 4/2 (four-line, two-position). To switch the air current between the outlets «2» and «4» with a common outlet.
		Pneumatic distributor 5/2 (five-line, two-position). To switch the air current between the outlets «2» and «4» with a separate outlet.
		Pneumatic distributor 5/3 (closed center, five-line, three-position). The middle position completely cut off from the pneumatic system.
		Pneumatic distributor 5/3 (open center, five-line, three-position). It is possible to release air in the middle position.
		Pneumatic distributor 5/3 (the center is under pressure, five-line, three-position). It is possible to apply pressure in the middle position.

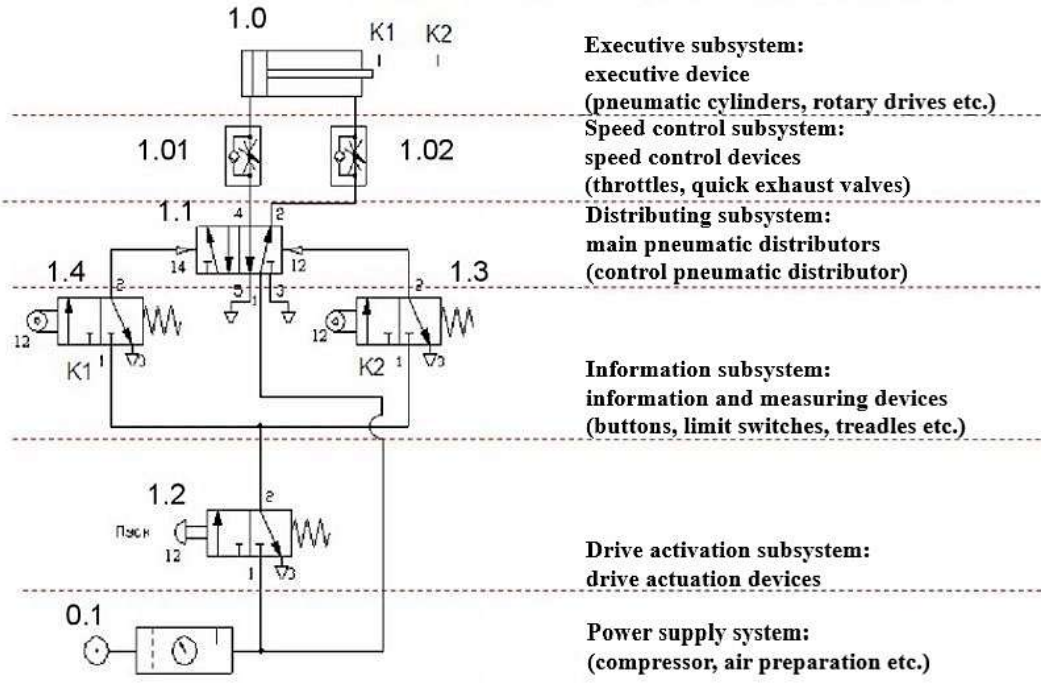


Figure 2. Schematic pneumatic diagram

There is often a logic-computing subsystem missing from this scheme located between the distributing and information subsystem. It includes various logic elements, time relays, etc.

Thus, the advantages and disadvantages of pneumatic automatic control systems, their main components, standards and rules for drawing up basic pneumatic circuits were considered in the article.

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УДК 681.5

RESIDENTIAL BUILDING AUTOMATION

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Abstract. The paper considers the relevance of developing a home control system, describes the basic principles and means of development, as well as the prospects and advantages of implementation, энергосбережение.

Keywords: automation, smart house, system, control, energy saving.

АВТОМАТИЗАЦИЯ ЖИЛОГО ЗДАНИЯ

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Аннотация. В работе рассматривается актуальность разработки системы управления домом, описаны базовые принципы и средства разработки, а также перспективы и преимущества внедрения.

Ключевые слова: автоматизация, умный дом, система, управление, экономия энергии.

Home automation in modern conditions is an extremely flexible system, which the user constructs and configures independently depending on his or her own needs. This implies that each owner of a smart home independently determines which devices to install and what tasks they will perform. In recent years, the growing popularity of automated home control systems is promoted by its high affordability, as well as by the intensive development of portable electronics and the Internet. The concept of “Internet of Things” has combined modern technical devices with the ability to control them remotely. Not infrequently, automation control systems combine various home devices in the house with each other.

The most common examples of automatic actions in a smart home are automatically turning lights on and off, automatically correcting the heating system or air conditioner, and automatically notifying of an intrusion, fire, or water leak. Home devices can be united by a computer network and controlled by a personal computer, the access to which is realized through the Internet. Smart home automation systems cope with the control of household appliances, as well as the internal lighting system. If such alternative energy sources as solar panels are used in the house, controllers can successfully automate their work. Such devices provide the ability to determine the maximum capacity of the batteries, thereby allowing you to effectively use the energy they generate [1]. By integrating all the systems inside the house, the interaction and control of them is greatly simplified, and the efficiency and safety increases. Sometimes incompatibility problems arise during the integration of different systems. In recent years, however, the unification of international standards has become increasingly universal.

A smart home is a combination of three main directions: increasing the level of safety of life, as well as improving living comfort, efficiency and saving on resource consumption.

The concept of “comfortable” life is too subjective, and each family member may have his or her own. But this is an advantage of the technology – it is possible to adjust the implementation of the laid-down scenarios for everyone, for weekdays and weekends. The monitoring system transmits online video information, as well as information about health and well-being, about missing medications, about lack of sleep. Special bracelets are used for this purpose. The computer and TV will shut off in time, preventing the child from overstressing. And animals will not stay hungry with automatic bowls [2]. Safety of life in the smart house is provided by round-the-clock video surveillance, limiting the number of people who are allowed into the house. Settings will help to limit not only the passage of a particular person, but also set a time interval, when this person is allowed to be in the house. During a long absence of the owners of the house the system is able to simulate the presence of a person (turning on lights, closing blinds). Comfortable microclimate is created by combining the work of four systems: cooling, heating, humidification and dehumidification. Thanks to the use of various sensors (light, motion, sound), energy savings with smart home technology reaches 20 to 40 % monthly [3].

An important question: what is the reliability of such systems, combining many "smart" devices, how confident can you be that after you command it via

your smartphone to close the front door, the lock will really latch? All the systems in the house, such as lights, heating and security, are subsystems of a single automation system. The advantage of this system is that it provides very reliable control and integration of all subsystems. And almost always, when the automation system fails, the subsystems continue to work. This will only cause you some inconvenience. For example, you can't turn off 20 light bulbs at the same time with the push of a button, but you can still do it one at a time and in the usual way.

The home automation system has a number of advantages.

Firstly, there are significant savings in electricity. Despite the impression that the entire system consists of technical equipment, it is its use that makes it possible to save on costs by applying various ways of reducing electrical traffic.

Secondly, the technology is a reliable security system, which will inform not only about the penetration of strangers into the house, but also about the occurrence of fire, flooding, as well as about leaving the house of a person at an unspecified time.

Thirdly, in the house, which is served by technology of the smart house, it is always comfortable, in summer the house keeps cool, in winter it is warm, the air is not overdry from the central heating. Routine household activities will no longer take as much time, the work will be taken care of by the system, freeing up your time for personal matters.

Finally, simple maintenance as well as smart home management is available to every adult member of the family, no special knowledge or experience is needed.

When studying this topic, it is also necessary to consider its downsides. The main disadvantage of installing a smart home system is the cost of equipment. The disadvantage is very subjective, because the system can consist of a different number of engineering solutions for each house. But a fully equipped and automated house will cost the owner millions of rubles.

The possibility of system failure is not excluded, because the technology depends on the equipment and its maintenance. To reduce the risks, choose proven manufacturers who give a full warranty on devices.

Another theoretical disadvantage is the leakage of information embedded in the system and its fall into the wrong hands (including personal information, health and other information that can be used to harm). Use modern security systems, and remember that every Internet user is exposed to this risk to a greater or lesser degree.

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УДК 621.359

SIMULATION OF PARTICLE SPEED IN ELECTRIC FILTER

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Abstract. In this article, the authors describe the principle of motion of suspended particles in electrofilters, consider the filtration process. In the course of the work, the authors derived the dependence of the particle velocity on a number of parameters, for clarity, using the program for working with spreadsheets “Excel”, the results were presented in graphical form.

Keywords: electric drive, electric charging of particles, corona electrodes, electric field.

МОДЕЛИРОВАНИЕ СКОРОСТИ ЧАСТИЦЫ В ЭЛЕКТРОФИЛЬТРЕ

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Аннотация. В данной статье авторы описывают принцип движения взвешенных частиц в электрофильтрах, рассматривают процесс фильтрации. В ходе работы авторы вывели зависимость скорости частиц от ряда параметров, используя для наглядности программу для работы с электронными таблицами «Excel», результаты были представлены в графическом виде.

Ключевые слова: электропривод, электрическая зарядка частиц, коронирующие электроды, электрическое поле.

Electrofiltration is increasingly used to remove dust from the air. The advantages of this type of cleaning include: the ability to obtain a high degree of cleaning (up to 99 % or more), low hydraulic resistance (100 – 300 Pa); independence of work from gas pressure; insignificant power consumption

(0,1 – 0,8 kWh per 1000 m3 of gas instead of 2 for other dust collectors); the ability to clean gases at high temperatures and their aggressiveness; a wide range of dust concentration (from fractions of a gram per 1 m3 to 50 g/m3); full automation of work [1].

Electric cleaning of gases from suspended particles (dust, fog, smoke) is based on the following. In the process of ionization of gas molecules by an electric discharge, the particles contained in the gas are charged, then, under the action of an electric field, these particles are deposited on the electrodes and released from the gas flow.

The particles are electrically charged in the field of a corona discharge that occurs in an electric field between corona (high voltage) and precipitation (grounded) electrodes. When a high voltage is applied to the corona electrodes, an electric field arises between the corona and collecting electrodes, the intensity of which can be changed by regulating the supply voltage (Fig. 1).

When the voltage increases to a certain value, a corona discharge is formed between the electrodes, as a result of which a directed movement of charged particles to the electrodes occurs [1].

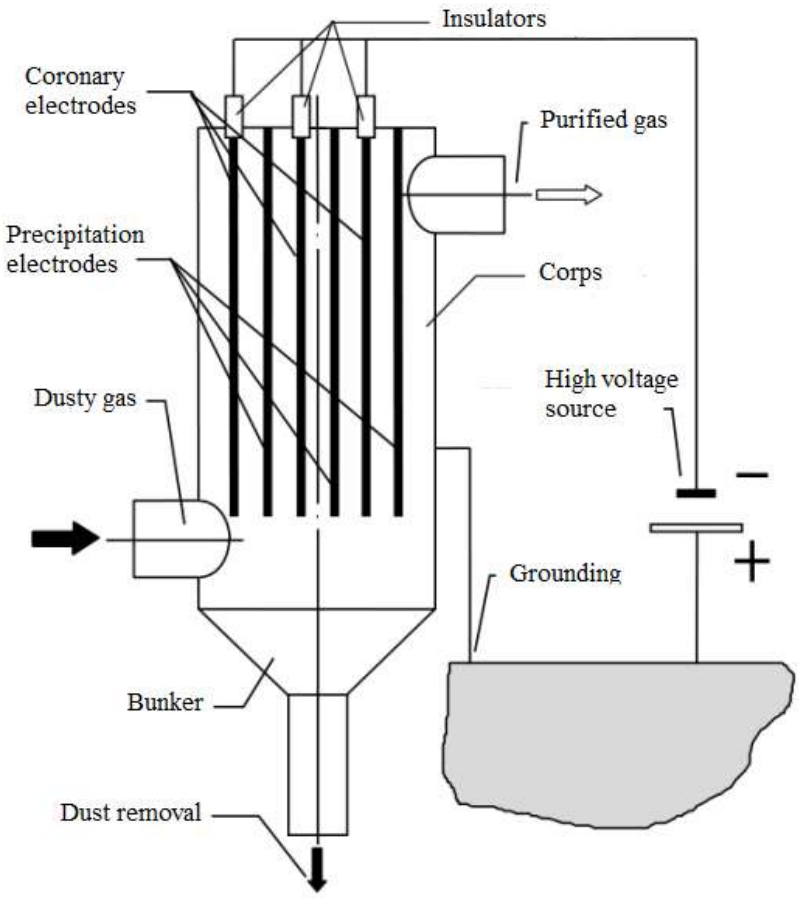

Figure 1. Particle movement in an electrostatic precipitator

When designing the parameters of an electrostatic precipitator, it is important to determine the velocities and trajectory of particles moving in the field of the electrodes. The movement of electrons occurs under the action of the force of the electric field of the electrode, as well as the resistance force [2]:

$$\vec{F}_{эл} + \vec{F}_c = m\frac{d\vec{v}}{dt},$$

moreover

$$F_{эл} = 4\pi\varepsilon\varepsilon_0 r^2 E^2$$

$$F_c = 6\pi\eta r v$$

where ε is dielectric constant of a particle,

ε_0 – electrical constant,

E – the intensity of the electrical fields,

η – coefficient of dynamic viscosity of the medium,

r – particle radius,

v – particle speed.

$$4\pi\varepsilon\varepsilon_0 r^2 E^2 - 6\pi\eta r v = m\frac{dv}{dt},$$

$$\frac{dv}{dt} = \frac{4\pi\varepsilon\varepsilon_0 r^2 E^2}{m} - \frac{6\pi\eta r v}{m}. \quad (1)$$

The mass of a particle can be represented in terms of the volume of the sphere and the density of the substance:

$$m = \frac{4}{3}\pi r^3 \rho.$$

Then equation (1) takes the form:

$$\frac{dv}{dt} = \frac{3\varepsilon\varepsilon_0 E^2}{r\rho} - \frac{9\eta}{2r^2\rho}v. \quad (2)$$

The coefficients are introduced to solve the differential equation (2)

$$a = \frac{3\varepsilon\varepsilon_0 E^2}{r\rho};\ b = \frac{9\eta}{2r^2\rho}.$$

Let us write equation (2) in the form:

$$\frac{dv}{dt} = a - bv$$

$$\frac{dv}{a - bv} = dt \quad (3)$$

By integrating expression (3)

$$-\frac{1}{b}\ln|a - bv| + c = t,$$

where the notation for the constant of integration is introduced:

$$c = \frac{1}{b}\ln\left|a - b\mathrm{v}_0\right| ...$$

$$\frac{a - b\mathrm{v}_0}{a - b\mathrm{v}} = e^{bt}$$

$$a - b\mathrm{v}_0 = (a - b\mathrm{v})e^{bt}$$

$$a - b\mathrm{v}_0 = ae^{bt} - b\mathrm{v}e^{bt}$$

$$b\mathrm{v}e^{bt} = ae^{bt} - a + b\mathrm{v}_0$$

From here we express the speed:

$$\mathrm{v} = \frac{ae^{bt} - a + b\mathrm{v}_0}{be^{bt}} = \frac{a}{b} - \frac{a}{b}e^{-bt} + \mathrm{v}_0 e^{-bt} = \frac{a}{b}(1 - e^{-bt}) + \mathrm{v}_0 e^{-bt}$$

At zero value of the initial particle velocity:

$$\mathrm{v} = \frac{a}{b}(1 - e^{-bt}) ... \qquad (4)$$

Thus, the dependence of the particle velocity in the electric field of the electrostatic precipitator on the parameters of the medium, the electric field and the particle itself has been obtained [3].

A numerical simulation of the change in the velocity of particles in an electrostatic precipitator was carried out depending on the radius of the particle (Fig. 2) and electric field strength (Fig. 3).

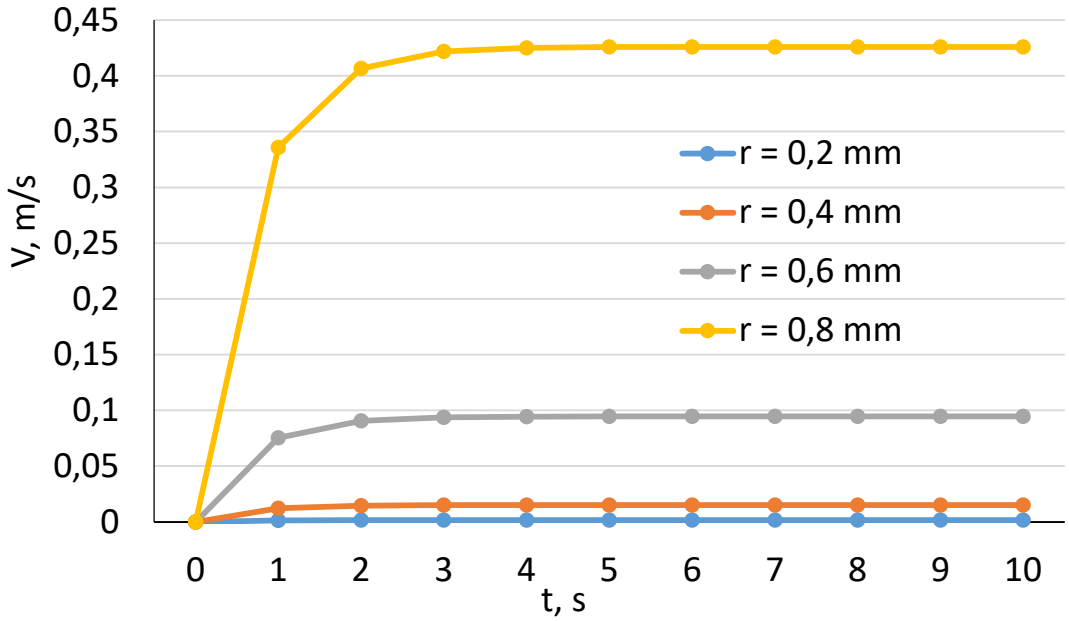

Figure 2. Calculated dependence of the change in the particle velocity depending on the radius

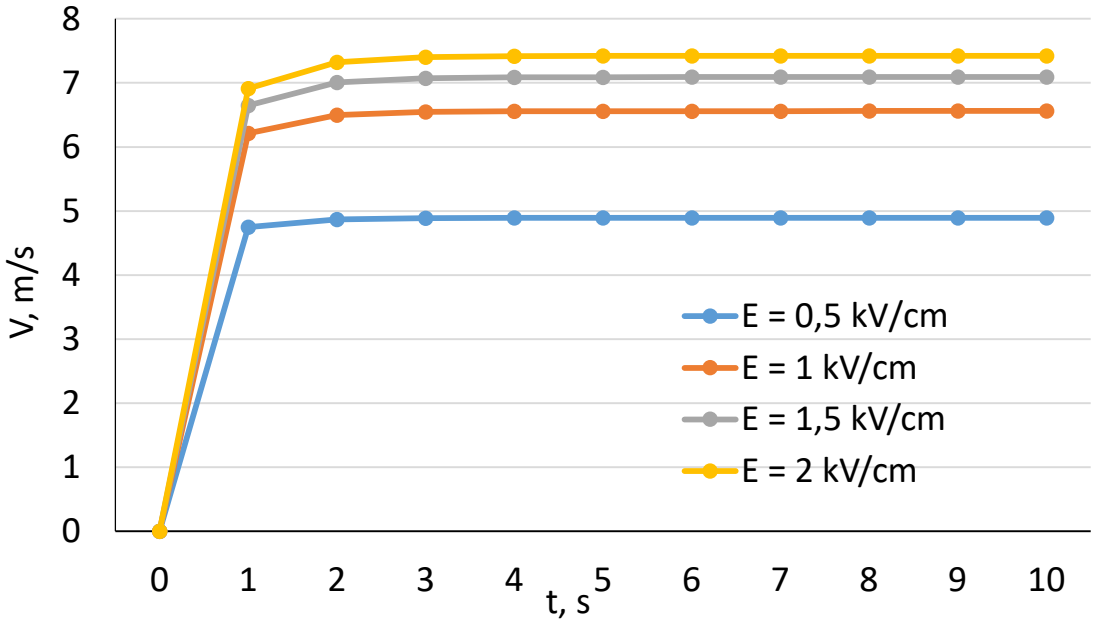

Figure. 3. Calculated dependence of the change
in the speed of particles depending on electric field strength

The calculation results show that small particles reach the steady-state speed of movement faster even at high electric field strength.

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ENVIRONMENTAL PROBLEMS OF BIOFUEL PRODUCTION

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Abstract. Currently, due to the greenhouse effect and global warming caused by the use of fossil fuels, the transition to alternative fuels has become an actual problem. Although biofuels have many advantages, their use is questioned due to the potential negative impacts on the environment. This article discusses how biofuels are produced, as well as the types of raw materials used for this purpose. Thus, based on the analysis of available data on the environmental impact of biofuel production, it can be concluded that biofuels are not a complete alternative to fossil fuels.

Keywords: biofuel, ecology, bioethanol, biodiesel, environmental problems.

ЭКОЛОГИЧЕСКИЕ ПРОБЛЕМЫ ПРОИЗВОДСТВА БИОТОПЛИВА

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Аннотация. В настоящее время из-за увеличения выбросов парниковых газов и последствий глобального потепления, вызванного использованием ископаемого топлива, остро встал вопрос о переходе на альтернативные виды топлива. При достаточном количестве плюсов биотоплива, его использование ставится под большим вопросом из-за возможного негативного влияния на окружающую среду. В данной статье рассматриваются способы получения биотоплива, а также виды сырья, используемые для этого. Таким образом, на основании анализа существующих данных о влиянии производства биотоплива на экологию

можно сделать вывод о том, что биотопливо не является полной альтернативой ископаемого топлива.

Ключевые слова: биотопливо, экология, биоэтанол, биодизель, проблемы экологии.

Biofuel is a fuel of plant or animal origin. It is expected to replace traditional fuels from exhaustible resources with those produced from renewable raw materials. One of the main reasons for biofuel production is to reduce greenhouse gas emissions and mitigate the effects of global warming caused by fossil fuels.

A potentially promising alternative source of energy is biofuel energy. Biofuel is commonly referred to as fuel obtained from biological raw materials. It can be in liquid, solid, or even gaseous form. Often in today's context, the term “biofuel” is usually used to refer to liquid fuel for internal combustion engines, usually derived from the processing of sugar cane, rapeseed, corn, soybeans or other crops. Two types of biofuels are used in practice. The first includes bioethanol (alcohol that can be made from anything that contains cellulose), as well as mixtures based on it, and the second is biodiesel (alcohol derived from oilseed crops). Generally speaking, the use of alcohol as a fuel dates back to the dawn of the automobile era. However, commercial interest in it appeared relatively recently. This was due to rising oil prices and worsening environmental problems.

Analysis of the global biofuel industry shows that, on the one hand – there is an increase in production, on the other – increasing criticism from environmental organizations. For example, the share of biodiesel in the total volume of biofuels in the EU is 80 %, and on the market of diesel EU reaches 1,5 %. The share of biofuels on the transport market of Europe can be increased up to 5,75 % by 2010, and can be increased up to 8 – 10 % by 2020. At the same time, the environmental friendliness of ethanol production is questioned [1].

At the same time, the ethanol industry, which just recently was predicted to have a bright future, is threatened by a structural crisis. Experts are questioning the environmental friendliness of bioethanol. Until recently it was considered that for countries not rich in hydrocarbons, ethanol is a better alternative to oil not only economically, but also ecologically as plant products (rye, barley, corn, oats, millet and potatoes) are mainly used in ethanol production. But the NRC report says that increased cultivation of corn, one of the main feedstocks for ethanol in the USA, as well as expansion of areas under crops in areas not prepared for it, can “have a serious negative impact” on US

water resources. The fact is that growing corn in the northern and southern states of the USA requires more water than growing traditional soybeans and cotton in these states.This can have a negative impact on local water resources already used for drinking, power generation, fish farming, etc. Moreover, production of ethanol from bio-raw materials also requires quite a lot of water: according to calculations of American scientists, a plant producing 100 million gallons (378 million liters) of ethanol a year needs as much water as a city with the population of 5 thousand people. Biofuel production hurts developing countries because it raises the price of food and harms the environment by forcing deforestation. Even if we exclude the problem of water consumption, growing the same crops (monocultures) will deplete the soil and increase the number of pests. Chemical pesticides will be used to control them, resulting in reduced soil fertility and loss of biodiversity.

There is an opinion that it is possible to use algae – thus, there is no need to cut down forests and take up land that could be used for food production. At the same time, environmental organizations warn that carbon dioxide emissions from processing algae may be higher than from using algae as an alternative fuel. In addition, there is the possibility that algae cultivation will limit freshwater supplies, as reservoirs will dry up and have to be filled with water.

The general concept is that growing crops for biofuels offsets greenhouse gas emissions because the plants directly remove carbon dioxide from the air.

However, the FAO (Food and Agriculture Organization of the United Nations) in its 2008 State of Food and Agriculture report states that scientific research has shown that different raw materials grown for biofuels have different impacts on the environment. He warns that nitrous oxide, or better known to all as “laughing gas” N2O, released from fertilizers that can be applied to the ground to help grow crops, will have 300 times more of a global warming effect than carbon dioxide [2].

FAO says the impact is at the beginning of the production cycle, and any change in land use can take years to correct, and in some cases may show that fossil fuels are more efficient than biofuels. Studies have shown that in some cases, converting arable land used to produce biofuels will emit more carbon than producing the fuel itself.

“If the goal of policies supporting biofuels is to mitigate global warming, then fuel efficiency and forest conservation and restoration would be better alternatives,” the report says. It concludes that energy efficiency and conservation are just as important and can be more cost-effective than biofuel production.

The FAO warns that there could be a negative effect of growing crops, especially as feedstock for biofuels. This could displace other crops and create more demand for new land to grow new raw materials. In Australia, Canada, and the United States this has been seen as land that is currently being used as non-crop land, in the EU it is set aside land, and in Latin America it is new uncultivated land. This takeover of land for biofuel crops could result in large tracts of land changing its use [3].

Brazil's sugarcane area is expected to nearly double to more than 10 million hectares over the next decade, and along with the expansion of Brazilian soybeans, this could lead to the displacement of land for cattle grazing and other crops. After all, it is a load on uncultivated land [4].

Other significant load on land will be the intensification of crop production through new technologies and the impact on soils through water use and potential water scarcity. This could be a limiting factor in biofuel crop production, and producing more biofuel crops would also affect water quality.

Domestic government policies need to be better informed about the international implications of biofuel development. International dialogue, often through existing mechanisms, can help formulate realistic and achievable mandates and goals for biofuels.

Recently, experts have increasingly noted the downside of mass production of biofuels. The downside of the biofuel boom is opening up – more intensive farming and therefore environmental damage. Most ethanol is made from grains, especially corn. And of all field crops, nothing compares with corn in terms of environmental damage. We cannot assume that biofuels have become a completely successful alternative to oil. But the world and technological progress does not stand still, so maybe in the future we will be able to find the most successful alternative.

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INTEGRATED PRODUCTION SYSTEM FOR REMOTE CONTROL AND OPERATION CONTROL OF CNC MACHINES

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Abstract. The materials for the creation of an integrated industrial system, including the functions of monitoring and analyzing the work of a group of machines; analysis of information exchange with the upper management level when using algorithms for collecting and processing information to provide information support for personnel are considered.

Keywords: integrated production system, CNC machines, monitoring system, “Dispatcher”, production automation.

ИНТЕГРИРОВАННАЯ ПРОИЗВОДСТВЕННАЯ СИСТЕМА УДАЛЕННОГО КОНТРОЛЯ И УПРАВЛЕНИЯ РАБОТОЙ СТАНКОВ С ЧПУ

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Аннотация. В статье рассмотрены материалы к созданию интегрированной промышленной системы, включающей функции мониторинга и анализа работы группы станков; анализ обмена информацией с верхним уровнем управления при использовании алгоритмов сбора и обработки информации для обеспечения информационной поддержки персонала.

Ключевые слова: интегрированная производственная система, станки с ЧПУ, система мониторинга, «Диспетчер», автоматизация производства.

Automation of the main stage technological divisions of a manufacturing enterprise is one of the most difficult issues facing both developers of automated control systems and a company engaged in production activities. Currently, it is

quite difficult to create an effective competitive production without automation of all stages of the technological process.

Automation of equipment significantly facilitates the operation of machine tools; this can also be attributed to the use of machines equipped with numerical control (CNC). The presence of a numerical control system allows you to increase the accuracy of workpiece processing and achieve high productivity in production.

Further development of production systems focuses on developments reflecting flexible production systems, including levels of monitoring, automation, planning and production management.

The subject of the study is an integrated production system designed for remote monitoring, signaling and control of the operation of CNC machines.

Over the past five years, the direction of modernization of lathes with the introduction of an add-on to the machines of the numerical control system has been increasingly determined in matters of automation of processes in metal cutting.

Attention is drawn to the issues of operational remote monitoring and diagnostics of industrial equipment, optimization and accounting of costs for the use and maintenance of machines. A comprehensive solution to these issues can be the creation of an integrated production system, which will allow combining heterogeneous automated equipment, such as CNC machines, etc., into single controlled systems designed to perform joint coordinated actions, including remote administration of technological programs on CNC machines.

Production process control systems or MES-systems are used to solve problems of synchronization, coordination, analysis and optimization of output within a production. MES systems belong to the class of workshop-level control systems, but can also be used to manage production at the enterprise as a whole. To do this, they integrate with top-level systems of the ERP class [1].

At the same time, the issue of remote control of the operation of industrial equipment in modern reality is becoming more and more relevant. And in case of absence of the same level at the enterprise, changes are required to the structure of the management of the production process and directly to the structure of management and control of the work of workshops equipped with CNC machines and other similar equipment.

The creation of an integrated production system for monitoring and controlling the operation of equipment will allow for the exchange of data between the top-level system “1C: ERP” and the equipment monitoring system “Dispatcher” adapted for production tasks to obtain information that allows

analyzing the actual load of production equipment, identifying the reasons for the deviation of the reporting indicators from the planned ones. In terms of information, it is required to provide the Dispatcher system with the necessary information to accumulate an array of data on the actual loading of equipment. And in the opposite direction, transmit data on the actual loading of equipment into the 1C: ERP system to generate analytical reports based on the data received.

The operation of the remote monitoring and control system of the equipment includes two-way data transmission: from the machines via a local or wireless network to the server, followed by data processing and visualization to the specified users in real time, generation of reports on the condition of the equipment, its efficiency, causes and downtime, the results of work for any accumulated period of time.

The implementation of such a system implies the use of hardware or software technologies, as well as their combination.

The hardware implementation includes sensors and special terminals that are connected to machine automation to register its basic states (for example, on / off, duty cycle / idle, error / accident signal, etc.) [2]. In the case of hardware implementation, it is possible to collect signals from almost any equipment, which allows the monitoring system to cover the vast majority of equipment in production. The operator servicing the machine, using the information received, can interactively bring it to the attention of departments at all levels of the enterprise's general system in order to resolve problematic situations, connect the necessary services to work and coordinate actions with the top-level system.

The software level of implementation is carried out by direct switching of the monitoring server and the CNC device via a local network/Wi-Fi, which, through an automated approach, allows you to: fix the basic states of the machine, read the memory of the CNC devices, collect details about the current operating parameters: feed, RPM, control program number, load, error code, etc. Monitoring of such complexity requires connecting a network card to the Ethernet network to the CNC devices. All the variety of equipment of the enterprise in the form of various machines, installations, furnaces, etc. it must be provided with appropriate communication devices, which is not always feasible and possible.

Optimization of machine tool maintenance costs, accounting for the intended use of equipment, operational remote monitoring of equipment work are tasks that arise before modern managers of enterprises.

The qualitative and quantitative composition of data related to the current operation of the equipment requires certainty in the choice of monitoring technology, which directly depends on the level of the user of the product and the emerging production problems. In other words, in the systems of the upper, middle and lower levels of management of an enterprise and production processes, the information needs differ.

Practice shows that:

- the director and chief engineer should have reports on the overall efficiency of the equipment and the reasons for downtime (in the form of reports);
- the head of the workshop and the master will need operational information about the status of the equipment, i. e. what happens to the equipment in real time;
- the chief mechanic should receive notifications about alarms and the actual operating time of the equipment;
- the repairman should have access to a list of machine error codes;
- the technologist is responsible for the stage and mode of processing, the information about the execution is operational and regular;
- the programmer is responsible for the transfer of control programs to the machine;
- the economist provides data on the cost of manufacturing each assortment unit of products, etc.

At the workshop facility under study, it is necessary to supplement the existing top-level information system “1C: ERP” with an expansion – the monitoring system for the work of industrial equipment MDA (MachineDataAcquisition).

According to the peculiarities of the production process of metallurgical enterprises and the main tasks required for the solution of the remote-control system, MDA-class monitoring systems were identified to varying degrees satisfying the tasks set. Systems [3] were accepted for consideration: adaptive management and monitoring of Omative ACM (Israel), monitoring of the operation of the equipment “Intent” (Russia, Belarus), control of the operation of industrial equipment and program administration on CNC machines “Dispatcher” (Russia).

The systems considered are similar in capabilities and in monitoring production, have been successfully tested in practice and have shown their efficiency.

However, none of the considered systems is able to solve all the tasks facing the enterprise without additional improvements. Therefore, it will require the development of additional modules and the adaptation of existing applications to the necessary functionality, and, as a result, integration [4].

If you choose a foreign system, language difficulties may arise when further configuring the hardware and software product and working in it. Foreign programs have a high cost of automatization of production. This entails a large financial investment in comparison with the unit cost of products and an increase in the payback period of automation.

The Dispatcher monitoring system, developed by a Russian company, has the largest integration area. In terms of its capabilities and functional application, it is not inferior to foreign analogues, in the price segment it wins over other systems. It should be noted that in the current economic and political situation in Russia, the Dispatcher system can support the solution of import substitution issues, the relevance of which has increased recently.

Based on the above, the conclusion follows: when creating an integrated production system for remote monitoring and control of the operation of CNC machines, the basis should be taken to use the Dispatcher system, which today more successfully monitors the operation of industrial equipment and program administration on CNC machines. With the technical improvements of this system, it is possible to implement the tasks set.

Creation of an integrated production system for remote monitoring and control of equipment operation at the enterprise, allows you to perform:

- integration of machines into a local network, which will include various models, regardless of the year of manufacture;
- control of equipment operation, including, if necessary, Internet and Wi-Fi;
- use of remote administration of technological programs on CNC machines;
- to generate reports promptly in the form of necessary forms, depending on the requirements of the management level links, containing a range of operating parameters of machines and the reasons for their downtime.

Since the working condition of the machines directly depends on the activities of the operators servicing the local network of the considered equipment of the enterprise. This requires an effective organization of the work

of these specialists, taking into account the use of the information environment, which will change the attitude to official duties and increase labor productivity.

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MODERN TECHNOLOGIES FOR IMPROVING THE QUALITY OF ELECTRICITY

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Abstract. This article describes modern ways of improving the quality of electricity, discusses the use of various methods, and draws conclusions on which ways of solving the problem are most applicable in specific situations.

Keywords: power quality, frequency, voltage, curve shape, quality correction devices, asymmetry.

СОВРЕМЕННЫЕ ТЕХНОЛОГИИ ПОВЫШЕНИЯ КАЧЕСТВА ЭЛЕКТРОЭНЕРГИИ

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Аннотация. В данной статье рассказывается о современных способах повышения качества электроэнергии, рассматривается применение различных методов и делаются выводы о том, какие пути решения проблемы наиболее применимы в конкретных ситуациях.

Ключевые слова: качество электроэнергии, частота, напряжение, форма кривой, устройства коррекции качества, несимметрия.

The quality of electricity is an aspect of the electric power industry that has been known to us since the creation of energy systems. Nevertheless, topics in the field of electricity quality have risen to the fore since the advent of powerful semiconductor switches, transmission networks. In addition, the trends in modern power engineering are to maximize the benefits of the existing installed system and this has focused attention on the accuracy of the sinusoidal

waveform, the absence of high and low voltage conditions and other distortions of the AC waveform.

A decrease in the quality of electrical energy can lead to noticeable changes in the operating modes of end consumers of electrical energy and, as a result, to a decrease in the productivity of working mechanisms, a deterioration in product quality, a reduction in the service life of electrical equipment, and an increase in the likelihood of accidents. The quality of electrical energy can vary depending on the time of day, weather and climatic conditions, changes in the load of the power system, losses during transmission over a distance, the occurrence of emergency modes in the network, etc.

The quality of electrical energy is the degree to which the parameters of electrical energy correspond to their established values. In turn, the parameter of electrical energy is a quantity that quantitatively characterizes any property of electrical energy. The parameters of electrical energy are implied voltage, frequency, and the shape of the electric current curve.

Since it is impossible to achieve perfect compliance with the declared parameters, deviations are provided for in the normalization of indicators. The main indicators of the quality of electricity are the following parameters: voltage deviation, voltage fluctuations, temporary overvoltage, voltage failure, pulse voltage, voltage asymmetry in a three-phase system and non-sinusoidal shape of the voltage curve [1].

The parameters of the quality of electricity affect the duration of operation of the connected devices; this often becomes critical in production. In case of serious deviations from the norm, the performance of the lines decreases, energy consumption increases. Thus, the torque on the motor shaft decreases when the values of the supply network indicators fall. The service life of lighting lamps is shortened; the luminous flux of lamps becomes smaller or flickers, which affects the products, for example, in greenhouses. A significant influence is exerted on the processes of other biochemical reactions. According to the laws of physics, a decrease in voltage with a constant load on the motor shaft leads to a rapid increase in current. This, in turn, leads to failures in the operation of protective switches. As a result, the insulation melts, at best the fuses burn, at worst the motor windings and electronics elements irretrievably deteriorate. Under similar circumstances, the electric meter begins to rotate at a higher speed, which leads to losses [2, 3]. Thus, there is a problem of the need to improve the quality of electricity supply.

The most effective ways to improve the quality of electricity are:

– rationalization of power supply, which consists, in particular, in increasing the power of the network, in powering non-linear consumers with increased voltage;

– improving the structure of the first level, for example, ensuring the rated load of motors, the use of multiphase rectification circuits, the inclusion of corrective devices in the consumer;

– the use of quality correction devices – regulators of one or more indicators of the quality of electricity or related parameters of power consumption. This method is the most preferable from an economic point of view, since changing the structure of the network and consumers requires serious costs.

Reduction of voltage losses in supply lines or cables can be realized by reducing the active and (or) reactive resistance. Resistance reduction is achieved by increasing the cross-section of wires or by using longitudinal compensation devices.

The longitudinal capacitive compensation of the line parameters consists in the sequential inclusion of capacitors in the dissection of the line, so that its reactance decreases. Voltage fluctuations in the power supply system of an industrial enterprise are caused by reactive power surges of loads. Unlike voltage deviations, voltage fluctuations occur much faster. The frequency of repetition of voltage fluctuations reaches 10 – 15 Hz at rates of reactive power up to ten and even hundreds of MVAr per second.

It follows from this that in order to reduce the scope of voltage fluctuations, it is necessary to reduce the short-circuit resistance at the point of connection of the load or the reactive power surges of the load, to reduce which high-speed reactive power sources should be used that can provide the rates of reactive power surges commensurate with the nature of the load change.

The connection of reactive power sources leads to a decrease in the oscillation amplitudes of the resulting reactive power, but increases their equivalent frequency. With insufficient speed, the use of reactive power sources can even lead to a deterioration of the situation.

To reduce the impact of a sharply alternating load on sensitive electrical receivers, a load separation method is used, in which double reactors, three-winding transformers with split winding, or feed loads from various transformers are most often used.

The reduction of voltage asymmetry is achieved by reducing the resistance of the network to the currents of the reverse and zero sequences and by reducing the values of the currents themselves. Considering that the resistances of the external network are the same for the forward and reverse

sequences, it is possible to reduce these resistances only by connecting an unbalanced load to a separate transformer.

In addition, the reduction of asymmetry is achieved, for example, by connecting powerful single-phase loads through its own transformer to 110 – 220 kW buses. Reduction of systematic asymmetry in low voltage networks is carried out by rational distribution of single-phase loads between phases so that the resistances of these loads are approximately equal to each other. If the voltage asymmetry cannot be reduced using circuit solutions, then special devices are used.

If the asymmetry changes according to the probabilistic law, then automatic balancing devices are used to reduce it, in the circuits of which capacitors and reactors are recruited from several small parallel groups and connected depending on the change in current or voltage of the reverse sequence. A number of devices are based on the use of transformers, for example, transformers that allow for phase-by-phase voltage regulation.

The reduction of non-sinusoidal voltage is achieved by:

– allocating nonlinear loads to a separate bus system;

– dispersing loads across various power nodes with electric motors connected in parallel to them;

– grouping converters according to the phase multiplication scheme;

– connecting the load to a system with higher power;

– using filter devices – switching on narrow-band resonant filters in parallel with the load;

– switching on filter-compensating devices; using filter-balancing devices;

– using reactive power sources containing filter-compensating devices.

The development of a modern base of power electronics and high-frequency modulation methods has led to the creation of devices that improve the quality of electricity – active filters, divided into serial and parallel, current and voltage sources.

Based on this, filter-compensating and filter-balancing devices simultaneously affect several indicators, such as non-sinusoidality, asymmetry and voltage deviations. The expediency of developing such devices lies in the fact that sharply alternating loads cause simultaneous voltage distortion in a number of indicators, which required a comprehensive solution to the problem [4].

Thus, it can be concluded that in order to improve the quality of electricity, the primary task is to determine parameters that do not comply with the norm. After that, a set of organizational and technical measures should be carried out. It is aimed at identifying and eliminating the causes, as well as

sources of violations and consisting in individual and centralized suppression of interference with increased noise immunity of distortion-sensitive electrical receivers. This set of measures is based on the required troubleshooting method.

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INNOVATIVE APPROACHES TO THE DEVELOPMENT OF WATER SUPPLY AND DRAINAGE SYSTEMS IN ST PETERSBURG

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Abstract. Human existence in the modern world is inherently connected with household activities and production that require energy consumption. Energy production, in turn, is impossible without the use of water. Thus, the water-energy connection is expressed and water can be considered as an energy resource. To conserve natural resources, water must be thoroughly purified and returned to natural sources, which is not feasible without the use of innovative approaches to purification. One of the enterprises using the achievements of modern technologies to improve the condition of the water is the State Unitary Enterprise “Vodokanal of St. Petersburg”.

Keywords: water purification, energy resource, water-energy communication, water supply, water disposal, innovative approach.

ИННОВАЦИОННЫЕ ПОДХОДЫ К РАЗВИТИЮ СИСТЕМ ВОДОСНАБЖЕНИЯ И ВОДООТВЕДЕНИЯ САНКТ-ПЕТЕРБУРГА

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Аннотация. Существование человека в современном мире неотъемлемо связано с хозяйственно-бытовой деятельностью и производством, для осуществления которой необходима энергия. Выработка энергии, в свою очередь, невозможна без использования воды. Таким образом выражается водно-энергетическая связь, и воду можно рассматривать как энергетический ресурс. Для сохранения природных

ресурсов вода должна быть тщательно очищена и возвращена в естественные природные источники, что неосуществимо без использования инновационных подходов к очистке. Одним из предприятий, использующих достижения современных технологий для улучшения состояния воды, является ГУП «Водоканал Санкт-Петербурга».

Ключевые слова: очистка воды, энергетический ресурс, водно-энергетическая связь, водоснабжение, водоотведение, инновационный подход.

Water and energy management systems are very closely linked. Energy resources are all sources of various types of energy available for industrial and domestic use in the energy sector. Energy resources are divided into non-renewable, renewable and nuclear. One of the first studies on the relationship between water and energy was a life cycle analysis conducted by the American scientist Peter Gleick in 1994, who initiated the interdependence and joint study of water and energy. The main purposes of water use are: household and drinking needs, cultural and household needs, extraction and production of energy

Water used for energy production

All types of energy generation consume water either for the processing of raw materials used at the facility, or for the operation and maintenance of the plant, or simply for the generation of electricity itself. Renewable energy sources such as photovoltaic solar and wind energy, which require little water to produce energy, require water to process raw materials for construction. Water can be used or consumed and can be classified as fresh, terrestrial, surface, blue, gray or green. Water is considered to be used if it does not reduce the supply of water to downstream consumers, i.e. water that is taken and returned to the same source (using instream), for example, in thermoelectric installations that use water for cooling and are by far the largest consumers of water. While the used water is returned to the system for downstream use, it is usually destroyed in some way, mainly due to thermal or chemical contamination. And the natural flow was damaged, which does not affect the estimate if only the amount of water is taken into account. When assessing water use, it is necessary to take into account all these factors, as well as spatial and empirical considerations that make it difficult to accurately calculate water consumption.

In the first years of this century, the following situation developed: the main production funds of enterprises were severely worn out, tariffs were constantly increasing without improving the services provided, the population increasingly switched to bottled water, not trusting tap water. The company’s

management realized that the time had come for big changes, without which the company would not only not make a profit, but could also go bankrupt. A “breakthrough” was needed, a fresh look at all aspects of the functioning of Vodokanal. It was not individual improvement measures that were required, but a different development concept.

The company has developed an “Innovative Development Program”. It included the introduction of new technologies and tools in all areas of the company’s activities. The goals were set both material and non-material, such as preserving the environment and fostering a careful attitude to water among the population. A separate very important goal was the introduction of digital technologies in accordance with the State Program of Digitalization of the Russian Federation.

Water treatment innovations

To date, water purification in St. Petersburg consists of two stages: chemical purification and subsequent UV treatment. St. Petersburg Vodokanal was the first to refuse to purify water with liquid chlorine at the first stage, now sodium hypochlorite is used for this purpose, which is safe for the end user. In addition, in St. Petersburg, for the first time, all water began to pass the second stage for the destruction of viruses. Another innovative technology allows you to remove unpleasant odors from the water and remove the remnants of petroleum products is the powdered activated carbon dosing system [1]. The latest developments implemented at the enterprise also include water ozonation and gravity filters with activated carbon and sand. An example of their use is the K-6 block at the Southern Station.

Biomonitoring

In 2005, the development of scientists from St. Petersburg on the use of bioindicator animals: crayfish and snails to determine water quality was implemented. Its main idea is that a living organism reacts to changes in the composition of the liquid instantly, significantly saves the time needed for analysis, in case of an emergency, it is possible to influence the situation immediately.

Innovations in water disposal technologies

One of the innovations was the method of phosphorus deposition by chemical means. By adding reagents to the water, phosphates precipitate and are removed. Now the “total phosphorus” in the drained waters is no more than 0,5 mg/l, which corresponds to the recommendations of HELCOM [2].

For the first time in St. Petersburg, membrane cleaning technology was put into operation at the sewage treatment plants of the village of Molodezhny. This made it possible to reduce the area of cleaning facilities, since there was no

need to settle twice. The pore size of hollow fiber membranes is 0,2 microns, which allows wastewater to meet all the requirements of Russian legislation.

Sludge treatment and disposal

Currently, high-speed centrifuges are used to separate sediment and liquid, the solid component is subsequently burned, which is recognized worldwide as the safest method of disposal and allows you not to arrange zones for its storage. In addition, methods for the production of secondary resources obtained during combustion were introduced.

Surface water, snow and flue gases

A number of technologies have been implemented that have made it possible to purify the surface runoff of water and gases from the combustion of sediment much more efficiently, as well as to melt the snow mass. These include: the technology of three-stage gas purification at solid sludge incineration plants, automatic control and dosage of reagents, the use of ultraviolet light for disinfection of surface runoff, snow melting due to the heat of wastewater, which reduces the impact on the environment.

Interaction with the consumer

One of the main innovative achievements of Vodokanal over the past years has been a radically changed system of interaction with the end user of the product. The company meets people halfway, tries to become closer and clearer to them, for which, first of all, a new service was launched on the official website – “Personal Account” for subscribers. The user gets the opportunity to quickly receive settlement documents and information about the volume of water consumption, independently submit readings of individual metering devices, as well as submit an application and receive technical specifications. Instagram and Vkontakte pages have been created for the convenience of responding and attracting the younger generation with a new concept of caring for water resources. It is possible to leave a request on the website portal about various emergency situations, for example, about an open manhole.

Water supply complex management system

The creation of an innovative management system will allow the city to be the first to automatically adjust the characteristics of the supplied water and instantly obtain the necessary quantities of water consumption. The first swallow of this project was the Uritskaya pumping station, where pumping equipment was replaced with more energy-efficient [3]. Pressure monitoring was fully automated, thanks to the new network equipment. Water quality control has been implemented in the networks. All consumers of this station were provided with the latest meters, which made it possible to automatically receive data on water consumption without the participation of the subscriber.

The result of the pilot project was a forty-three percent reduction in energy consumption, a thirty-nine percent reduction in unaccounted water losses, and a thirty-two percent reduction in damage. By now, the project has been put into operation in the Southern zone of St. Petersburg, the number of people provided with new generation meters has reached one and a half million [4, 5].

In recent years, SUE Vodokanal of St. Petersburg has achieved a lot on its path of innovative development. This happened thanks to new technologies that the management was not afraid to look for, develop and implement. However, Vodokanal is not going to stop there, it is still in search of new ideas and technical innovations. The company has set itself a very high goal – to become the best company, both in the field of water supply and in Russia as a whole.

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VECTOR CONTROL OF SYNCHRONOUS ELECTRIC MOTOR

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Abstract. This article discusses basic principles of vector control system for AC synchronous motor with permanent magnets on rotor without rotor position sensors and prospects of its technical implementation.

Keywords: electric drive, synchronous electric motor, vector control, microcontroller.

ВЕКТОРНОЕ УПРАВЛЕНИЕ СИНХРОННЫМ ЭЛЕКТРОДВИГАТЕЛЕМ

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Аннотация. В статье рассмотрены основные принципы построения системы векторного управления синхронным двигателем переменного тока с постоянными магнитами на роторе без применения датчиков положения ротора, а также перспективы ее технической реализации.

Ключевые слова: электропривод, синхронный электродвигатель, векторное управление, микроконтроллер.

A synchronous electric motor is an AC electric motor in which, at steady state, the rotation of the shaft is synchronized with the frequency of the supply current; the rotation period is exactly equal to an integral number of AC cycles. Synchronous motors contain multiphase AC electromagnets on the stator of the motor that create a magnetic field which rotates in time with the oscillations of the line current. The rotor with permanent magnets or electromagnets turns in step with the stator field at the same rate and as a result, provides the second synchronized rotating magnet field of any AC motor. A synchronous motor is

termed doubly fed if it is supplied with independently excited multiphase AC electromagnets on both the rotor and stator [1].

Either a DC electromagnet or permanent magnets are placed on the rotor. For small power ratings (up to 10 kW), these motors are mainly designed with permanent magnets on the rotor. In the following article we will only consider this type of motor, so by synchronous motor we will understand that it has permanent magnets on the rotor [2].

Valve motors, commutatorless DC motors are all synchronous motors and the control method discussed in this article applies to them. At the moment, this type of motor is the most promising for regulated electric drive applications. They have a number of advantages over induction and DC motors, namely:

– High power characteristics (efficiency over 90 %);
– Smaller weight and dimensions with the same power;
– Large speed variation range;
– High overload capability in terms of torque;
– Long service life and high reliability.
– The only disadvantage of synchronous motors is their relatively high cost, which is due to the high cost of permanent magnets. Because of this, until recently, these motors were mainly used in high-precision applications (e. g. CNC machine feed drives, industrial robots, military technology, precision mechanics). However, there has been a downward trend in the cost of synchronous motors in recent years due to the advent of cheaper production technologies for high-coercivity permanent magnets. And this is leading to an increasing adoption of this type of motor in domestic and industrial applications such as compressor drives in refrigeration engineering, circulation pump drives, ventilation systems. This allows, first of all, to reduce the size of the drive and make it controllable. There are tendencies of gradual replacement of synchronous motors by their asynchronous predecessors and collector motors. In addition, asynchronous motors have a significant drop in efficiency when the speed drops below 40 % of nominal speed. With synchronous motors this disadvantage is less pronounced. These factors make synchronous motors almost ideal for energy-saving drives with a wide control range. Unfortunately, synchronous motor control systems currently occupy a small segment of the drives market. Most frequency inverters are only designed for use with induction motors and manufacturers who use synchronous motors in their products produce highly specialised drives for their own needs which are difficult to adapt to third-party solutions. Engineers who use synchronous motors in their designs often have to design the drive themselves [3].

In developing integrated control systems, it is often necessary to integrate the drive into the overall control system. An example of this is a heat pump control system which can consist of a top level system and local actuator systems – compressor, fans, valves. All these must form part of a single unit. Consequently, the actuator must be flexible and adaptable to the specific system.

This makes the task of developing a synchronous motor control system that can be adapted to the specific application and easily integrated into more complex automatic control systems all the more important [4].

There are several ways to control synchronous motors. Classical is the principle of control as a function of rotor position. Here the rotor position sensor is mounted on the motor shaft and the windings are commutated at certain positions of the rotor, thus producing a rotating magnetic field. The control system in this case is relatively simple, but it increases the complexity of the motor design and requires a larger number of wires between the motor and the drive. This reduces the reliability of the system. In order to increase the reliability of the system, control methods without rotor position sensors are applied [5]. This is primarily a scalar control method where the motor windings are switched at a certain frequency without tracking the rotor position, but the motor may fall out of synch and stop. This is a disadvantage that the counter electromotive force pulse based control method does not have this disadvantage. The current flows through 2 motor phases and the third phase is used to follow the counter EMF. In this case the maximum motor torque, and therefore the power output, is reduced. The vector control method lacks most of the disadvantages of the above methods. This method is widely used in AC asynchronous drives. However, it is also applicable to all other three phase motor types.

Vector control is a method of controlling synchronous and induction motors that not only generates harmonic phase currents (as in scalar control) but also controls the magnetic flux of the rotor, or in other words, the position of the magnetic flux vector in space. Vector control of a three-phase motor allows it to be controlled in the same way as a DC motor.

We will consider the control of a motor with an implicit pole rotor. It is well known that the stator inductances of such a motor are equal along the d and q axes. Therefore, the expression for the torque of such a motor will be simplified:

$$M = \frac{3}{2} Z_p I_{sq} \psi_f.$$

This expression shows that with a constant rotor flux (permanent magnet), the motor torque depends only on the q-component of the stator current. The d-component is parasitic, does not create torque and only causes additional losses. The motor torque can therefore be controlled by controlling the q-component of the stator current, keeping the d-component equal to zero.

To implement vector control, the instantaneous currents in the three motor phases are measured. Then a conversion is performed first from the three-phase system to a Cartesian system (Clark, PC conversion in the diagram) and then from the Cartesian to the rotary system (Park conversion, PP). The result is two current signals, Id and Iq. For both currents, the proportional-integral regulators (in the diagram, PTq and PTd) are constructed. The signals from the outputs of the regulators are converted back to the Cartesian coordinate system (Inverse Park Transformation, RPD). The space vector modulator (VM) calculates the necessary switch-on durations of the power switches as well as the switching sequence to realise the calculated current vector in space, i.e. directly in the motor windings. The speed controller (PC), which maintains the motor shaft speed setpoint, is a parallel PI controller. The speed reference signal is an external signal set by the user or a higher-level control system. The speed feedback is a signal proportional to the current motor speed calculated by the state observer (NS) as a derivative of the rotor angle. The output signal from the speed controller is the motor torque reference signal. This system implements what is called a slave coordinate control system. A so-called state observer (NS) is used to determine the rotor angle of rotation. It calculates the current rotor angle of the motor based on the measured instantaneous motor currents and voltages [6]. At the same time, it calculates the speed and torque of the motor. All calculations are based on a mathematical model of the motor. The state observer is one of the most complicated units of vector control system and its development is not considered in this article.

It is obvious from the above mentioned that the principle of vector control allows to control three-phase synchronous motor as easily as a direct current motor, i.e. by regulating only one quantity – motor current (torque). Vector control also gives better motor performance than other control methods. The modern element base enables a low-cost, yet high-quality drive that can be easily adapted for specific control tasks.

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УДК 359

STUDY OF TRANSVERSE BENDING OF TiNi PLATE

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Abstract. The aim of this work is to study the transverse bending of a titanium nickelide plate. The paper also considers the functional and mechanical characteristics of materials with thermoelastic martensitic transformations, characteristic temperatures and factors affecting their magnitude.

Keywords: smart-materials, shape memory alloys, shape memory effect martensitic transformations, titanium nickelide.

ИССЛЕДОВАНИЕ ПОПЕРЕЧНОГО ИЗГИБА ПЛАСТИНЫ ИЗ TiNi

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Аннотация. Целью данной работы является исследование поперечного изгиба пластины из никелида титана. Также в работе рассмотрены функциональные и механические характеристики материалов с термоупругими мартенситными превращениями, характеристические температуры и факторы, влияющие на их величину.

Ключевые слова: «смарт»-материалы, сплавы с памятью формы, эффект памяти формы, мартенситные превращения, никелид титана.

In recent decades, there has been a rapid development of a new generation of materials called “smart” or “smart” materials. Such materials have additional properties that expand their structural capabilities when external influences change. External factors include mechanical, temperature, light effects, the effects of electric or magnetic fields, changes in the parameters of the medium in which the material is located.

Smart materials include alloys with shape memory, which have the property of restoring significant deformations when heated, and with significant counteracting forces. This ability of materials with shape memory is used in devices and structural elements for various purposes: temperature and pressure sensors, converters of thermal or electrical signal to mechanical, etc. Elements made of alloys with shape memory may have the shape of a spring, plate, rod or a more complex configuration. Such elements are characterized by a nonlinear dependence of large displacements on external forces, while the deformations of the material itself remain small and the material works elastically [1, 2].

Plates made of titanium nickelide, the most famous shape memory alloy, are used in medicine for fixing bone fractures. In engineering, there are structures in which a rod or a thin strip bends strongly when the material is working within the limits of elasticity, for example, flexible current leads to moving parts in electromechanical systems (in gyroscopic devices), valve parts, flexible elastic connections, moving elements (potential energy accumulators), mechanical sensors of nonlinear dependencies or rectifiers of nonlinear dependencies. In the process of bending a thin part, its initial configuration changes greatly, and the movements during bending become commensurate with the dimensions of the part itself.

The shape memory effect is manifested due to phase austenitic-martensitic transitions with a reversible change in the size of crystals of a new phase with a change in temperature or mechanical stress. Experimental studies of the temperature-deformation behavior of elements made of alloys with shape memory are of particular interest, since theoretical models of products from shape memory are built on the basis of experimental data, and the calculated results obtained are verified [3, 4].

In this paper, an experimental study of the flat bending of a rectangular plate with a thickness h = 0.60 ± 0.05 mm, width b = 18.31 ± 0.08 mm and length l = 77.16 ± 0.08 mm, made of equiatomic titanium nickelide with phase transition temperatures M_s = 62 ^{0}C, M_l = 30 ^{0}C, A_s = 44 ^{0}C, A_l = 72 ^{0}C, was carried out. The moments of inertia of the rectangular cross-section are $J_x = bh^3/12$ = 0,33 mm^4 and $J_y = hb^3/12$ = 306,93 mm^4, therefore, the smallest

and greatest stiffness of the plate section for bending with the elastic modulus of martensite $E_м$ = 30 GPa are equal, respectively, EJ_x = 0.01 Nm^2 and EJ_y = 9.21 Nm^2.

The plate was pre-annealed at a temperature of 500 ^{0}C for an hour in a salted state between flat iron bars.

Then experiments were performed on thermal cycling of the plate in the temperature ranges of martensitic transitions under constant load. To do this, the plate was pinched rigidly on one of the short sides, heated in a free state to a temperature of 900C, loaded with a constant concentrated force P applied to the opposite loose end, and cooled under load to a temperature of ~ 24 °C. The load values in the experiments were P: 0,2; 0,4; 0,6; 0,8; 1,0 H. Subsequent heating of the plate to 90 ^{0}C was performed using an infrared lamp with an electric power of 250 W (Fig. 1). When cooled under load, the plate bent in the vertical plane, changing the curvature (Fig. 2), when heated under load, the flat shape was restored. The displacement of the loose end of the plate vertically y_{max} and horizontally z_{max} was measured during thermal cycling, and the maximum displacement from the initial position of the plate was calculated $r_{max} = \sqrt{y_{max}^2 + z_{max}^2}$ (Fig. 3).

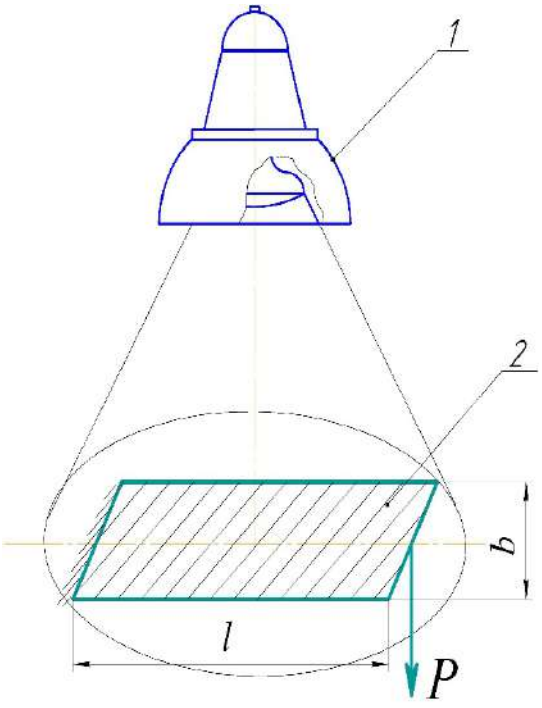

Figure 1. Installation diagram

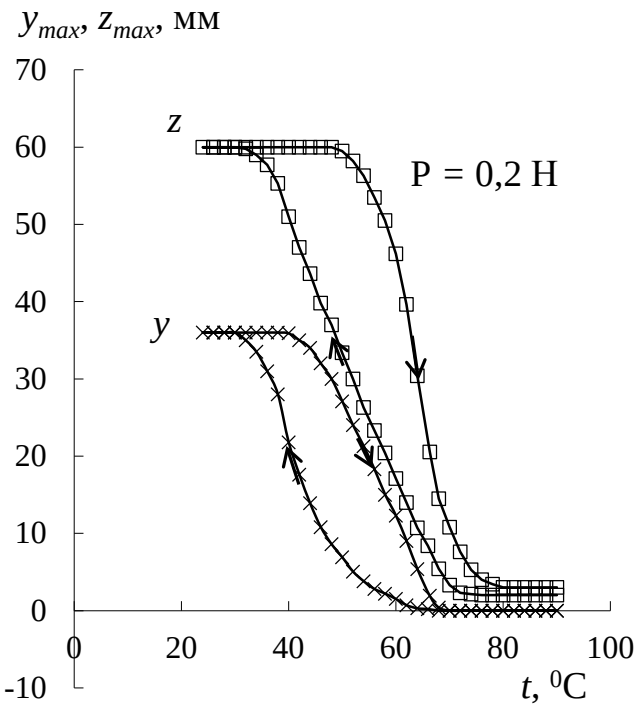

Figure 2. Temperature-deformation hysteresis of the plate under load

The dependence of the maximum displacement of the loose end of the plate on the applied load is shown in Fig. 4 and shows that even with small loads P = 0,2 N, the maximum displacement has a significant value $r_{max} = \sqrt{y_{max}^2 + z_{max}^2}$ with a plate length L = 77,16 mm

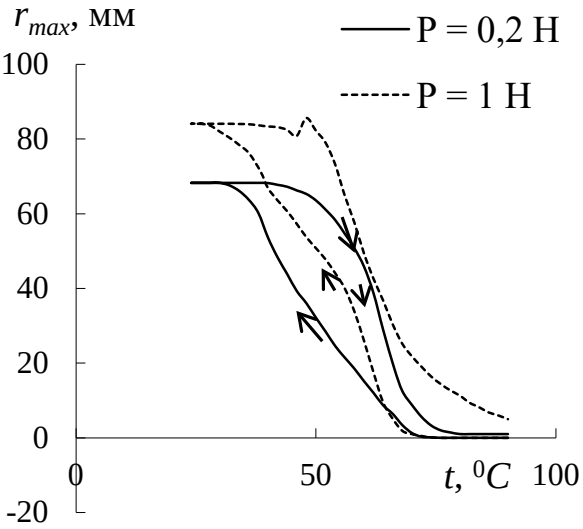

Figure 3. Temperature dependence of the displacement of the loose end of the plate during thermal cycling under load

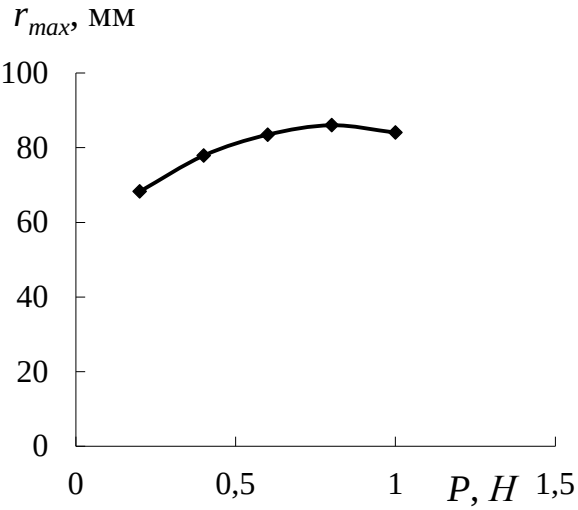

Figure 4. Dependence of the maximum displacement of the loose end of the plate on the applied load

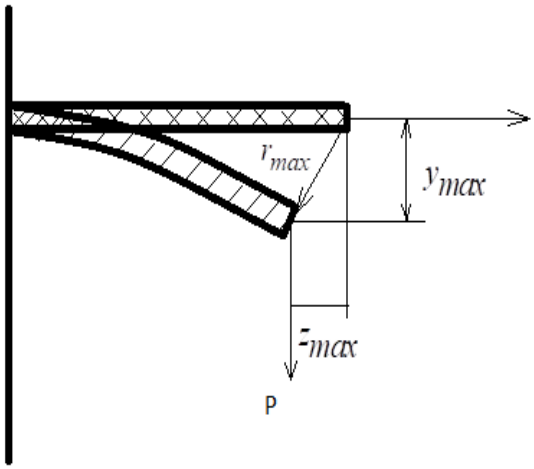

Figure 5. Graph of plate bending changes

With a subsequent increase in the load in the thermal cycle, the maximum displacement reaches the highest value and does not increase further (Fig.5).

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ENERGY AND DYNAMICS OF A NON-FLOODED FREE JET IN AN AREA WITH AN OBSTRUCTION

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Abstract. A numerical study of the aerodynamic structure of the flow arising from the transverse injection of a series of circular jets into a wall-bounded stream washing a flat obstacle of finite length has been carried out.

Keywords: jet, stream, hydromonitor, energy.

ЭНЕРГЕТИКА И ДИНАМИКА НЕЗАТОПЛЕННОЙ СВОБОДНОЙ СТРУИ ПРИ ВЗАИМОДЕЙСТВИИ С ПРЕГРАДОЙ

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Аннотация. В работе выполнено численное исследование аэродинамической структуры течения, возникающего при поперечном вдуве ряда круглых струй в ограниченный стенками поток, омывающий плоскую преграду конечной протяженности.

Ключевые слова: струя, поток, гидромонитор, энергия.

A free jet is a flow of a liquid that is not limited by solid walls and flows out into the environment with a significant absorbing or gaseous phase.

The jet flowing from the landing, gradually expanding, disperses in another environment. but, as is known from experience, the jet takes place on the surface or represents the probability of occurrence between its structure and its consequences [1].

The outflow velocities of the jet from the nozzle are high enough, therefore, its flow has a turbulent character, while pulsations of all parameters are observed in the flow core and in a turbulent boundary state.

Under the influence of transverse pulsating velocities, an intensive exchange of particles of the jet and its environment occurs. As a result, the momentum is exchanged, the jet expands and drags the particles of the medium along with it at a speed that decreases. The zone in which the main exchange of energy takes place is called a turbulent sublayer.

The results of the experiments show that the non-flooded consists of a compact, crushed and sprayed part.

The compact part consists of the jet material and is located at a relatively large distance from the nozzle orifice.

The shape of the jet and its continuity in this part do not change.

In the fragmented part of the jet, it expands and breaks down into separate large parts.

In the sprayed part, the jet consists of an ensemble of polydisperse droplets, the distribution of which generally obeys the normal law.

With the sweat of the jet and the force of inertia, gravity forces, the resistance of the air medium and the forces within the core of the jet, explained by turbulence and the heaving-wave motion of the structure of the liquid in the jet, act on it [2]. It is possible that this also includes the forces causing deformation of the jet shape.

The combined action of these forces causes the jet to disintegrate. The droplets formed after disintegration are under the action of interfacial or surface tension.

Jet use in industry.

Hydro-jet jets used for excavation should have a compact part of the maximum possible length, since this part has the necessary power. For this purpose, the design of the water jet at the outlet should have a surface that maximally suppresses the initial intensity of turbulence and the possibility of significant suppression of internal oscillations in the jet. The optimal length of the component jet of the water jet with the power required for soil development ends from the outlet section at a distance [3]

$$l = 0,415\sqrt[3]{H^2 d_0 \cos\theta}$$

Where: d_0 – outlet diameter

H – head in front of the outlet

θ – the angle of inclination of the trunk to the horizon

This formula belongs to N.P. Gavyrin.

Also used are vertical, like sprinkler, sprinkler and sprinkler impulse jets. Sometimes water injections are used to clean internal combustion engines.

Jet and wall dynamics

The force of action of a free non-submerged jet on the wall is determined in the following way.

Consider a conical wall, the axis of which coincides with the axis of the jet. Consider 2 sections: 1-1 and 2-2, respectively, inlet and outlet. The pressures in these sections are equal to atmospheric, therefore the corresponding pressure forces are equal to zero, and the weight of the liquid y in the considered section of the flow is neglected.

Then the static reaction of the flow will be equal to:

$$F_{cm} = \overline{F_1} + \overline{F_2} + \gamma = 0 \quad (1)$$

where $\overline{F_1}$ – cross-sectional pressure force 1-1; $\overline{F_2}$ – cross-sectional pressure force 2-2; γ – fluid weight between sections 1-1 and 2-2.

Dynamic reaction from the side of the obstacle wall:

$$F_{дин} = W * \rho * \omega_1 - W * \rho * \omega_2 ,$$

where ρ – fluid density, W – volumetric flow rate.

Neglecting the difference in heights in section 2-2 for its various points and hydraulic resistance, we obtain from the Bernoulli equation written for these sections that the velocities $\overline{\omega_1}$ and $\overline{\omega_2}$ are the same [3].

$$\omega_1 = \omega_2 = \omega \quad (2)$$

Due to the axial symmetry of the flow and the wall, the force of its action is directed along the axis. By projecting the force vectors on this axis from equation (1), we obtain:

$$F_{дин} = W * \rho * \omega_1 - W * \rho * \omega_2 * \cos\alpha = W * \rho * \omega(1 - \cos\alpha)$$

where α – taper of the mesh relative to the axis of symmetry.

Consider special cases:

1. The dynamics of a jet and a flat wall perpendicular to the flow (α =90 °)

$$F_{дин} = W * \rho * \omega$$

2. Concave walls (cup-shaped)

She turns on α =180 °. In this case:

$$F_{дин} = 2W * \rho * \omega$$

3. Curved wall (cup-shaped)

$$F_{дин} = W * \rho * \omega * (1 - \cos\alpha)$$

The greatest value of the jet pressure is on the concave bowl-shaped wall.

4. Consider a flat stationary wall located at an angle to the jet axis. Obstruction and jet are on the same axis.

Let us assume that the liquid spreads out in two streams over the wall surface with mass flow rates $W_1 * \rho * \omega_2$ and $W_1 * \rho * \omega_1$ respectively. The wall is shaped like grooves so that the liquid does not spread over the surface perpendicular to the plane of the drawing. We neglect friction forces due to their insignificance. In this case, the force of action of the jet on the wall is directed perpendicular to the wall [4]. Let us consider sections 1-1.2-2.3-3, in which the pressure forces are equal to zero, and the static reaction of the flow as a whole is equal to zero, and then the force of the action Fdin of the flow on the wall will be equal to:

$$F_{дин} = W_1 * \rho * \omega_1 - W_2 * \rho * \omega_2 - W_3 * \rho * \omega_3$$

Having projected the vector of forces included in equation (2) on the y-axis and on the x-direction parallel to it, we write:

$$F_{дин} = W_1 * \rho * \omega_1 * \sin\alpha$$

$$F_{дин} = W_1 * \rho * \omega_1 * \cos\alpha - W_2 * \rho * \omega_2 - W_3 * \rho * \omega_3 \quad (2)$$

Neglecting losses due to friction of the fluid against the wall, we assume that the velocities in sections 1-1, 2-2, 3-3 will be equal.

Then from equation (2) we obtain:

$$W_1 * \rho * \cos\alpha - W_2 * \rho - W_3 * \rho = 0 \quad (3)$$

According to the equation of costs, we get:

$$W_1 * \rho = W_2 * \rho + W_3 * \rho \quad (4)$$

Using equations (3) and (4), we determine the costs $W_1 * \rho$ and $W_2 * \rho$.

The stated theoretical information is supplemented by an experimental work with the title “force of action of a free non-submerged jet on an obstacle».

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УДК 621.3.05

APPLICATION OF BLOCKCHAIN TECHNOLOGY IN THE POWER INDUSTRY

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Abstract. The article shows the importance of energy saving. The disadvantages of centralized power supply are indicated. The reasons for the use of Blockchain technology in the electric power industry are described. The blockchain platform Erachain, which allows for automated accounting along the entire electricity supply chain from generating companies to end consumers, and the benefits of using this technology are considered.

Keywords: energy saving, technological breakthrough, Blockchain technology, Erachain platform, “I am a power engineer” program.

ПРИМЕНЕНИЕ ТЕХНОЛОГИИ БЛОКЧЕЙН В ЭЛЕКТРОЭНЕРГЕТИКЕ

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Аннотация. В статье показано значение энергоресурсосбережения. Указаны недостатки централизованного электроснабжения. Описаны причины применения технологии Блокчейн в электроэнергетике. Рассмотрена блокчейн-платформа Erachain, позволяющая вести автоматизированный учет по всей цепочке поставки электроэнергии от генерирующих компаний до конечных потребителей, и преимущества использования этой технологии.

Ключевые слова: энергосбережение, технологический прорыв, Blockchain-технология, платформа Erachain, программа «Я энергетик».

Energy conservation is one of the important tasks of the XXI century, since energy consumption is a necessary condition for human life and the creation of favorable conditions for his life. Improving the competitiveness, financial stability, energy and environmental security of the Russian economy, as well as the growth of the level and quality of life of the population is impossible without realizing the potential of energy conservation and energy efficiency through modernization, technological development and transition to rational and environmentally responsible use of energy resources. The place of our society among economically developed countries also depends on the results of solving this problem.

The technological breakthrough in the field of energy management is based on the use of the SmartGrid concept [1] and intelligent energy networks, marketing logistics related to the reasonable and rational redistribution of energy flows in domestic and industrial energy systems. The implementation of key requirements based on the basic approach can be guaranteed by combining traditional development with the creation of new attributes of its key element of the energy system.

Reducing the level of electricity losses generates the expected profit of energy companies, and for the state this parameter allows you to build an energy efficient society. The improvement of energy system management processes satisfies the condition for the development of energy systems from the perspective of stakeholder groups.

Management decisions on the introduction of energy saving technologies at industrial enterprises are implemented in the Russian Federation under conditions of risk and uncertainty. The expert discussion within the framework of the meeting with representatives of legislative and executive authorities is aimed, as a rule, at improving the dialogue at the interdepartmental level with development institutions with an entrepreneurial association to launch new solutions, primarily the need to use the capabilities of Blockchain technology in energy conservation [2].

Currently, the current centralized power supply system in the electric power industry is experiencing significant drawbacks: electricity losses, according to various estimates, reach 30 – 40 % per year [3], the cost of services is constantly growing, the debt of the population and the total costs of ensuring the operation of the unified energy system of Russia are increasing, remote regions of the country lack electrification, and the quality of energy supplied does not meet the established values.

The main causes of these problems are outdated technology, faulty metering devices, errors in taking readings, incorrect receipt filling and illegal connections. Experts see the main vector of development of the domestic electric power industry in the transition to distributed generation and the construction of the Internet of energy. The introduction of smart meters and other Internet of Things technologies forms a huge data market. Improving the efficiency of energy infrastructure directly depends on its reliability. Validation and data security functions can best be implemented on the basis of a distributed registry. The Erachain blockchain platform allows automated accounting of the entire supply chain of electricity from generating companies to end consumers and provides deep protection against unauthorized access to data at all levels. The system allows you to make records not just by the amount of energy resources, but also for a certain time interval.

The platform can be integrated into the infrastructure of the city, region and the whole country. Erachain allows you to create authenticated profiles of participants of the Internet of Electricity ecosystem. This gives control over making any changes to the software of metering devices and changing their settings from below. The construction of distributed generating capacities creates new market models. Where consumers can also be electricity producers, and all participants freely exchange energy resources.

Blockchain technology allows you to establish direct contractual relations between consumers and electricity producers. The essential advantages of performing an operation through a Blockchain transaction is that all electricity supplied to the power grid can be clearly attributed to the accounts of specific consumers in the shortest period of time up to several minutes. At the same time, the calculation for all electricity produced and consumed can be very accurately made at variable prices. A simplified settlement process will lead to a reduction in the amount of balancing energy on which market participants are billed.

The use of Blockchain technology provides consumers with a higher level of transparency of transactions. Consumers will be able to track where the electrical energy they purchased was produced. As part of the transition to a more complex intelligent distributed energy model, the Erachain platform has been integrated into the electricity metering and remote data collection program “I am a power engineer”. The use of blockchain in conjunction with the Internet of Things, big data and machine learning in the concept of the Internet of energy will allow to obtain the following system-wide effects:

1) building civilized relations between all participants in the process of generation and transfer of energy sales;

2) verification of the reliability of the amount of energy resources presented by the supplier for payment;

3) increasing the flexibility and efficiency of the country's energy system;

4) saving budget funds and consumer funds to pay for resources.

Building an energy management system model based on the use of Blockchain technology capabilities will contribute to the decentralization of energy production and supply based on renewable and traditional sources. In this regard, it is proposed to analyze the technical side of this technology as a software for monitoring, measuring the energy of an energy transmission device with the function of remote data transmission online. This will significantly reduce financial costs, costs for the purchase / sale of energy resources, the transfer of ownership of permits for the emission of greenhouse gases that guarantee clean electricity generation.

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УДК 504.052

THE ISSUE OF “SEASONALITY” OF ALTERNATIVE ENERGY IN COMPARISON WITH CONVENTIONAL ENERGY

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Abstract. The article touches on ecology and energy saving by describing alternative and traditional energy sources, their positive and negative sides. The main focus of the text is the problem of “seasonality” of renewable energy sources, comparing them to non-renewable sources, which do not have this disadvantage. The aim is to point out the impossibility of rapid transition to a full cycle of renewability in the current environment.

Keywords: alternative energy, traditional energy, ecology, power plants, renewable energy.

ПРОБЛЕМАТИКА «СЕЗОННОСТИ» АЛЬТЕРНАТИВНОЙ ЭНЕРГЕТИКИ В СРАВНЕНИИ С ТРАДИЦИОННОЙ

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Аннотация. В статье затрагиваются темы экологии и энергосбережения путем описания источников альтернативной и традиционной энергетики, их положительные и отрицательные стороны. Ключевой мыслью работы является проблематика «сезонности»

возобновляемых источников электроэнергии, сравнивая с невозобновляемыми, лишенных данного недостатка. Цель заключается в указании на невозможность быстрого перехода на полный цикл возобновляемости в существующей конъюнктуре.

Ключевые слова: альтернативная энергетика, традиционная энергетика, экология, электростанции, ВИЭ.

Nowadays, alternative energy is strongly popularized because of its environmental potential compared to traditional power generation. Undoubtedly, alternative energy prevails in this regard, but despite all its positive aspects, it is worth considering its disadvantages. The essence of alternative energy is the use of renewable or inexhaustible sources, such as wind, solar and geothermal energy. Unlike non-renewable sources such as fossil gas, coal and oil, which in combustion emit into the atmosphere various oxides, dioxides and carbon dioxide, which, in turn, cause the greenhouse effect.

The main problem with alternative energy is the dependence on variable weather or geographical limitations, in other words – the inability to regulate the capacity of generation to cover the uneven daily consumption of a community. For example, during the dark hours of the day, electricity consumption increases due to city illumination and the mass use of household appliances by city dwellers.

Solar power plants are powered by electromagnetic radiation from the sun. Undoubtedly, a huge plus of solar energy is its inexhaustibility, zero emissions and low costs of use. This technology can be used both on a regional scale and on the scale of a single site. Also, on the plus side, there is the relative ease of installation and subsequent use of solar panels, as there is no need for its frequent maintenance or even its absence in case of installation of solar panels in private households in a mainly continental climate. The leaders in the use of solar energy are Germany, China and Italy with 25,5 %, 14,3 % and 12,5 % of the world's solar generation, respectively [1]. But there are many disadvantages of this technology. Firstly, its inefficiency in places where the annual number of sunny days is low. Secondly, the sensitivity of solar panels to dust and precipitation reduces their efficiency. Thirdly, their low efficiency: in order to pay off the cost of solar panels, it is necessary to install a large number of them and this, accordingly, will take up a lot of space that could be given to pastures or agricultural land. In addition, for the greatest efficiency solar panels must be installed on flat terrain, which narrows the possibility of providing solar energy

to mountainous areas. The main problem with this type of energy is its seasonality. Since, for example, most of the energy is produced in summer, when, as in winter, the demand for energy increases and the length of the day shortens, respectively, the use of solar energy at this time of year will be inefficient. There is also uneven daily consumption of electricity by humans. At the moment this problem is trying to be solved with the help of battery stations to provide electricity at night, but this solution has a certain number of disadvantages, such as a large amount of toxic emissions into the atmosphere during mining the necessary lithium and, in fact, the production of battery stations. It is also necessary of replacing the batteries themselves due to aging and further disposal [2].

Another type of power generation exploits the power of wind, which man has been using for a long time. One of the advantages of this type of alternative energy is the inexhaustibility of resources. And compared to solar power plants, it does not take up much space. Terrain pattern and duration of the day are not such an important factor, in contrast to solar energy. Also, wind power has a higher efficiency than solar power. An important advantage is that wind farms can be located in the vicinity of arable land. The undisputed leaders in wind energy are China, the United States and Germany. The downsides of wind energy include the high cost of manufacturing wind farms, the difficulty of transportation from the point of production to the site of installation and assembly. Bird mortality increases in regions where wind farms are located. Inefficiency of this energy in regions with low wind potential, cannot cover the daily surges in energy consumption, and increased noise has a negative impact on nature and human psychological condition; therefore, it is necessary to install them away from human settlements.

There are also plants that use geothermal sources to generate electricity. They are at the stage of development as part of the transition to alternative energy. The advantages include environmental friendliness and availability in regions of volcanic activity, low cost of energy produced, renewability, high efficiency compared to other types of alternative energy, the ability to produce energy regardless of environmental conditions and the season. The negative side of this type of alternative energy is geographical limitations and the high cost of constructions. It is not reasonable to build this type of plants in places with insufficient temperature of geothermal water [3]. Other disadvantages include expensive construction of geothermal power plants in comparison with other types of energy, possible depletion of geothermal reservoirs, excessive

consumption of fresh water by the plant, which may lead to its shortage, release of large amounts of toxic chemicals and geothermal gases during drilling.

Hydroelectric power plants use the natural currents of water resources, converting them into electricity with the help of turbines. Their share of global distribution is higher than that of solar and wind energy. The advantage is the large amount of generated power and its cheapness for the end user and the absence of harmful emissions into the atmosphere. The negative sides of hydroelectric power plants are the following: they are expensive and difficult to build, flooding of settlements and agricultural land above the level of the dam, the risk of landslides and a strong negative impact on the ecosystem due to the formation of lakes and the lack of soil moisture downstream from the power plant, reducing fish and bird populations. The leaders in absolute values of hydropower generation are China, Canada, Brazil, and per capita – Norway, Iceland and Canada. There are also Small Hydro Power Plants working on the same principle. The distinctive feature of SHPPs from HPPs is their smaller size, hence they are characterized by the lower cost, lower complexity of construction and lower impact on the ecosystem as there is no need to flood livable and irrigated areas, lower risk of landslides, though the production of electricity in accordance will be lower than that of large hydropower plants [4]. Other positive aspects include the high efficiency factor, the cheapness of generated electricity for the end user and the absence of harmful emissions into the atmosphere. Special types of hydroelectric power plants include tidal and wave power stations. They also use the natural currents of water masses. One of their advantages is that they can be used as wave breakers to protect coastal areas. In addition, the specific generated power is higher than that of wind power, and this can be a profitable support. The disadvantages of this technology include interference with the fishing industry and the movement of water transport.

An important subject of debate is nuclear power, which raises the question of its environmental friendliness, as there is a possibility of man-made disasters, which can severely affect not only the ecosystem, but also the settlements near the plant. Despite this disadvantage, this type of energy is widespread in developed countries, because nuclear power is a highly efficient way of generating electricity. The world leader in installed capacity is the United States (20 % of the country’s total energy mix). The leader in terms of the share of total generation is France (72 % of the country’s total energy mix). Nuclear power plants operate on the principle of thermal power plants, but their distinctive feature is the absence of carbon dioxide emissions. However, the

negative environmental factors are thermal pollution, radioactive waste and radiation as well as accidents. There is a global trend to abandon the “peaceful atom,” and the first country to completely abandon nuclear power plants was Italy.

The main type of traditional power generation is thermal power generation, which uses the chemical energy of fossil fuels. It leads in the generation of electricity around the world. The incomparable advantage of this type of power over alternatives include the power output and the ability to regulate it, that is, the ability to generate more electricity when needed, which is not possible with solar or wind energy; the possibility of building a power plant close to a settlement, due to which the cost of power transmission is lower, and the small financial costs are also an undeniable advantage [5]. However, thermal power plants are one of the least environmentally friendly types of electricity, because the burning of fuel emits large amounts of toxic substances, which negatively affects the atmosphere of the globe. Moreover, the extractive industry, the development of which also destroys the ecosystem, depletes the reserves of minerals, and affects landscapes of the earth, not intended for mining.

Considering the pros and cons of alternative energy, we can conclude that to replace the traditional power generation at the moment is not possible due to difficulties connected with the infrastructure, its optimization, the dependence of alternative energy on the environment. On the other hand, although nuclear power plants are a more environmentally friendly version of thermal power generation, they also have a number of disadvantages, due to which they are less common than thermal power plants. Geothermal energy is a different matter. It is a relatively efficient and harmless type of power generation, but its advantages are outweighed by the geographical limitations of its use. In the end, it all comes down to the inability of today’s energy industry to completely switch to more environmentally friendly types of power generation.

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УДК 621.4

RESEARCH OF PRESSURE DISTRIBUTIONROTATING TURBINE BLADE LATTICE

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Abstract. This article reviewed the distribution of pressure over rotating blades. Based on the data obtained, a graph was built. Based on the experimental data obtained, a graph of the relative pressure distribution was constructed, which showed good reconciliation with the theoretical data.

Keywords: turbine, lattice profile, pressure, angle of attack.

ИССЛЕДОВАНИЕ РАСПРЕДЕЛЕНИЯ ДАВЛЕНИЯ ПО РАБОЧИМ ЛОПАТКАМ ТУРБИННОЙ РЕШЕТКИ

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Аннотация. В данной работе рассмотрены теоретические основы распределения давления по рабочим лопаткам турбины. На основании полученных экспериментальных данных был построен график распределения относительного давления, который показал хорошее согласование с теоретическими данными.

Ключевые слова: турбина, профиль решетки, давление, угол атаки.

The main engine of thermal and nuclear power plants nowadays is a steam turbine. It follows from this that in the study of turbine construction, a bias is being made to increase the efficiency and efficiency of steam turbine installations, as well as to increase the turbine power. One of the factors affecting the efficiency of the installation is the blade profile, which depends on

its purpose. Blade profiles can be characterized by the following geometric characteristics: chord, middle or axial arc, maximum thickness and concavity. The final form for working out the blade profile can be taken after conducting an experimental study. The theory of profile lattices is used to describe the hydrodynamic process of the blade profile flow [1].

If the studied blade profile is located at an angle or has an asymmetrical shape, then the pressure distribution along the convex and concave contours of the profile turns out to be unequal. Due to the difference in the flow velocity along the considered channels, the pressure on the concave part of the profile will have a greater value than the pressure on the concave one in accordance with the Bernoulli equation. Based on this, it can be noted that the asymmetry of the pressure distribution will lead to the appearance of a resultant force that will affect the blade. This force of influence can be determined by the sum of all the forces that act on each elementary site based on the analysis of pressure distribution plots on the profile surface, it is possible to calculate the force acting on this profile [2].

The turbine grid is a set of blades installed at the same angle and located relative to each other at the same distance

The question of the spatial flow of turbine gratings is extremely complex and can be solved only for some of the simplest cases, speaking of qualitative and quantitative dependencies between individual quantities, when flowing around the gratings with a compressible medium, only the experimental material can serve as reliable.

When setting up an experiment on a running turbine, you may encounter a number of specific conditions that complicate the experiment. In practice, when studying the turbine array, they follow the path of simplifying the model under study, as a result of which, it becomes possible to study particular issues for a general task.

One of the simplified turbine models is a flat grid. It is possible to study a number of phenomena characteristic of the operation of real turbine gratings; the influence of the angle of attack, to estimate the magnitude of edge and profile losses, to study the development of the boundary layer, to study the development of the boundary layer in the inter-blade channel.

By the distribution of static pressure and velocity, it is possible to determine whether the flow in the lattice is confusory or diffusory, and to find the force acting on the blade. At the same time, the flow analysis by the lattice flow is significantly simplified. This allows you to calculate the characteristics of the boundary layer and the place of its separation.

In work [3], pressure changes along the profile for a working blade with a small channel confusability are given (Fig. 1).

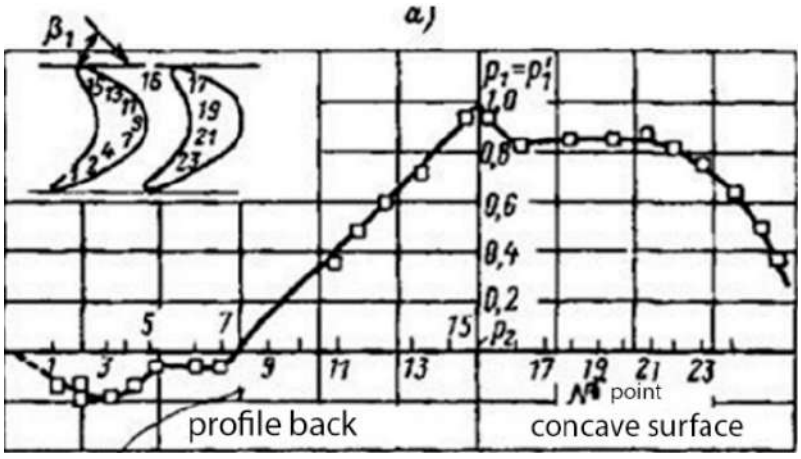

Figure 1. Pressure distribution along the contour of the profile of the working blade

Fig. 1 shows that the flow branches, that is, the velocity is zero, and the pressure is maximum. Beyond the pressure branching point, the flow accelerates.

Further, the pressure distribution depends on the shape of the profile and the interscapular canal. An area with positive, negative and zero pressure gradients is formed on the concave surface and back.

Fig. 2 shows the pressure distribution along the blade profile.

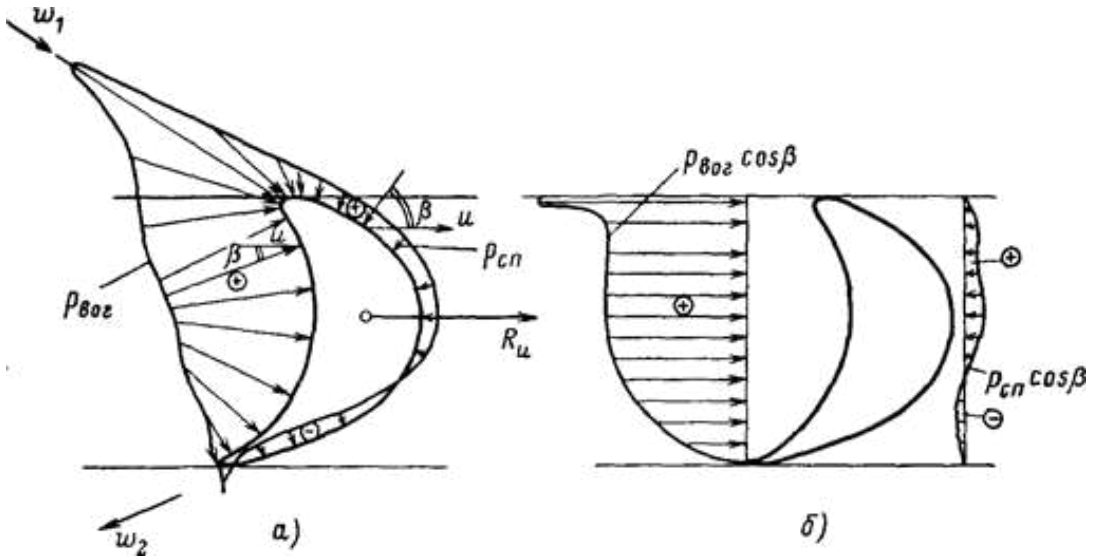

Figure 2. Pressure distribution along the profile of the working grid (a) and the projection in the circumferential direction of the pressures on the concave and convex (b) surfaces of the profile

As can be seen from Figure 2, the pressure on the concave surface is much higher than on the back. The efficiency of the grating is directly proportional to the Ru force.

To conduct the experiment, an installation was assembled, the main components of which are shown in Fig. 3. This is a simplified wind tunnel, a fan, a guide device that allows you to change the angle of entry from 15 to 45 °, a replaceable flat grating with a height of 20 mm from standard profiles P3-2-35 and P1-1-20 with appropriate installation angles, measuring fittings.

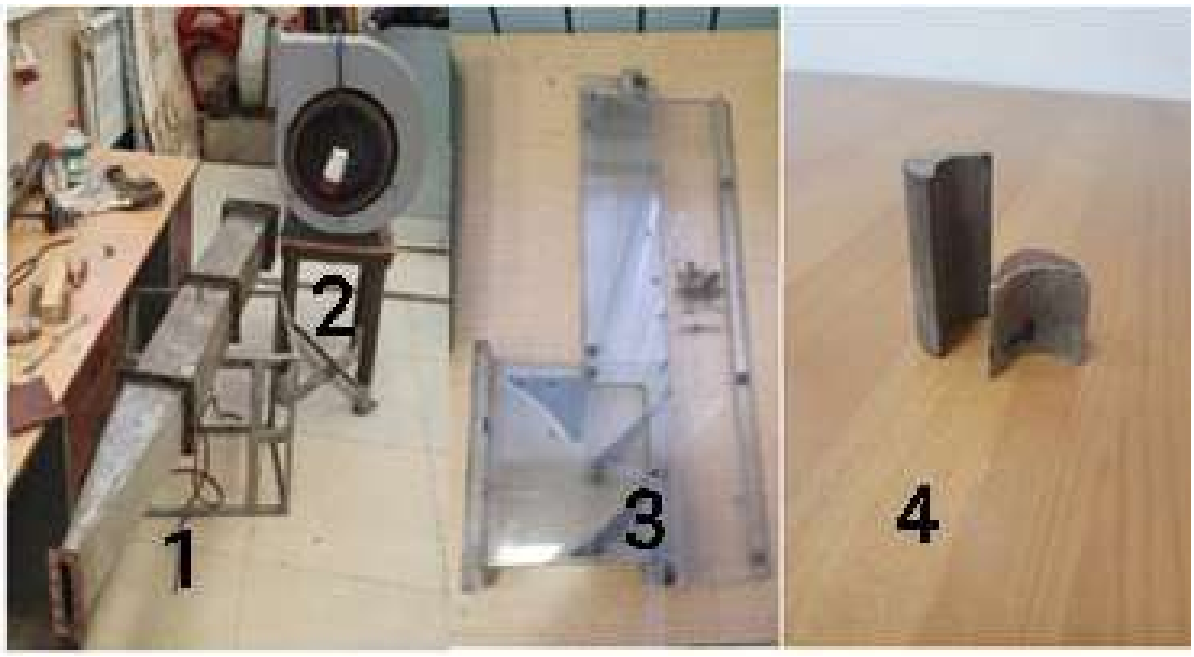

Figure 3. The main components of the experimental installation:
1 – simplified wind tunnel; 2 – fan; 3 – guide device; 4 – blade profiles

To study the contour of the pressure distribution law, the profile must be equipped with special holes for pressure sampling, the location of which can be seen in Fig. 4.

To determine the angle of attack, we use the following formula:

$$i = \beta_{1л} - \beta_{1п}$$

To plot graphs, we need to find:

Pressure drop at the i-th sampling point (Ry) and behind the profile (H0)

$$\Delta P_i = P_i - P_0$$

During the experiments, pressure readings were taken – full pressure, static Rs in the wind tunnel to the grid, and the dynamic pressure was calculated by the formula:

$$P_д = P_п - P_с.$$

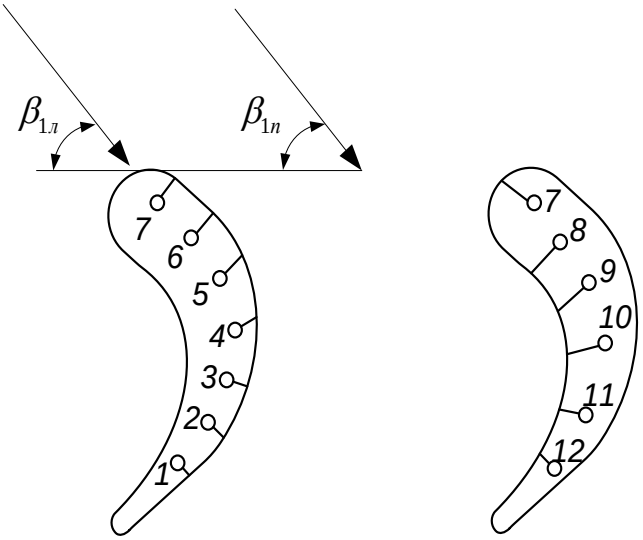

Figure 4. Profile of blades with special holes: $\beta_{1л}$ is the input angle of the blades; $\beta_{1п}$ is the angle of the flow entrance to the grid

Pressure coefficient at the i-th sampling point ($\overline{P_i}$) we find by the formula:

$$\overline{P_i} = \frac{\Delta P_i}{P_д}$$

Pressure measurements Pi were carried out for each point on the blade profile from 1 to 12. The pressure P0 did not change during the experiment. The experimental data obtained are presented in Fig. 5. It shows the distribution of the relative pressure Pi along the blade profile. The abscissa axis shows the numbers of the selection points.

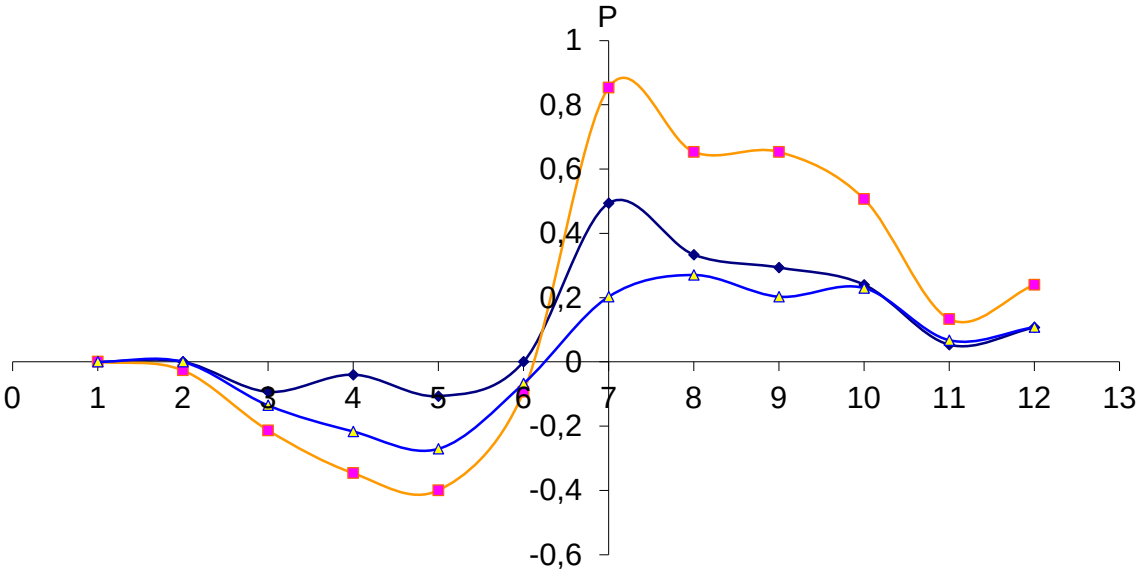

Figure 5. Distribution of the pressure coefficient Pi

The experimental data obtained are in good agreement with the theoretical ones and fully confirm the data of other researchers.

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УДК 620.9

ALGORITHM FOR CALCULATING THE THERMAL SCHEME OF A STEAM TURBINE INSTALLATION

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Abstract. The calculation of the thermal scheme of a steam turbine installation is the basis of the knowledge that the student receives during the study of industrial thermal power plants and thermal power plants. The main task of calculating the thermal scheme of a vocational school is related to the formation of competencies and obtaining skills in finding the absolute internal efficiency of a vocational school and the specific heat consumption under the specified thermal scheme.

Keywords: steam turbine installation, calculation scheme, h-s diagram, steam consumption, steam meters.

АЛГОРИТМ РАСЧЕТА ТЕПЛОВОЙ СХЕМЫ ПАРОТУРБИННОЙ УСТАНОВКИ

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Аннотация. Расчет тепловой схемы паротурбинной установки лежит в основе знаний, которые студент получает в ходе изучения промышленных теплоэлектростанций и теплоэлектроцентралей. Главная задача расчета тепловой схемы ПТУ связана с формированием компетенций и получением навыков в нахождении абсолютного внутреннего КПД ПТУ и удельного расхода теплоты при указанной тепловой схеме.

Ключевые слова: паротурбинная установка**,** расчетная схема, h-s диаграмма, расход пара, параметры пара.

When calculating the thermal circuit, the parameters and costs of the media are determined, which are found in all elements of the circuit (heat exchangers for various purposes, including regenerative and network heaters, pumps, ejectors, turbine compartments, etc.), as well as installation capacity and thermal efficiency indicators.

For the construction of a new turbine installation, the results of such a calculation under normal operation are necessary for design developments or selection from catalogs of circuit elements, including pipelines. If the turbine unit is designed, the calculations are given for other possible modes of its operation other than the nominal one. The results of this calculation are also necessary to determine the possibility of operation of all circuit elements in the range of specified modes, indicators of thermal efficiency, as well as for the selection of various regulating equipment and fittings [1].

The calculation is based on the equations of thermal balances, material balances of energy carriers. First of all, this is the working fluid of the turbine installation, as well as equations for determining the flow pressures at various points of the circuit. The latter is not possible if design developments of elements are not carried out in parallel; in this case, approximate dependencies or data on similar schemes and devices are used.

The first stage of the calculation is the preparation of the design scheme of the installation. At this stage, the type, turbine power and initial steam parameters are set. When drawing up a design scheme based on existing design experience or from approximate dependencies, choose:

1. pressure in the condenser;
2. scheme and main parameters of intermediate turbine systems;
3. the number and types of regenerative heaters (as well as a deaerator), the scheme of their inclusion;
4. feed water temperature;
5. type of feed pump, type and circuit of the drive turbine in the case of a turbo drive;
6. the water temperature after the heating stages and the values of the minimum temperature pressures for surface-type heat exchangers;
7. the scheme of heat release to the consumer;
8. method and scheme of preparation of additional water;
9. the place of inclusion of evaporators and vaporizers;
10. schemes for the use of heat from various elements of the station (turbine seals, generator, station's own needs, steam generator purge, evaporator, etc.).

The choice of all or part of these parameters may require optimization calculations.

The second stage of the calculation consists of constructing the h-s diagram of the steam expansion process in the turbine. For the calculated mode, first, according to the available dependencies, the following are determined:

1. pressure losses in the steam intake devices of the turbine
2. pressure losses during steam bypass between cylinders (including in turbine intermediate devices, if any);
3. losses with the output speed and pressure recovery in the outlet pipe, as a result of which the heat transfer in the central heating system can be increased with superheated and weakly moist steam for an axial design.
4. internal relative efficiency of compartments, taking into account the peculiarities of their execution and steam parameters.

On the h-s diagram of the steam expansion process, the values of the selection parameters are applied. If, in the calculated mode, a slight change in steam consumption in the turbine compartments is expected compared to the normal one, then the available h-s diagram is usually not recalculated. In the case, for example, of calculating the thermal scheme of a turbine installation at partial loads, the parameters of the steam expansion process in the turbine should be clarified [2].

The third stage of the calculation is the determination of steam consumption for circuit elements and turbine power. It can be executed in the following sequence.

The material balance of the working fluid for the turbine plant as a whole is compiled.

The total flow rate of all flows from elements external to the calculated installation (including the flow rate of fresh steam, additional water) must be equal to the total flow rate of flows from this installation (feed water consumption, loss of working fluid, selection for other installations of the station, for own needs)

The values of flows that are not related to the operation of the heat exchange equipment of the installation are set.

These include, for example, steam flows through turbine shaft seals, valve rods. The exact values of these costs are determined by the calculation of the corresponding devices. They can be estimated on the basis of data on existing turbine installations.

Based on the information about the heat load given to each of the external heat consumers and the parameters of the corresponding heat carriers, steam extraction points from the turbine are selected for these purposes.

The necessary pressures of the condensate-feed tract pumps are determined.

If the installation of condensate pumps of the 1st and 2nd lifts is provided, calculation equations are compiled for each, and the initial pressure for calculating the pump pressure of the 1st lift is the required pressure on the suction pipe of the pump of the 2nd lift.

The parameters of steam and water are determined at various points of the circuit.

According to the known pressure values in the turbine selections, the steam pressure in the corresponding heaters is determined.

The temperature of the heating steam condensate for heaters without drainage coolers is equal to the saturation temperature at the appropriate pressure. The flow rates of steam and water are calculated.

The basis of the calculation is the equations of material and thermal balances. For a mixing type heater, into which N streams are supplied D_R1,D_r2,...,D_rnc by enthalpy h_r1,h_r2,...,h_rn, and the total flow with enthalpy h_gnac is diverted.

Steam and water costs are calculated in absolute values Dr or in fractions of steam consumption per turbine ar. In the first case, the electrical power of the Ne installation is determined by a given steam consumption per turbine D0, in the second case, the inverse problem is solved. It is convenient to summarize the results of determining the parameters and flow rates according to the turbine installation scheme in a table.

The indicators of thermal efficiency of the steam turbine installation are determined.

For condensing steam turbine plant:

- absolute electrical efficiency of the turbine unit (gross):

$$\eta_э = N_э/Q_0; \quad (1)$$

- efficiency of the turbine unit (net):

$$\eta_э^{нг} = (N_э - N_{с.н})/Q_0; \quad (2)$$

- specific steam consumption:

$$d_0 = D_0/N_э; \quad (3)$$

- specific heat consumption, kJ/kW or kW/kW, is the inverse of $\eta_э$.

For a steam turbine heating plant (for example, for a thermal power plant), in which thermal power $Q_т$ is consumed and $Q_т^0$, is released to external consumers, the heat consumption Q_0 can be defined as the sum of $W_i + Q_к + Q_т$.

Usually the following indicators of thermal efficiency are calculated:

- Efficiency of electricity production:

$$\eta_э = N_э/(Q_0 - Q_т); \quad (4)$$

- Efficiency of heat energy release:

$$\eta_т = Q_т^0/Q_т; \quad (5)$$

- total efficiency (estimating total thermal efficiency):

$$\eta_{э.т} = (N_э + Q_т^0)/Q_0; \quad (6)$$

- specific generation of electric power on thermal consumption:

$$э = N_э^т/Q_т, \quad (7)$$

where $N_э^т$– is the electrical power developed by steam flows that do not pass into the condenser, but are output from the turbine to generate $Q_т$.

If auxiliary drive turbines are used in the scheme, their power $N_{т.п}$ must be added to the power $N_э$ in the equations (1), (3), (4) and (6) [3].

Summing up, we can say that the calculation of the thermal scheme of a steam turbine installation is carried out in three stages: drawing up a design scheme of the installation, constructing a h-s diagram of the steam expansion process in the turbine and determining the steam consumption for the circuit elements and turbine power. In each of the stages, separate calculations are carried out, the values of water and steam flows are set, different steam parameters are determined, the necessary water consumption, efficiency coefficients are calculated, etc.

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PRINCIPLE OF OPERATION AND EXAMPLES OF APPLICATION OF VALMET DNA AUTOMATION MEASURING AND COMPUTATIONAL COMPLEX

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Abstract. The article discusses the Valmet DNA measuring and computing complex, its software and hardware components, reveals the relevance of the use of this complex in technological production, as well as examples of real objects under the control of Valmet DNA.

Keywords: Valmet DNA, Metso, metering and computing complex, PLC (programmable logic controller), training program.

ПРИНЦИП РАБОТЫ И ПРИМЕРЫ ПРИМЕНЕНИЯ ИЗМЕРИТЕЛЬНО-ВЫЧИСЛИТЕЛЬНОГО КОМПЛЕКСА АВТОМАТИЗАЦИИ VALMET DNA

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Аннотация. В статье рассматривается измерительно-вычислительный комплекс Valmet DNA, его программная и аппаратная составляющие, раскрывается актуальность применения данного комплекса на технологических производствах, а также приводятся примеры реальных объектов под управлением Valmet DNA.

Ключевые слова: Valmet DNA, Metso, измерительно-вычислительный комплекс, ПЛК (программируемый логический контроллер), программа обучения.

The organization of automation of technological processes is one of the most important tasks of any modern industrial production, and requires an integrated approach, for the implementation of which systems containing the necessary components and nodes for the organization of an effective automated process control system (automated process control system) are increasingly used.

The Valmet DNA measuring and computing automation complex allows, using the design tools included in the system, to develop an automated process control system and visualize the main stages of technological processes. The Valmet DNA automation complex is a development of the Finnish company Valmet, which is a world leader in the pulp and paper industry and energy. In 2013, Valmet separated from Metso Corporation into a separate conglomerate.

Since the understanding of the current state of the technological process by operators and employees of the enterprise is one of the most important tasks, one of the applications of Valmet DNA is the provision of dispatching and control achieved by using mnemonic circuits and displaying parameters in real time, and audible alarms. In addition to designing operator screens, the complex has the possibility of modeling the contours of technological processes, which allows you to develop a training program that does not rely on a real technological process, and use an automation complex for operator training, in relation to the required technological process.

The training program may include a visual part designed to familiarize operators with the progress of the technological process and display changes in key measured parameters. It is important to be able to track changes in one parameter and its effect on another. For example, the effect of the degree of pulp grinding on the density of m^2 of paper web in a paper machine. Understanding how a change in some parameters will lead to the reaction of others allows you to increase the efficiency of real production and prepare personnel to work with the control object.

Another possible application of this system may be the prediction of economic benefits by achieving and maintaining optimal process parameters for the fulfillment of a certain order. Thus, it is possible to achieve greater production efficiency by determining the effective limits of the parameters by selecting them and evaluating the result using Valmet DNA.

The Valmet DNA automation complex consists of hardware and software. The key element of the hardware is a programmable logic controller (PLC). This device collects information from sensors, processes programs downloaded by automated process control system developers, and distributes control signals.

The PLC is also a link for operator workstations. Fig. 1 shows the PLC of the ACNCS model manufactured by Valmet.

Figure 1. ACNCS model PLC

In addition to the PLC and operator workstations, the hardware part of the complex includes I/O groups for connecting sensors and actuators, as well as a server with which the system is debugged.

The measuring and computing automation complex Valmet DNA includes a variety of software components and tools necessary for access to process data, data collection, data processing, emergency prevention and control action formation. Among the tools, the following should be high lighted [1]:

– DNA Process Explorer. This tool increases the productivity of the process due to the fact that it allows you to display information about the technological process in a form that will be convenient and intuitive to use.

– DNA Summary. This tool is designed for conducting statistical analyses and creating reports. For example, if a non-standard situation is observed in the technological process, then the trends created with the help of this tool (up to 10 monitored parameters in one trend window) will be able to present information to the operator in an understandable form.

– DNA Total. This tool is necessary for compiling a cumulative report on the necessary process variables, as well as for building diagrams for a more visual presentation.

– DNA Runtime. This tool is designed to calculate statistics and process trends in the condition of equipment, which simplifies the performance of maintenance work. Using the information provided by statistics, it is possible to optimize service intervals and resource efficiency.

– DNA Replay. The tool is necessary to determine the causes of malfunctions and evaluate a large array of data for a fairly short period of time.

– DNA Alarm Browser. This tool is one of the main ones providing security in the measuring and computing automation complex. It allows you to view and process accident signals, compile reports that can be sorted by a large number of criteria (time interval, variable, event text, etc.), as well as combine accidents into groups for easier analysis.

– DNA Alarm. This tool works together with DNA alarm Browser and collects information about accidents from various sources and stores it in a single database. The information collected by this method is used to find out the cause of the accident and to prevent an accident of the same type in the future.

– DNA Log Report. The tool is necessary for the preparation of simple reports and reports on general characteristics and allows you to create them easily and quickly without knowledge of special programming languages.

– DNA Spc. This tool is an important part of monitoring, as it is designed to provide operators and engineers with special statistics on the state of the process in real time. Statistics can be displayed in the form of tables, graphs, diagrams with control limits, standard deviation diagrams, change range diagrams, histograms, etc.

– DNA Multivariate. This tool is multitasking and is designed to develop complex models, deploy them, as well as to identify, diagnose malfunctions and build an effective process model.

– DNA Event. The tool is designed to manage events, track the values of variables, and combine process data with events.

– DNA Batch Reporting. This tool is used when processing information about processes during production for continuous monitoring and analysis.

– DNA Calc. The tool is a powerful and flexible tool for calculations working with data from a single Valmet DNA database. DNA Calc can be useful in calculating efficiency, mass balance, averages, etc.

The measuring and computing automation complex Valmet DNA is successfully used in the production of Segezha Pulp and Paper Mill, a

papermaking enterprise located in the city of Segezha in the Republic of Karelia. The automated control system includes the control of the Kamur digester and its flushing, as well as a cooking optimization system [2].

In relation to the paper-making machine, a distributed control system is implemented that provides grinding at low concentration, sorting, machine circulation, pressure box with dilution, mesh, pressing parts, steam condensate system, automated rolling [3].

The introduction of the Valmet DNA measuring and computing complex in modern conditions made it possible to ensure the maximum possible performance at low resource costs and to change the grade of the pulp produced depending on the needs of the enterprise.

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SIMULATION MODELING OF A BOOSTER PUMPING STATION

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Abstract. The article reviews and analyzes several simulation options for a booster pumping station. As a result of the review, the most effective model that meets all requirements was identified.

Keywords: simulation modeling, automated control system, oil, booster pump station, automation.

ИМИТАЦИОННОЕ МОДЕЛИРОВАНИЕ ДОЖИМНОЙ НАСОСНОЙ СТАНЦИИ

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Аннотация. В статье проведен обзор и анализ нескольких вариантов имитационного моделирования дожимной насосной станции. По результату обзора была выявлена наиболее эффективная модель, соответствующая всем требованиям.

Ключевые слова: имитационное моделирование, система автоматизированного управления, нефть, дожимная насосная станция, автоматизация.

Currently, simulation software complexes for various technological processes are widely used [1, 2, 3, 4]. Consider the options for the use of simulation modeling for booster pumping stations (DNS).

DNS is a technological part of the system of oil and gas failures in the fields and their subsequent transportation. The DNS is designed for degassing

and pretreatment of oil coming from well bushes and pumping partially decomposed oil to the central oil collection point.

One of the variants of the simulation modeling of the DNS is the modernization of the automated system of the booster pumping station of the gas condensate field by installing an electric dehydrator [5]. For the correct operation of the electrodehydrator, the phase separation level should not be higher than the set one, respectively, it must be constantly maintained. The control object in the work under consideration [5] is an electrodegridator. The adjustable parameter of the technological process is the section level. With the operator's automated control system, the required level for the electric dehydrogenator is set, after that the pressure is brought to a unified current signal and fed to the PLC. The PLC is fed a value from the pressure sensor, the values are compared and an output signal is generated, which is fed to the PID controller of the internal circuit. The output of the external signal is the setpoint for the internal one, the internal one is set first, and only then the external one. This is necessary in order to work out the setpoint as quickly as possible without overshooting.

Mathematical model in the form of a system of differential equations:

Frequency converter: $T_1 \frac{df}{dt} + f = K * I_y$

Electric drive: $T_2 \frac{df}{dt} + \omega = K_2 * I_y$

Gate valve: $\frac{dx}{dt} = \omega$

Conversion of opening to liquid: $p = K_3 * x$

Incoming fluid flow rate: $V = p - q$

Level: $T_3 \frac{dh}{dt} + h = V$

where f is the output frequency from the frequency converter, ω is the rotational speed of the actuator shaft; x is the movement of the valve stem, p is the amount of liquid, q is the amount of liquid, V is the flow rate of the fluid entering the input.

Fig. 1 shows a model of the system.

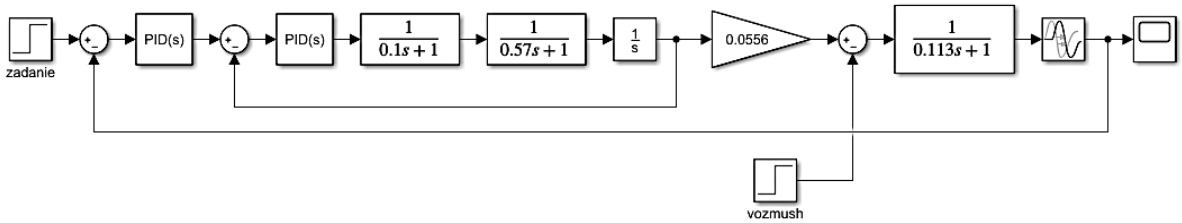

Figure 1. System model

As a result of simulation modeling, a graph of the transition process is obtained (Fig. 2): the process is monotonous, the transition time is about 25 seconds, there is no overshoot, at 38 seconds a disturbing effect occurs in the system.

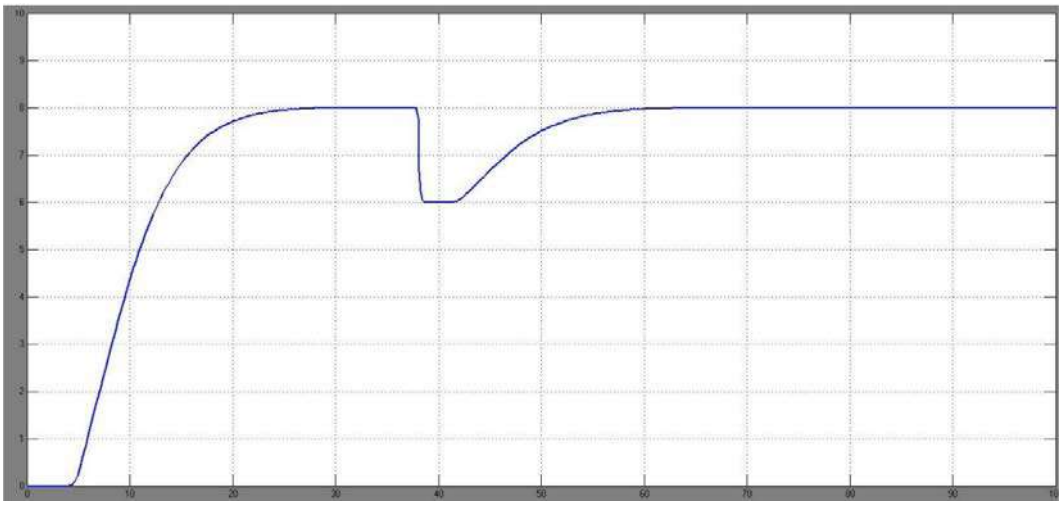

Figure 2. Timeline of the transition process

The next variant of the DNS simulation considers the stabilization of the given technological modes.

Transfer function for fluid flow rate:

$$W(s) = \frac{1}{Tp+1} e^{-\tau_0 s}\ ; T = \frac{2Lfc^2}{Q}; \tau_0 = \frac{Lf}{Q};\ c = \frac{Q}{f}\sqrt{\frac{\rho}{2\Delta P g}},$$

where L is the length of the pipeline section between the measuring point and the control point, p is the density of the liquid, d is the diameter of the pipe, f is the cross-sectional area of the pipe, ΔP is the pressure drop on the pipeline, τ_0 is the delay, T is a time constant.

Fig. 3 shows a model of the system.

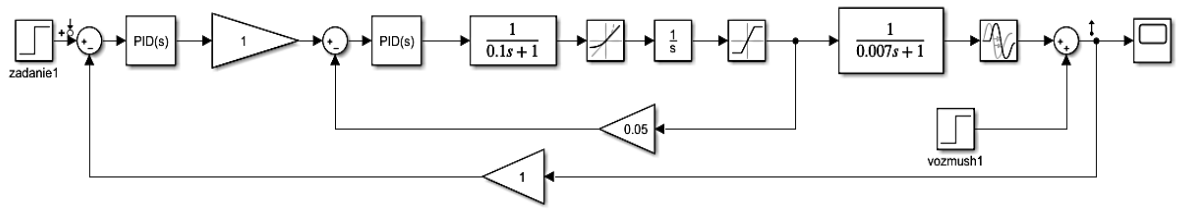

Figure 3. System model

As a result of simulation modeling, a graph of the transition process is obtained (Fig. 4): the transition time is about 7 seconds, the overshoot is less than 10 %.

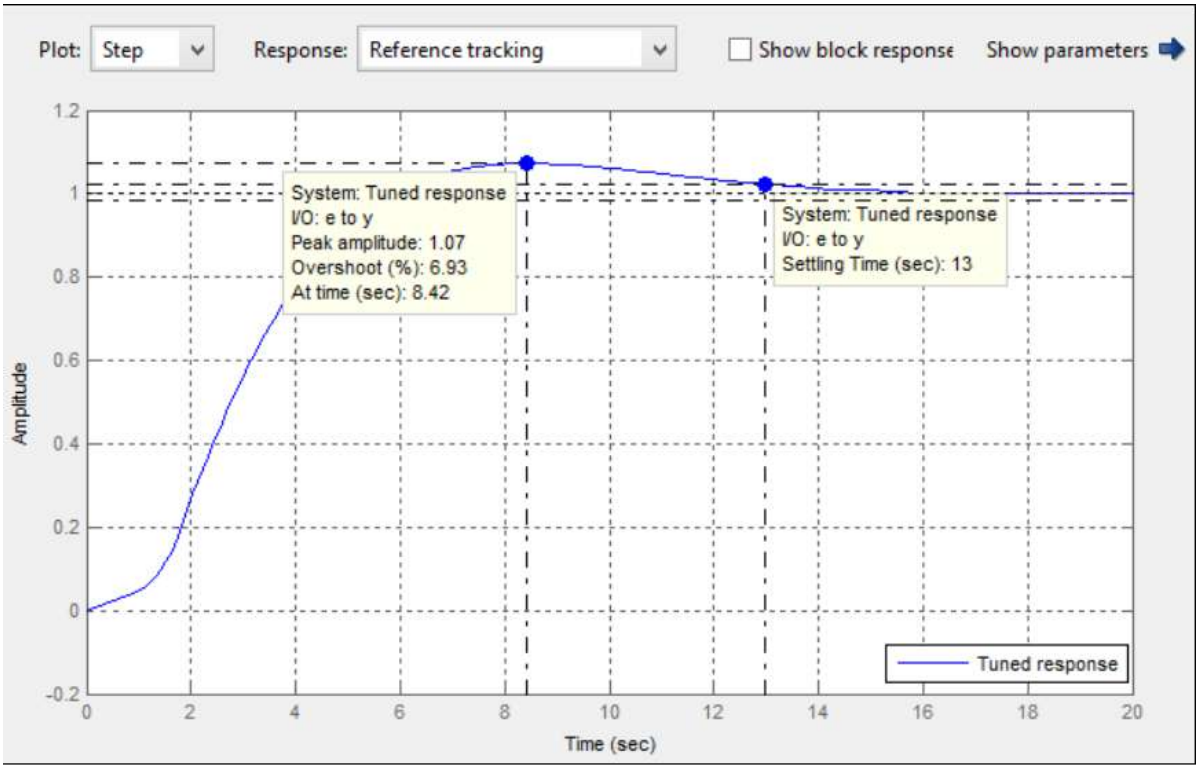

Figure 4. Timeline of the transition process

Conclusion: the considered options for the use of simulation modeling for booster pumping stations make it possible to analyze the operating modes of the DNS and compare them with the operating modes of real objects.

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STEAM TURBINE PLANTS WITH SUPER CRITICAL AND ULTRA-SUPER CRITICAL PARAMETERS IN POWER ENGINEERING

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Abstract. The article covers sich topics as steam turbine plants operating at super critical and ultra-super critical parameters of live steam. The paper reveals the concepts of super critical and ultra-super critical parameters. Russian installations operating at super critical parameters are presented. At the same time, the prehistory of installations is told, relevant issues and possible ways of solving them are described.

Keywords: steam turbine plant, supercritical parameters, ultra-supercritical parameters, efficiency, fittings.

ПАРОТУРБИННЫЕ УСТАНОВКИ НА СВЕРХКРИТИЧЕСКИХ И СУПЕРСВЕХКРИТИЧЕСКИХ ПАРАМЕТРАХ В ЭНЕРГЕТИКЕ

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Аннотация. В материале рассматриваются паротурбинные установки, работающие на сверхкритических и суперсверхкритических параметрах свежего пара. В работе раскрываются понятия сверхкритических и суперсверхкритических параметров. Представлены российские установки, работающие на сверхкритических параметрах. В статье также рассказывается предыстория установок, описаны актуальные проблемы и возможные способы их решения.

Ключевые слова: паротурбинная установка, сверхкритические параметры, суперсверхкритические параметры, эффективность, арматура.

Coal has always been considered the dirtiest fuel, but due to the latest developments in the field of its combustion and flue gas removal and the interest of countries in supporting the environmental situation, it is worth paying attention to highly efficient stations operating on supercritical and super-supercritical steam parameters.

Nowadays, the issue of increasing efficiency is acute, and the issue of increasing the efficiency of vocational schools is no exception. Having studied the analysis of the thermal efficiency indicators of a steam turbine installation, it is possible to come to a way to increase efficiency. An increase in efficiency can be achieved by increasing the efficiency. One way is to increase the initial parameters of the steam. For example, for a cycle on superheated steam with an increase in the initial temperature and at constant pressure, the thermal efficiency is constantly increasing. The higher the initial parameters, the closer the pair is in values to the critical point and, accordingly, to the critical parameters [1].

Critical parameters are the parameters at which the boiling liquid and dry saturated steam are in an equilibrium state and are 22,1 MPa for water at 374 °C. The point with critical parameters at which the lower and upper boundary curves intersect is marked with the index K (Fig. 1).

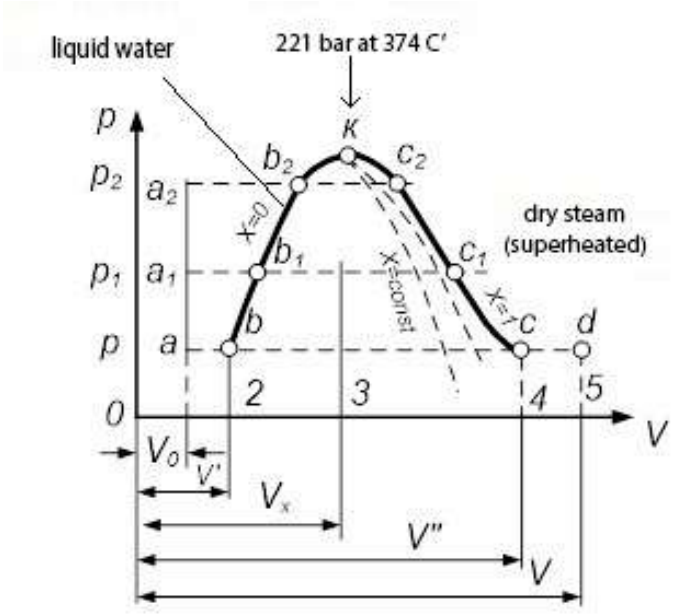

Figure 1. Diagram of water vapor in pressure – volume coordinates

Therefore, it is important to design steam turbine installations at high initial steam parameters, including super-critical and super-critical.

What are supercritical and super-supercritical steam parameters and why are stations on these parameters highly efficient? The values that are above

critical are supercritical, at values from 24,5 MPa to 28,5 MPa and from 540 to 580 °C, super-supercritical – from 28 MPa and at a temperature of 600 °C [2, p. 23].

The capacity of stations on such parameters can increase from 6 to 7 % – which is significant for the energy sector. Such stations have existed for quite a long time, and recently they are beginning to gain wider popularity due to their high efficiency. In England and Europe, attempts to create boilers with such parameters were made as early as the 30th year of the last century, but they were in vain, and it is still impossible to accurately determine which station first started working on supercritical parameters. The Philo plant in Ohio (USA) with a capacity of 1300 MW was commissioned in 1957 with operating parameters: 31 MPa and 621 °C. This station is considered the first station operating at supercritical parameters. Nowadays, the number of such stations only in Japan and China reaches several dozen. Such stations are very popular in countries with large coal reserves, because this type of fuel is the most affordable and does not contain sulfur. Electricity generation on this type of fuel is not so expensive compared to nuclear fuel [2].

It is worth noting that such steam turbine units operating at supercritical and super-supercritical parameters are also produced in Russia. For example, a steam turbine installation To-800-240-5 (Fig. 2), manufactured at the Leningrad Metal Plant. This PTU has the following initial steam parameters: pressure 23,5 MPa and temperature 540 °C. The values of the fresh steam of this turbine are supercritical.

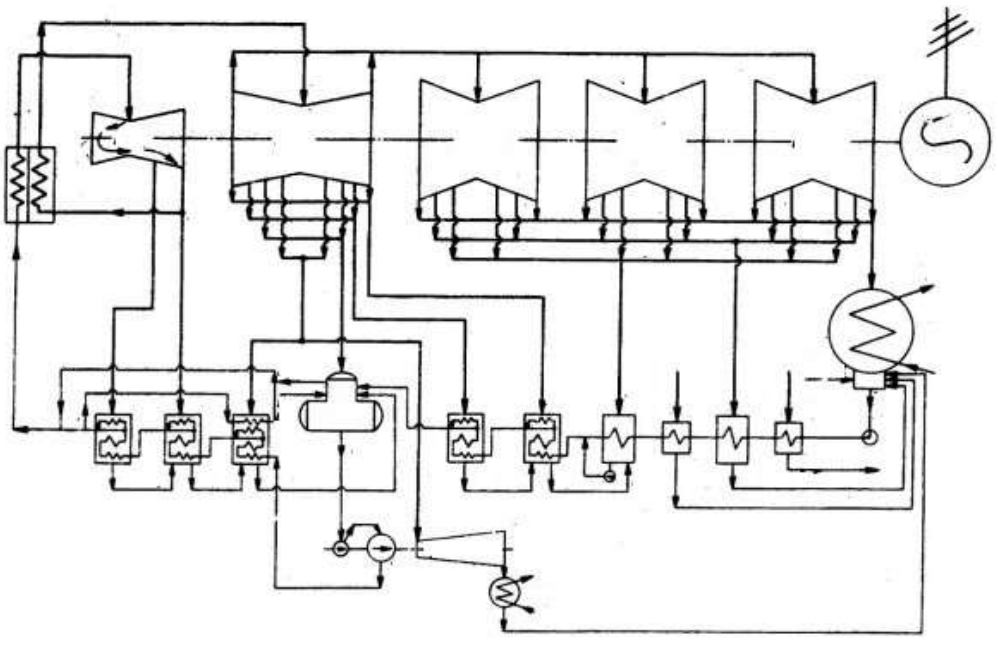

Figure 2. Schematic thermal diagram of a turbine installation To-800-240-5

Not only LMZ produces steam turbine units operating at supercritical parameters. Some installations of the turbo-engine plant also have in their catalog technical equipment, which, we can say, work on supercritical steam parameters. Such installations as T-250/300-240-3 and T-260/300-240 operate on these parameters of fresh steam: pressure – 23,5 MPa, temperature – 540 °C. Turbines have the same design, differ only in power.

If stations with such vocational schools are more efficient, why haven't we completely switched to these installations yet? Special conditions are required, under which long-term operation of the steam turbine unit on supercritical and super-supercritical steam parameters is possible. Since the parameters are high, the materials must correspond to them. Special high-pressure fittings must be used: gate valves, check valves, rotary disc valves [3]. Fittings will also be needed in the feed water systems of high-pressure steam boilers, the supply and removal of steam from medium and low-pressure turbines, the supply of steam from medium and low-pressure turbines, a condensate cleaning system. Each of these systems consists of several subsystems, which also need special equipment. The fittings must be made of non-rusting carbon, chromium-molybdenum and stainless steels of such grades as: 10X2M, 10X2M1Au others, which are designed for operation at high temperatures.

There is another engineering and design problem. At the present time, it is formally accepted to believe that for high speeds of steam flows, fittings of large passages are necessary. In this regard, customers often set the condition for the valve “full passage”, while in the design of the valve it is necessary to take into account the limitations on the output speed of steam. Currently, this problem can be solved by special calculations, with the help of which it is possible to accurately calculate the picture of exit velocities [2].

In conclusion, we can say that this type of steam turbine installations has a great future, as it already allows to increase the efficiency of thermal power plants. Some countries with huge coal reserves are already building stations on supercritical and super-supercritical parameters [4]. With the development of metallurgy and environmental cleaning technologies, this type of power plants will open up with increasing potential.

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УДК 502

SEQUESTRATION OF CARBON DIOXIDE (CO_2) IN THE ATMOSPHERE IS ONE OF THE WAYS TO OPPOSE GLOBAL WARMING OF THE EARTH'S CLIMATE

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Abstract. Reducing and stabilizing carbon dioxide (CO_2) emissions is the main task for the world community in the fight against climate change and its negative consequences. The article presents the main measures to mitigate the effects of climate change, taking into account the reduction of carbon dioxide emissions, as well as sequestration (capture and storage from the atmosphere) of carbon.

Keywords: global warming, carbon sequestration, greenhouse gas, bio coal, ecosystem, biomass.

СЕКВЕСТРАЦИЯ ДИОКСИДА УГЛЕРОДА (CO_2) В АТМОСФЕРЕ – ОДИН ИЗ СПОСОБОВ ПРОТИВОДЕЙСТВИЯ ГЛОБАЛЬНОМУ ПОТЕПЛЕНИЮ КЛИМАТА ЗЕМЛИ

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Аннотация. Сокращение и стабилизация эмиссий углекислого газа (CO_2) является основной задачей для мировой общественности в борьбе с изменением климата и его отрицательными последствиями. В статье представлены основные меры по смягчению последствий изменения климата с учетом уменьшения выбросов углекислого газа, а также секвестрация (улавливание и хранение из атмосферы) углерода.

Ключевые слова: глобальное потепление, секвестрация углерода, парниковый газ, биоуголь, экосистема, биомасса.

Global warming of the Earth's climate is a real threat to the human existence. At the same time, it is human activity that makes the main "contribution", exhausting the reserves of ecosystem restoration. The development of industry, mining, deforestation, overpopulation of the planet, the formation of landfills – all this contributes to the release of large amounts of greenhouse gases, which, in turn, leads to an increase in the temperature of the planet's surface.

Many world communities, political and public organizations are actively participated in the elaboration, coordination and adoption of international climate agreements. Reducing and stabilizing CO_2 emissions is one of the priorities for the world community. The main role in combating climate change and its negative consequences should be played by industrialized countries and countries with economies in transition. They account for the largest share of anthropogenic greenhouse gas emissions. Carbon dioxide is the most significant long-lived greenhouse gas in the Earth's atmosphere. The main measures to mitigate the effects of climate change can be confidently called the reduction of carbon dioxide emissions through the development of the following projects:

1. Search for alternative energy sources.
2. Reduction of CO_2 emissions, subject to the improvement of existing production facilities and transport.
3. Planting trees.
4. Extraction of carbon dioxide from the Earth's atmosphere.

Carbon capture and storage or sequestration is one of the approaches that can be used to neutralize the increasing amount of CO_2 emissions. Carbon capture and storage or sequestration is one of the approaches that can be used to neutralize the increasing amount of CO_2 emissions. These technologies are actively evolving in more than 30 countries around the world (more than 300 projects for CO2 capture and disposal), and relate to various sectors of the national economy, however, this issue is practically not covered in the domestic literature, which makes this study certainly relevant [1, p. 1781].

In world practice, there are the following basic concepts of CO_2 capture: post-combustion, pre-combustion, and oxy-combustion.

Post-combustion processes separate CO_2 from burning exhaust gases. CO_2 can be captured using a liquid solvent, such as an aqueous solution of amine. When absorbed by a liquid solvent and then heated, CO_2 is released, forming a

clean stream. This technology is used to capture CO_2, but on a relatively small scale in the food and beverage industry.

Pre-combustion processes convert fuel into a gaseous mixture of hydrogen (H_2) and carbon (CO_2). The hydrogen is then separated and can be burned without the formation of CO_2 in the exhaust gases. The remaining CO_2 can be compressed for transportation. The pressure and concentration of CO_2 in post-combustion processes are relatively high, which facilitates the achievement of separation and opens up opportunities for the use of new capture technologies, such as membranes (a material that is selectively permeable to one or more chemical species and therefore can be used to separate this species from the gas stream) [2, p. 462]. The stages of fuel conversion required for pre-combustion are more complex than the processes associated with subsequent combustion. This makes the technology more difficult to use in existing power plants. Pre-combustion capture is used in industrial processes, but has not been demonstrated in much larger coal gasification concepts.

In oxygen fuel combustion processes, oxygen, not air, is used to burn fuel. This leads to the formation of exhaust gases, which are mainly water vapor and CO_2, which are easily separated to produce a clean CO_2 stream. Oxygen fuel combustion systems are being developed on a small scale, in laboratory or pilot projects. This process can be applied to existing power plants. These processes mostly capture carbon emissions from power plants, factories, oil and gas complex enterprises, etc. Then there is the stage of CO_2 disposal – injection into deep salt formations, into developed oil and gas fields and into undeveloped coal seams. [2, p. 464] (salt-bearing formations – having in their composition a significant amount of various salts that are in certain ratios with each other and their accompanying carbonate, less often volcanic rocks).

Scientists at the Humboldt University of Berlin are also engaged in the study of carbon dioxide control mechanisms [3].

Researchers at the University of Southampton (England) have proposed a method of “mineralization” of carbon dioxide and its removal from the atmosphere using basalt rocks in Iceland, which actually instantly absorbs CO_2 and turns it into carbonates [4, p. 1312].

Bio sequestration or carbon sequestration through biological processes also affect the global carbon cycle. In many works it is noted that an increase in the concentration of carbon dioxide and an increase in the air temperature in the atmosphere can influence an increase in the biomass content of plants [5, p. 14].

The largest biomass is represented in forest ecosystems. Temperate forests and rainforests cover twice as much land area as boreal forests, but boreal forests contain 20 % more carbon than the other two combined. Soil, swamps,

peatlands in boreal forests are also significant carbon sinks in the world [6, p. 13].

According to the results of research over the past 15 years, carbon absorption by the biomass of boreal forests in Russia significantly exceeds its losses associated with forest fires and logging, as well as other negative phenomena. These statistical estimates confirm that the boreal forests of Russia remain an ecological donor of our planet and play an important role in mitigating climate change [7, p. 107].

Another very important aspect of carbon dioxide sequestration is the contribution of biofuels. Bio coal or biochar is coal produced artificially from biomass or any other organic matter. In the process of carbonation, practically all the carbon of organic biomass is converted into bio-coal. Wood contains up to 50 % carbon (an absolutely dry substance), which, when carbonized, turns into a bio-coal, capable of being in the environment for several thousand years without noticeable decomposition. Thus, carbon dioxide absorbed as a result of photosynthesis is converted first into plant tissue, and then into biocarbon. Such a sequence of transformations provides a real possibility of removing carbon dioxide from the atmosphere. The main advantage of bio-coal is the fact of its greater biological safety as a fuel and an increase in the stability of CO_2.

There are still many issues in the study of CO_2 sequestration, quantitative characteristics of the interaction of biochar with other greenhouse gases have not been determined, despite the active research activities of scientists around the world. In the future, it can be assumed that large-scale projects will appear that have important environmental and social significance in this direction.

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ТЕОРИЯ И ПРАКТИКА СОВРЕМЕННОЙ НАУКИ: ВЗГЛЯД МОЛОДЕЖИ
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