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UDK 628.1

The Use of Needle Corona Electrodes to Increase the Efficiency of Industrial Electrostatic Precipitators

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Abstract. The purpose of the study is to discuss the possibilities of practical increase in the performance of electrostatic precipitators through the use of needle corona electrodes and, accordingly, an increase in the degree of inhomogeneity of the electric field. This makes it possible to increase the corona discharge current density and the maximum values of the electric field strength without the danger of complete breakdown of the gas discharge gap. This method of intensifying the operation of electrostatic precipitators is quite simple and reliable, does not require large investments, and can be used for upgrading serial electrostatic precipitators.

In order to identify the main factors affecting the efficiency of gas purification in electrostatic precipitators, the paper considers the mechanism of dust particle movement in the active zone of the electrostatic precipitator (Fig. 1).

The aerosol particle moves in the gas stream along the electrodes (along the field) with an average velocity of V_g. When injected into the active zone of the electrostatic particle charging, and it begins to operate the electric field created between the corona electrode 1 and the receiving electrode 2 or 3. Under the influence of an electric field, a charged particle moves at an average speed of W_t to the receiving electrode 2 or 3. It is clear that for the deposition of particles it is necessary that during its movement the gas flow t_g within the height of the electrodes H, the particle had definitely time to move under the action of electric power at the desired distance from the zone of deposition, i.e. to the electrodes 2 or 3. Therefore, a necessary condition for the deposition of particles in the electrostatic precipitator can be recorded as

$$\frac{h}{W_t} \leq \frac{H}{V_g}.$$

(1)

Due to the increase in the productivity of technological units and the volume of treated gases, it is difficult to ensure a low gas velocity V_g in electric filters. In this regard, in order to increase the efficiency of electric dust and gas cleaning devices, both in domestic and foreign practice, the
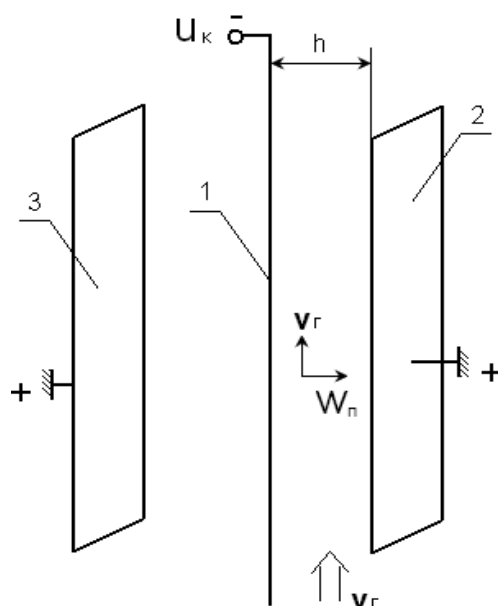
Fig. 1. Electrostatic precipitator operation diagram: 1 – corona electrode (thin wire); 2, 3 – precipitation electrodes (planes); V_g – gas flow velocity; W_t – the particle transfer rate to the precipitation electrodes, in most electrostatic precipitators it is equal to the particle velocity W_e under the action of electric field forces, i.e. $W_t = W_e$

height of the electrodes H is often increased to 15 m [1]. This approach is based on preserving the value of the right-hand side of inequality (1), i.e., when the gas velocity V_g increases, it is necessary proportionately to increase the height of the electrodes H proportionally. However, an increase in the height of the electrodes leads to an even greater increase in the size, weight and metal content of the electrostatic precipitators.

While maintaining the basic dimensions H and h, the efficiency of the electrostatic precipitator ultimately depends on the ratio of the particle deposition rate W_t by the electric field to the gas flow rate V_g. A decrease in the ratio W_t/V_g caused by an increase in the flow rate V_g leads to a sharp decrease in the efficiency of gas purification. Therefore, it is possible to maintain high efficiency of dust and gas cleaning with an increase in the gas flow velocity V_g by increasing particle deposition (transfer) rate W_t in the core of the device (Fig. 1). This enables to increase the performance of the electrostatic precipitator without compromising the degree of purification.

Taking into account the dependence of the particle charge on the electric field strength, i.e., $q = f(E)$ for particles larger than 1 μm, the particle deposition rate [1]:

$$W_e = 2 \, E^2 \, r \, õ \, \text{Є}_0 \, / \, 3μ, \tag{2}$$

where E is electric field strength; r is particle radius; μ is dynamic coefficient of air viscosity; $\text{Є}_0 = 8.85 \times 10^{-12}$ F/m is dielectric constant; õ is indicator of the dielectric properties of the particle; it is determined by the formula given in [1]:

$$õ = 1 + 2(\text{Є} - 1)/(\text{Є} - 2), \tag{3}$$

where Є is the relative permittivity of the particle.

The speed of a particle motion under the action of electric field forces is not constant and
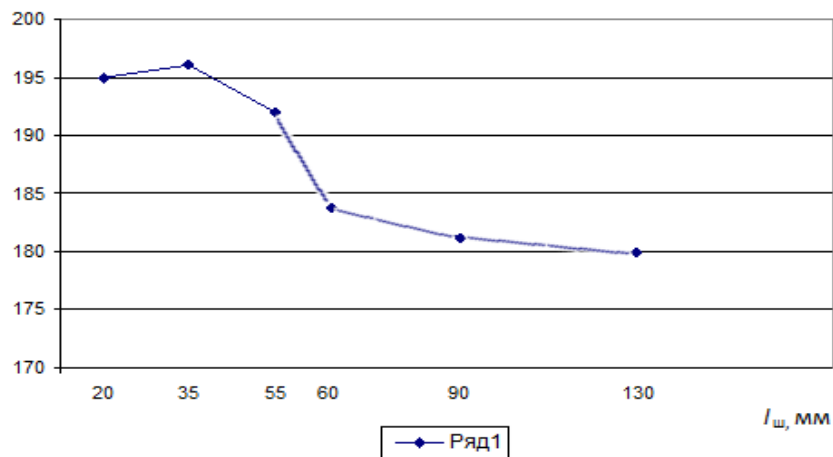
Fig. 2. Dependence of the average breakdown voltage on the pitch between the needles for an electrode wire with needles located at a certain distance
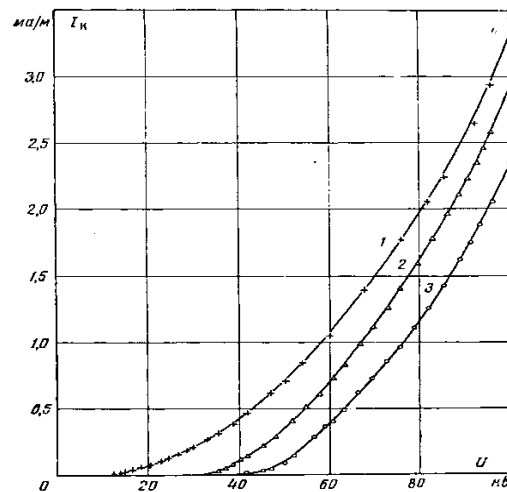
Fig. 3. Volt-ampere characteristics of corona discharge for different types of corona electrodes: 1 – wire with needles located with a pitch of 20 mm; 2 – cylindrical wire with a diameter of 2 mm; 3 – electrode bayonet section 4 × 4 mm

depends on the particle coordinate, since initially the particle charge changes from zero to q_{max} and the particle's acceleration will change in proportion to the charge q. When the maximum charge q_{max} is obtained, the acceleration of the particle will be constant, i.e. its motion will become equidistant.

As can be seen from formula (2), the deposition rate of a particle under the action of electric forces is directly proportional to the square of the electric field strength in the electrostatic precipitator; therefore, to increase the deposition rate, it is advisable to increase the electric field strength in the working area of the electrostatic precipitator. But it is impossible to simply increase the voltage U at the electrodes and, consequently, the values of the field strength of the electrostatic precipitator, because of the danger of a complete breakdown of the air gap and the transition of the corona discharge into the arc. In the case of using "a series of wires between planes" electrode system, the most widely used in modern dust and gas cleaning

devices, the maximum values of breakdown voltages and breakdown field strength are achieved by using thin corona wires with a diameter of 3 mm or less [2]. Consequently, there are no opportunities for field amplification in traditional design electrostatic precipitators. An increase in the breakdown voltage can be achieved only if the degree of inhomogeneity of the electric field increases, and for this it is necessary to use needle corona electrodes. For industrial electrostatic precipitators, it is recommended to use "a series of wires with needles between the planes' electrode system. With such a design of the electrode system, the task arises of establishing the optimal dimensions of the corona electrodes and, above all, the distance (step) between the needles [3].

The studies conducted by the author of the research are consistent with the data given in [2] and indicate that with a small distance (step) between the needles, up to a certain value, increased values of the breakdown voltage and, accordingly, the breakdown voltage are observed. With a step exceeding a certain value, a sharp decrease in breakdown stresses is observed. Fig. 2 shows the dependence of the average breakdown voltage on the step between the needles for "a row of wires with needles between planes" electrode system with an interelectrode distance of 10 cm and a needle height of 10 mm. Significantly lower values of the breakdown voltage are observed at a step of more than 50 mm and, in this case, it is already approaching the values of breakdown voltages for systems with a "row of wires between planes" electrode of industrial electrostatic precipitators. Therefore, to intensify the dust collection process, it is advisable to use electrodes with a needle spacing of 20 to 40 mm for an electrostatic precipitator with the above parameters.

In [2], comparative studies of the volt-ampere characteristics of the experimental electrode "wire with needles installed with a 20 mm pitch" with characteristics for a thin cylindrical wire (2 mm in diameter) and a bayonet electrode with a size of 4 × 4 mm (Fig. 3). As follows from the graphs shown, the maximum values of the initial voltage and, accordingly, the lowest discharge currents are observed for the bayonet section electrode and the minimum values of the initial voltage and, accordingly, the maximum corona discharge currents are available for the "|wire with needles installed in increments of 20 mm" electrode. The minimum values of the initial voltage and, accordingly, the highest discharge currents are observed for needle electrodes. Therefore, the optimal from this point of view is the current-voltage characteristic of the needle corona electrode, which makes it possible to increase the value of the maximum allowable supply voltage, and, accordingly, to increase the electric field strength and the current density of the corona discharge on the specific surface of the precipitation electrode.

The value of the initial voltage of the corona discharge and the associated value of the corona discharge current is very important for electric and gas cleaning [2], and the use of a needle system of electrodes allows you to increase the value of the discharge current. This is due to two main reasons, firstly, according to the data from [4], the degree of purification of the electrostatic precipitator is higher, the higher the power consumed by the corona discharge. Naturally, with the same supply voltage, this power will be the greater the higher the current consumed by the electrostatic precipitator and, accordingly, the lower the initial voltage of the corona discharge.

Secondly, when using electric filters to purify gases with a significant concentration of fine dust, such a physical phenomenon as "locking" of the corona discharge and a significant deterioration in the efficiency of electric dust and gas purification often occurs [1; 5]. With an increased discharge current, when dust of the same composition is captured and the degree of dustiness is equal, the phenomenon of corona "locking" will occur to a much lesser extent.

Thus, the area of effective use of electrostatic precipitators is expanding towards the capture of fine aerosols with significant concentrations of solid particles. The research and analysis of literature sources show that the use of needle electrodes ("series of wires with needles – a plane" and "series of wires with needles between planes" electrode systems) enables not only to increase the performance of the electric filter without reducing the degree of purification, but also expands the area of effective use of electric filters. Needle electrodes can be manufactured with a greater margin of mechanical strength than thin electrodes of the "row of wires – plane" and "row of wires between planes" systems, which ensures their greater reliability and durability during operation.

In general, this direction of intensification of the working process of electrostatic precipitators will significantly increase their efficiency, expand the scope of application and significantly reduce their main disadvantages. It is possible to modernize the electric filters already in operation by replacing the "series of wires between planes" electrode system with the "series of wires with needles between planes" system. This will not require significant investments, but it will improve the operational characteristics of electric dust and gas cleaning devices.

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Использование игольчатых коронирующих электродов с целью повышения эффективности промышленных электрофильтров

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Ключевые слова и фразы: вольтамперная характеристика; напряженность электрического поля; осаждение частиц; плотность тока коронного разряда; система электродов; степень очистки газа.

Аннотация. В данной статье рассматриваются возможности практического увеличения производительности электрофильтров за счет использования игольчатых коронирующих электродов и, соответственно, увеличения степени неоднородности электрического

поля. Это дает возможность повысить плотность тока коронного разряда и максимальные значения напряженности электрического поля без опасности полного пробоя газоразрядного промежутка. Гипотеза исследования предполагает возможность применения инновационных технологий и материалов. В работе использованы общенаучные методы исследования. Данный способ интенсификации работы электрофильтров достаточно прост и надежен, не требует больших капиталовложений и может быть использован при модернизации серийных электрофильтров.

UDK 620.165.79

Development of Test Methods for the Study of Fire Safety of LED Lighting Devices

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Key words and phrases: quality of lighting networks; test methods of LED street lights; fire and electrical safety of LED lighting.

Abstract. The purpose of this article was to develop methods for testing LED lighting devices for fire and electrical hazards, to assess the risks of negative phenomena in these products. At the same time, the task was to identify the most typical negative phenomena for the development of research methods and assess the risks of their occurrence and the spread of negative consequences. The article used the methods of bibliographic analysis of existing research and test methods for LED lighting devices. The result of the article is the development of methods and techniques for setting up a full-scale experiment.

Introduction

Currently, developments in the field of energy-efficient lighting technologies have allowed LED lighting devices to penetrate the domestic and commercial lighting market with huge growth potential. Currently, work is actively underway in the field of adopting and clarifying technical national standards to improve the safety and performance of LED lighting. It is obvious that such developments need to study risk factors from the point of view of electrical safety in order to ensure the overall safety of operation of these products, along with quality and performance control [1]. To ensure and control electrical safety, develop accident prevention technologies and identify the causes of accidents, it is necessary to have software and methodological support that takes into account the features of LED lighting equipment.

The need for such research and development based on their methods of control and testing for fire and electrical safety is also confirmed by reports and studies of specialized organizations [2]. Thus, according to the International Fund for Electrical Safety (**ESFI**) in developed countries actively implementing LED lighting technologies, 15 % of fires in 2016–2018 were caused by household or decorative lighting devices.

In the electromechanical system of an LED lighting device, the main risk factors for electrical ignition are a short circuit between power lines and/or grounding, dielectric breakdown, leakage currents, voltage surges, weakened contact connections, etc. [2; 3].

In addition to the risks of fire-hazardous situations, there is a possibility of harmful effects of the internal components of the electromechanical system of the LED lighting device.

To determine the significance of the possibility of such factors, there is a need for research and analysis of the life cycle of LED lighting products. Thus, a joint study of the toxic potential of LEDs from South Korean and American researchers showed that the potential toxicity of harmful materials in the electromechanical system of an LED lighting device such as arsenic or lead is 3 times higher than that of similar lamps of another type [4]. Additional temperature exposure to these materials may increase the likelihood of its harmful effects, which indicates the need for additional research in this area.

Methodology of testing for electrical fire hazard of an LED lighting device

Aggressive environmental conditions of street lighting devices have a significant impact on the occurrence of negative fire and electrical hazards in artificial lighting networks. In order to prevent the occurrence of these phenomena caused by aggressive environmental effects, the design, production, construction and maintenance of lighting networks should be carried out in accordance with relevant standards and standards [4]. However, for the effective execution of processes to reduce the occurrence of fire and electrical hazards, it is necessary to conduct experimental modeling to identify weaknesses of these devices, for which it is advisable to develop new and improve existing methods for testing for fire and electrical safety of these products.

Conducting research on the fire hazard of an outdoor LED lighting device as a result of insulation breakdown between the lines of a DC converter

Fig. 1 shows a variant of testing the wire in the DC circuit of the converter for the risk of fire due to breakdown of the insulation between the wires of the LED street lamp. For testing, it is necessary to provide a small space for depressurization of the housing to open the inner part of the conductor by peeling off the coating. Then, with the help of a contaminating liquid representing an aqueous solution of NaCl (2 %), a uniform drip mechanism is applied to the previously slightly damaged wire sheath. During the drip exposure, the electrical characteristics and heat release characteristics of the secondary side of the converter were measured and analyzed using an oscilloscope and infrared thermal imaging equipment. To evaluate the time of exposure to the solution before the occurrence of changes in the system.

After the breakdown of insulation occurs between the lines of the secondary side of the converter, record the time until the heating occurs and the subsequent occurrence of an electric arc. Evaluate the melting and carbonation of the coating, record the time until the coating ignites
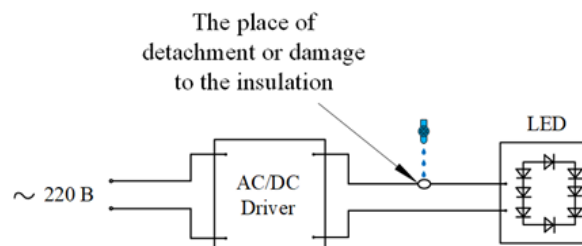
Fig. 1. Structural test scheme for conducting fire hazard studies of the DC circuit of the converter of an LED lighting device of street design
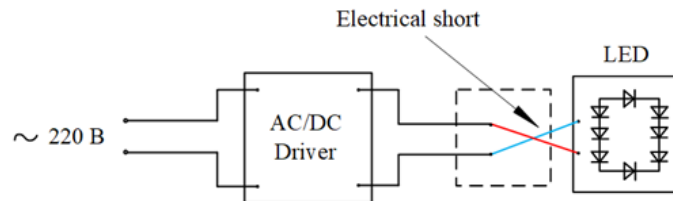
Fig. 2. Structural test scheme for conducting fire hazard studies as a result of a short circuit between the lines of a DC converter

and changes in the operation of the lighting device (brightness changes, flashing, shutdown). To record changes in heat distribution during insulation breakdown between DC circuit lines using infrared thermal imaging equipment. To fix the waveforms of voltage and current in a steady and changing state by measuring the output voltage.

After switching off the lighting device and eliminating hazards as a result of testing, fix the external shape and internal structure of the wire. The internal structure of the damaged wire should be analyzed using X-ray transmission analysis equipment.

The result of this test should be an assessment of the risk of ignition of the lighting device as a result of a violation of the insulation between the lines of the DC converter.

Conducting research on the fire hazard of an outdoor LED lighting device as a result of a short circuit between the lines of a DC converter

Fig. 2 shows the configuration of the device and the necessary condition for testing for a fire hazard of a short circuit (short circuit) between the lines in the DC circuit of an LED street lighting device.

During the experiment, the conductor of the secondary side of the converter must be in direct contact, thus causing a short circuit between the lines. At the same time, the contact time between the lines should correspond to a short (0.1 s) or long (300 s) exposure to short circuit. To carry out tests for short-term short-circuit effects, a short-circuit change and overload test device should be used.

The result of this test should be an assessment of the risk of ignition of the lighting device as a result of the occurrence of a short circuit between the lines of the DC converter.

Conducting research on the fire hazard of an outdoor LED lighting device as a result of the occurrence of abnormal voltage

In this experiment, it is necessary to analyze the performance characteristics of an LED lighting device depending on the occurrence of abnormal voltage. As an experimental abnormal voltage, an overvoltage of 380 V should be applied to the primary winding of the converter instead of 220 V AC by using a voltage regulator. To record the process of burning out of the lighting device and the inside of the converter. Record changes in the brightness of light sources and other changes in the process of burning out the lighting device. Pay attention to the possible occurrence of unusual sounds, crackling, the appearance of an electric arc. At the end of the experiment, analyze the inside of the converter, pay attention to possible damage to the varistor and capacitors.

Conclusion

To ensure and control fire and electrical safety in artificial street lighting networks, it is necessary to develop methods for predicting the occurrence of the described phenomena in the electromechanical system of LED lighting equipment. The development of the described methods of factor analysis and risk assessment makes it possible to manage the processes of reducing negative phenomena in these lighting networks and lighting devices, to take into account the mechanisms of the occurrence of an accident according to the described factors. In the future, according to these methods, it is planned to conduct a number of experiments in accordance with the described recommendations. It is expected that these techniques will be useful for assessing the level of risks and conducting research to improve the electrical safety of LED lamps for outdoor lighting.

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Разработка методик проведения испытаний на исследование пожаробезопасности светодиодных осветительных приборов

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Ключевые слова и фразы: качество сетей освещения; методики испытаний светодиодных уличных фонарей; пожарная и электробезопасность светодиодного освещения.

Аннотация. Целью данной статьи являлась разработка методик проведения испытаний светодиодных осветительных приборов на предмет пожарной и электрической опасности для оценки рисков возникновения негативных явлений в данных изделиях. Вместе с тем задачей являлось выявление наиболее характерных негативных явлений для разработки методик проведения исследований и оценки рисков их возникновения и распространения негативных последствий. В статье использовались методы библиографического анализа существующих исследований и методик испытаний светодиодных осветительных приборов. Результатом статьи является разработка методов и методик постановки натурного эксперимента.

UDK 69:658

A Fuzzy Inference System
for Assessing the Need for Major Repairs
and Reconstruction Based on the Potential
of Organizational-Technological Solutions

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Key words and phrases: major repairs, reconstruction, public buildings, organizational-technological solutions, integral potential, planning, fuzzy inference, term-sets, rules, membership functions.

Abstract. The article describes a system of fuzzy inference to assess the need for major repairs and reconstruction based on the potential of organizational-technological solutions. Basically, studies aimed at evaluating the potential use additive convolution of the transformation of factors affecting the integral potential. In this paper, it is proposed to use a fuzzy inference system for its calculation. This is justified by the fact that almost all assessments of the technical condition of the building are formulated in such vague concepts as: "pre-emergency", "normal", "unsatisfactory", etc. The assessment of the quality of major repairs is also evaluated in the form of vague concepts such as "satisfactory", "unsatisfactory". Tthis situation is the case for almost all factors that influence decision-making on the assessment of the need to include a building in the capital repair and reconstruction plan. For the practical use of the fuzzy inference system, a universal technique is proposed that allows forming a system of linguistic variables, then forming a term-sets of its values in the form of fuzzy concepts. After that, the issues of constructing membership functions for all values of linguistic variables are considered. The last stages of the methodology are the selection of the fuzzy inference method, its parameterization, followed by modeling and obtaining the results of an integral potential assessment to assess the need to include a public building in the major repairs and reconstruction plan.

Introduction

To date, the Town Planning Code of the Russian Federation (clause 14, article 1) [3] clearly

defines the concepts of reconstruction and overhaul. Thus, the reconstruction may affect the change in the parameters of the building (number of storeys, height, area, and so on, while during the overhaul, the restoration or replacement of building structures is carried out, with the exception of load-bearing structures.

These definitions apply to any objects, including public buildings [11; 12]. In other words, reconstruction involves making changes to buildings and structures: changing the number of storeys, changing sizes, replacing building structures, landscaping adjacent territories, and overhaul – provides for the restoration of the original characteristics of the object without changing its technical and economic indicators: replacement of equipment, laying of new engineering networks, insulation, redevelopment and others [2; 4].

At the same time, many factors influence the decision-making on determining the need for major repairs and reconstruction, namely [8; 9; 19; 21; 24]:

– development plan of the land plot (**DPLP**);

– technical conditions for all objects;

– developed and approved territorial planning documents;

– a qualification structure, including specialists with work experience and an appropriate level of qualification;

– use of modern equipment with high accuracy of all operations and productivity;

– and many others.

However, if we consider the wording of the assessment of indicators, such as the physical deterioration of the building, obsolescence, technical condition, and others, then we can note a fairly free form of the description of the state (Table 1), where such terms as "satisfactory", "defects are practically absent" appear.

The presented extended scale of physical wear and tear is based on the assessment of the technical condition (3), for which the corresponding abbreviation (2) is chosen. An estimate of the cost of the repair (4) can be made for the relevant item. In this case, the selected values of the interval assessment (1) correspond to the percentage of wear and tear of the building and are adjusted in accordance with the Harrington scale.

In this regard, for a formalized presentation of expert data on the evaluation of overhaul and reconstruction works, the dissertation also proposes to use the apparatus of fuzzy sets.

Table 1. Qualitative descriptive indicators of physical deterioration of buildings

1	2	3
0–20	Normal	There are practically no deformations or damages. There are some minor defects that are eliminated by current repairs. They practically do not affect the performance of the building
20–37	Satisfactory	The damage and defects can be eliminated by strengthening structures and repairs. All structural elements are suitable for operation
37–63	unsatisfactory	The stability and performance of the building is broken. Restoration or replacement of load-bearing structures (overhaul) is required
63–80	Pre-emergency	The building is not functional. The state of the main load-bearing elements is pre-emergency
80–100	Emergency	Bearing elements are not recoverable. The building is to be demolished

Materials and methods

In the most general case, a fuzzy set is determined based on the use of a function that is similar to the indicator for ordinary sets, and is a membership function [1; 5; 15]. To build membership functions (MFs), it is proposed to use the method of hierarchies, which assumes that the universal set X consists of n elements, and the expert's judgment regarding the x_i values accepted by the phenomenon A may turn out to be non-transitive. As a result, the construction uses the method of pairwise comparison of membership degrees $\varphi_i = \mu_A(x_i)$ of the element x_i in a fuzzy set *X*.

In addition, the desirability function can be used to describe the membership function. One of the most used forms is the Harrington desirability function [16], since it has the properties of monotonicity, smoothness, and continuity. The Harrington scale is often used to interpret the solution of multicriteria problems, when various methods are used to form a generalized indicator, given on the basis of convolution with or without weights based on some metric (Euclid, Hölder, generalized, etc.). The generalized Harrington desirability function determines the relationship between the numerical value of a dimensionless scale and the psychological perception of the person making a decision regarding this value, expressed in fuzzy concepts of "very good", "good" (Table 2), etc. The numerical values given in the table, correspond to the points of the curve, which is given by the equation [16]: $d = exp[-exp(-y)]$.

In general, a product is a set of components:

$$(i)\text{: } Q, P, A \Rightarrow B, S, F,$$

where (*i*) specifies the name of the product, indicating the scope *Q*, and the values *P* of the core applicability. The core of the production is a fuzzy implication $A \Rightarrow B$ with condition *A* and conclusion *B* of the core. In addition, a method for estimating the truth value *S* of the core conclusion and the confidence factor *F* for each production must be determined [7].

As a result, the rule system can be written as:

1) IF the technical condition of the facility is emergency, the duration of operation is more than the norm, the engineering and transport infrastructure is present, the period of work is short and the quality of the work is excellent, THEN the need for inclusion in the plan is high;

Table 2. Harrington Desirability Scale

Desirability	Score	
Very good	1,00–0,80	
Good	0,80–0,63	
Satisfactorily	0,63–0,37	
Bad	0,37–0,20	
Very bad	0,20–0,00	

2) IF the technical condition of the facility is average, the duration of operation is normal, the engineering and transport infrastructure is partially present, the deadline for completing the work is standard and the quality is excellent, THEN the need to be included in the plan is average;

…

n) IF the technical condition of the facility is average, the duration of operation is less than the norm, the engineering and transport infrastructure is partially available, the period of work is long and the quality is satisfactory, THEN the need for inclusion in the plan is low.

Results

Based on the studies of the practical application of fuzzy sets in various applications, the article proposes a methodology for making decisions on the need for major repairs and reconstruction, which consists in the sequential implementation of a number of interrelated steps.

1. The first stage involves compiling a list of all factors, which is supposed to be used in the fuzzy inference system. For each factor, a linguistic variable should be formed that describes this factor. For a formal description of a linguistic variable, it is necessary to form: a term-set of its values; universal set, i.e. some numerical scale on which the membership functions of all its base values will be formed; a syntactic rule generating terms and term-sets and a semantic rule generating all possible membership functions of its values (terms).

This set of factors is selected based on the specific situation and stage of decision making. So, the technical condition, physical wear and tear and obsolescence are most likely to be chosen as the most significant.

2. The second stage comprises substantiation and selection of the term-set of values of each linguistic variable (determined on the basis of the established practice of assessing the technical condition), for example, Table 1, or the quality of work, when the concepts of "unsatisfactory" and others are used.

3. The third stage is the choice of a universal set of membership functions or a numerical scale, which is also made on the basis of generally accepted gradations. However, the current practice does not always take into account the aspect of the universality of the accepted scale, so the article proposes a linear transformation of generally accepted gradations to the Harrington scale.

For indicators of physical and moral depreciation, the generally accepted scale is the segment [0, 100], which represents either absolute values or a percentage. For other factors, there are also different scales. For different authors, they differ somewhat [6; 10; 14]. The paper proposes to use a single scale for all factors [0, 100], to which, in the general case, any other scale can be reduced by conventional scaling, and it corresponds to the Harrington desirability scale [0, 1] in terms of percentages [13].

It should be noted that the values of the boundaries of the intervals for physical wear (Table 1) are quite close to the boundary points of the Harrington function. Therefore, in the work, when constructing membership functions for the values of linguistic variables, it is proposed to use the categories of desirability in the Harrington scale for their interpretation.

4. The fourth stage involves the construction of membership functions for all values of linguistic variables. To build membership functions, a number of models and methods can be used (for example, scaling models) [20]. However, the very fact of constructing the membership function, the choice of its type and parameters is a rather difficult task associated with the uncertainty of the choice and the ambiguity of the solution. The complexity of assessing any

property of an object is always associated with the complexity of the object itself [22]. Often, the basis for constructing a membership function is the introduction of the concept of preference for one attribute over another. That is, the expert answers the question: "Which numerical value is more preferable for the selected value of the linguistic variable?".

5. The fifth stage is the use of abbreviations of linguistic variables and their values, the base of fuzzy inference rules is formed.

6. The sixth stage involves selecting one of the fuzzy inference system methods and its parameterization is performed. Thus in the MatLab programming system there are two methods, namely: the method of Mamdani and Sugeno [17; 18; 23].

7. The seventh stage consists in the expert evaluation of the numerical values of all input linguistic variables.

8. The eighth stage involves modelling the fuzzy inference system and calculating the value of the output linguistic variable.

9. The ninth stage is to make a decision based on the analysis of the output variables calculated on the Harrington scale:
- on the need for major repairs;
- the need for reconstruction;
- about the absence of the need for major repairs and reconstruction.

Conclusions

The use of the proposed methodology makes it possible to assess the feasibility of major repairs or reconstruction of public buildings, taking into account various factors. In addition, unlike simple logical conclusions, the proposed methodology using fuzzy inference rules allows you to get a specific numerical value of the need for major repairs and reconstruction, the opposite of the potential of organizational and technological solutions, on the basis of which you can reasonably make an appropriate decision.

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Методика нечеткого вывода для оценки необходимости проведения работ по капитальному ремонту и реконструкции на основе потенциала организационно-технологических решений

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Ключевые слова и фразы: интегральный потенциал; капитальный ремонт; нечеткий вывод; общественные здания; организационно-технологические решения; планирование; правила; реконструкция; терм-множества; функции принадлежности.

Аннотация. В статье описана методика нечеткого вывода для оценки необходимости проведения работ по капитальному ремонту и реконструкции на основе потенциала организационно-технологических решений. В основном работы, направленные на оценку потенциала, используют аддитивную свертку преобразования факторов, влияющих на интегральный потенциал. В данной работе для его расчета предлагается использовать систему нечеткого вывода. Это оправдано тем, что практически все оценки технического состояния здания формулируются в таких нечетких понятиях, как «предаварийное», «нормальное», «неудовлетворительное» и т.д. Оценка качества работ по капитальному ремонту также оценивается в форме таких нечетких понятий, как «удовлетворительно», «неудовлетворительно». И такое положение имеет место практически для всех факторов, которые влияют на принятие решений по оценке необходимости включения здания в план капитального ремонта и реконструкции. Для практического использования системы нечеткого вывода предлагается универсальная методика, позволяющая сформировать систему лингвистических переменных, затем сформировать терм-множества ее значений в виде нечетких понятий. После этого рассматриваются вопросы построения функций принадлежности для всех значений лингвистических переменных. Последними этапами методики являются выбор метода нечеткого вывода, его параметризация с последующим моделированием и получением результатов оценивания интегрального потенциала для оценки необходимости включения общественного здания в план реконструкции и капитального ремонта.

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Technology for the Construction of Energy Efficient Buildings in Hot Climates

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Key words and phrases: cold losses; energy efficient buildings; energy saving; heat losses; technological solutions.

Abstract. Energy efficiency is one of the important factors affecting economic and social growth in all countries of the world. Residential buildings account for a significant share of the world's total energy consumption. At the same time, energy efficiency directly depends on the technological solutions adopted in the development of design documentation and the thermal properties of the enclosing structures of buildings and structures. The analysis of the scientific works of Russian and foreign researchers dealing with the problem of energy conservation testifies to deep and large-scale theoretical studies carried out in this area. At the same time, all the results of research and recommendations refer to the reduction of heat loss in conditions of negative temperatures and therefore cannot be used in the design and construction of buildings in hot climates. In addition, in the course of the analysis, it was found that there is no connection between theoretical studies and the requirements of construction production. This task is to be solved through the example of the climatic conditions of Iraq, based on the country's technical and economic capabilities, labor and material resources. The article examines energy-efficient elements of building envelope; the impact of the combination of elements of the building envelope on heat and cold losses is shown; it was determined that the building envelope and its thermophysical properties are directly related to the amount of heat and cold losses. The results of the study are to identify and optimize indicators that affect the energy efficiency of buildings in hot climates. Specific values of the ratios of windows and walls in rooms are proposed; the relationship between the type of window glass and the energy consumption of the building is established. Based on the results obtained, recommendations were formulated for further research on improving the energy efficiency of buildings in hot climates. Recommended measures can be

implemented in the development of design documentation for new construction, as well as in the renovation of buildings.

Introduction

Recently, modern buildings have begun to proliferate, accompanied by a clear increase in energy consumption. Construction activities consume 38 % of the energy used worldwide every year [1], and energy is consumed at all stages of the building's life cycle [2] The standards governing thermal engineering standards continually emphasize the provision of thermal resistance requirements in all external building structures [5], the physical and structural characteristics of building components such as walls, windows, floors and doors have a large impact on energy consumption. Thermal characteristics, thickness and color of the materials used play an important role in regulating the loss and gain of heat in a building [6]. An analysis of the principles of heat loss and gain was carried out, as well as some of the methods used to reduce heat loss in order to improve the energy efficiency of buildings, conserve energy sources and reduce energy costs.

Factors affecting heat loss

Heat transfer can occur in three ways: conduction that occurs through walls, windows, ceilings and floors, convection, which is heat transfer caused by wind or air movement, and radiation, in which the heat generated by solar radiation from the sun passes through the glass into the room. Fig. 1 shows the mechanism of heat transfer in buildings [7].

In practical calculations, heat transfer inside a building material is calculated in accordance with the laws of heat conduction, and heat transfer occurs due to convection and radiation in air voids and on surfaces at the interface between indoor and outdoor air.

In any building, many factors affect the rate of heat flow from the inside of the building to the cooler air outside as the air passes through the windows, doors and through any voids in the structure, and the air exchange rate depends on two forces, namely, on the strength of the wind
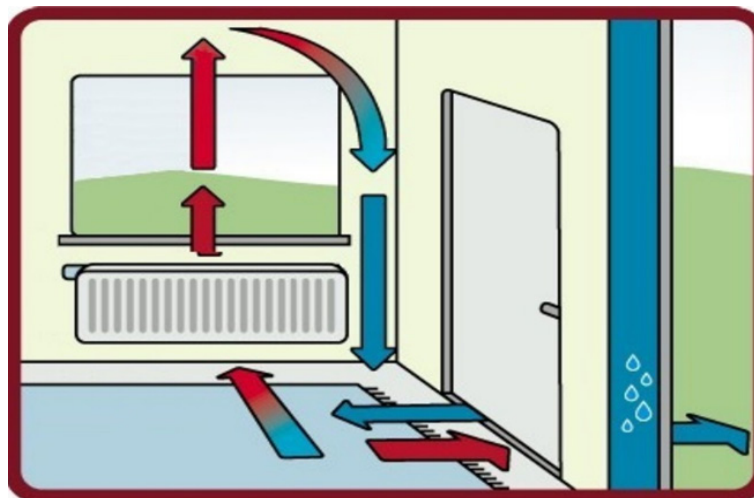

Fig. 1. Heat transfer mechanism in buildings

and the temperature difference between the room and the room.

The thermal characteristics of the building components are described below.

Exterior walls. The thermal properties of external walls are related to the building materials. The walls, which reduce heat loss and gain, are massive, well-insulated walls with a high thermal capacity. In [8], the program is used to calculate two-dimensional and three-dimensional temperature fields when determining the low resistance to heat transfer of external walls [9; 10].

Roofs. The shape, materials, gradation, direction, color of the outer surface and the insulating properties of the roof determine the thermal performance of buildings, so roofs must be designed to suit the surrounding climatic conditions [11].

Windows. Windows affect the energy efficiency of buildings through heat loss and gain, natural ventilation and lighting. The most suitable direction is the south from the point of view of obtaining energy. Large windows reduce the need for artificial lighting [12] and windows on summer days can be easily protected with blinds [13], when deciding on the degree of transparency of the building envelope, it is necessary to determine in advance the climatic zone in which the building is located [14].

Doors. The location of the external doors must be selected taking into account the effects of wind and heat.

Floor covering. The floor covering must be laid on the ground in such a way that it can fulfill the desired functions in terms of heat and humidity.

The orientation of a building affects the percentage of the building's sides for solar radiation, and the direction of buildings affects the ability to naturally ventilate and the amount of heat loss due to convection [15]. The shape of a building can be determined, which is an important factor affecting heat loss and gain, using engineering variables such as the ratio of the length of the building to its width, the height of the building, and the type and gradation of the roof.

Ways to reduce heat loss in buildings

Determination of a design solution with the lowest heat losses is a solution to the problem of construction of energy-saving buildings, since the use of modern high-quality thermal insulation materials and building materials with low heat transfer (aerated concrete, porous ceramics) can achieve high energy performance. It is not possible to recommend a solution that can provide energy efficiency for all buildings because the function, system, location and importance of a building vary from one building to the next.

Samsonova et al. compared a stone block and a wall made of aerated concrete blocks, and drew attention to the most vulnerable place in the wall – a window support, and by calculation comes to the conclusion that the heat flow of a homogeneous part of the wall from a block masonry is 1.28 times higher than that of aerated concrete wall. Regardless of climatic conditions, a buttress joint in buildings made of insulated panels is more energy efficient than the same joint in a house with aerated concrete walls [16].

Researchers have found that large amounts of energy can be saved in buildings constructed with low insulation levels by retrofitting these buildings, and have come up with the following results [17]:

• providing a 50 mm thick insulation layer at the roof level will reduce the U-value of the roof and reduce heat loss by about 9 GJ;

• insulating the wall cavity will reduce the U-value of the outer wall and heat loss by about 17 GJ;

• the use of double glazing throughout the house will reduce heat loss by no more

than 7 GJ.

Ozdemir concluded that the technical performance of thermal insulation depends on the climatic conditions of the region, in wet and dry areas and in cold areas, well insulated stepped surfaces should be detailed, while in hot and dry climates, flat surfaces should be chosen to reduce the impact solar radiation, and the position of the outer doors should be selected taking into account the effects of wind and wind. Achieve the required performance for insulated floors to be detailed in cold and temperate climates and above ground floors in warm and humid climates as airflow becomes important [18].

Vinnichenko made a decision to raise energy efficiency of buildings on the introduction of window blocks made of wood, from PVC sheet windows, reinforced with multilayer double-glazed windows, an experimental assessment of the changes in the thermal properties of the outer walls was carried out after the installation of new windows with new blocks by means of a thermal survey. According to the study, thermal insulation placed at the junction between the window block and the wall is an important element for eliminating heat loss and maintaining a constant room temperature [5].

Laustsen found that HVAC systems significantly affect energy consumption in buildings and define the relationship between building specifications and HVAC systems as follows: High-performance building insulators reduce the need for heating and cooling systems, well-designed buildings can reduce the need for HVAC systems and increase the efficiency of HVAC systems can lead to significant savings, for example if the efficiency of air conditioning systems improves, the total savings will depend on the total cooling requirement, and I recommend dividing the building into thermal zones. appropriately sized, which reduces the need for heating, cooling and ventilation. Through careful construction planning [19].

AL-HOMUD has conducted research to improve the design parameters of buildings in order to reduce annual energy consumption, and it was noted that the proportion of windows is preferable to 15 %, except in cold climates, where more space is required for glass in order to use solar energy for heating [20].

Young et al. Constructed a simulation model and analyzed it using the Dest simulation toolkit to evaluate the optimal window-to-wall ratio and the best glass type. The results increase energy consumption when the percentage of windows increases, and that energy efficient glass is more energy efficient than hollow glass. It can be concluded that the percentage of windows depends on three factors: the style of the air conditioning system, the direction of the outer windows and the type of glass, and these factors must be considered when designing residential buildings [21].

Research results

The figure shows the dependence of the heat loss coefficient from the window pillar on climatic conditions and the external design of buildings.

The effect of window-to-wall ratio on annual heat demand, annual cooling energy demand and total energy consumption has been shown. For windows facing east and west, compared to windows facing south and north, but windows facing east or west must be carefully designed, that is, the area of the windows should not be reduced by ventilation and natural light.

We also note that the total energy consumption varies depending on the type of glass used for the windows, since low emissivity glass is more energy efficient than hollow glass, which means that we must reduce the percentage of windows when using hollow glass.

Based on the previous discussion, the specific value of the window to wall ratio and the
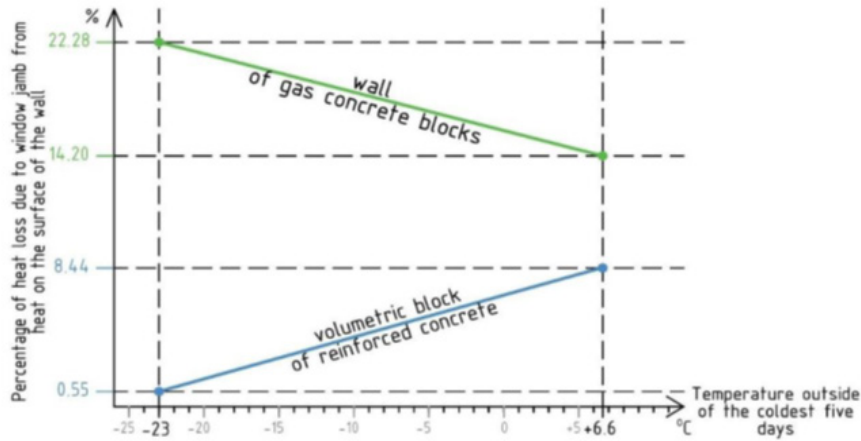
Fig. 2. The percentage of heat loss varies depending on climatic conditions and the design of the external structure of the facility
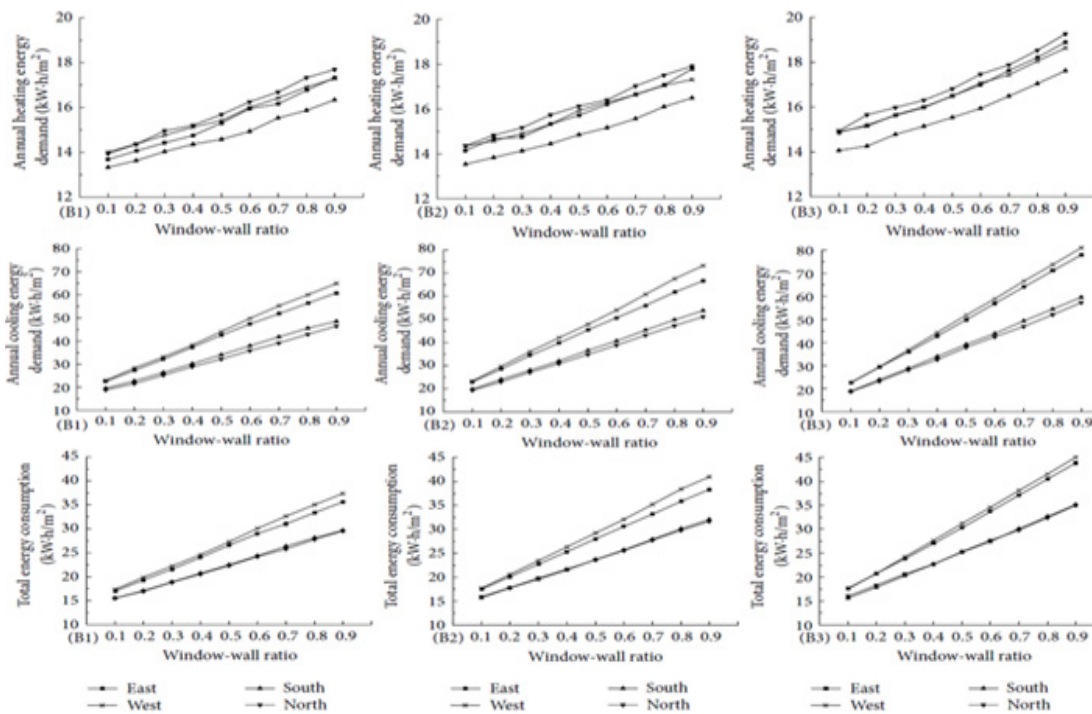
Fig. 3. The relationship between window-to-wall ratio and energy consumption when using hollow glass

effect of using low energy glass has been proposed, which will play an important role in the design of external windows, Figure 5 shows the specific value of the ratio of external windows in different directions and compare the impact of low-emissivity glass on energy efficiency.

The problem of energy saving testifies to deep and large-scale theoretical studies carried out in this area. At the same time, all the results of research and recommendations refer to the reduction of heat loss in conditions of negative temperatures, and therefore cannot be used in the design and construction of buildings in hot climates. In addition, in the course of the analysis,
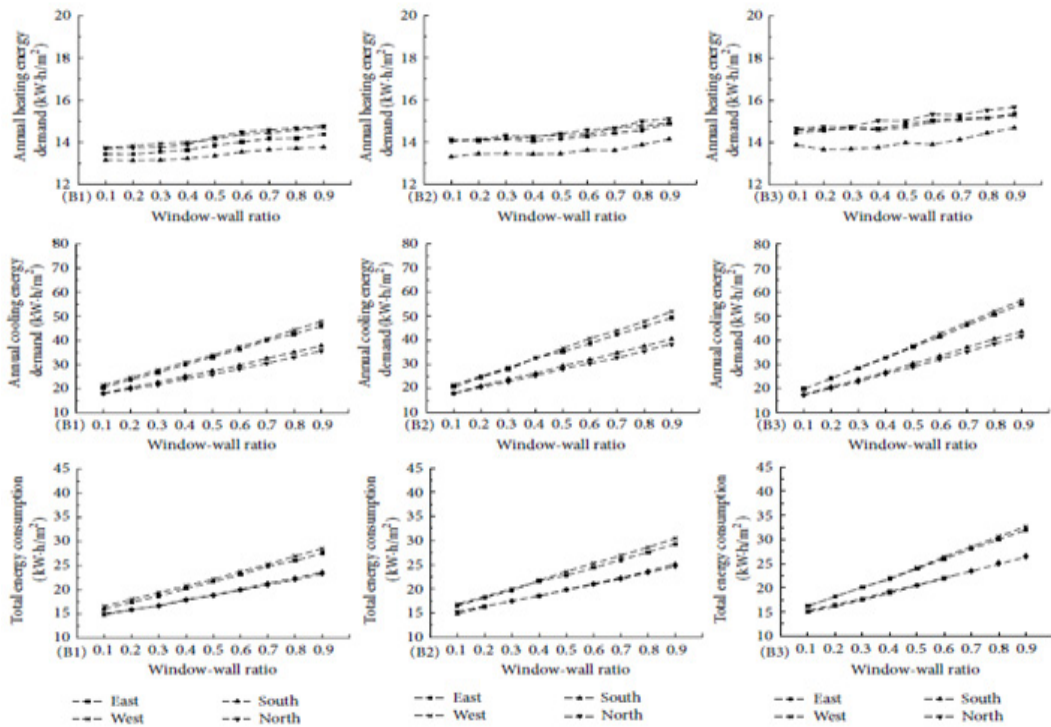
Fig. 4. The relationship between window-to-wall ratio and energy consumption using low-emissivity glass
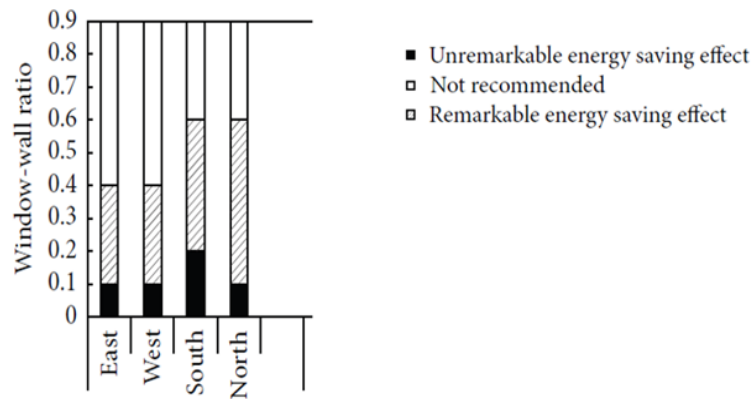
Fig. 5. Proposed window-to-wall ratio range and comparison of the impact of low-emissivity glass on energy efficiency in different directions

it was found that there is no connection between theoretical studies and the requirements of construction production. This task is to be solved by the example of climatic conditions Iraq, based on the technical and economic possibilities available in the country. Research into new forms and methods of technology for the construction of energy-efficient buildings should be carried out taking into account the availability of labor and material resources in the country. In the process of research, it is necessary to improve the regulatory framework, the operational planning system, design the construction of a group of houses of the same type energy efficient buildings in hot climates.

Conclusions and recommendations

• The building envelope and its thermal properties are directly related to the amount of heat loss in buildings.

• It was found that most apartments suffer from heat loss through doors and windows, which increases the heating load.

• Wall, ceiling and floor construction should be appropriate for the local climate to ensure the required indoor temperature in the building and reduce heating and cooling energy consumption.

• Compliance with thermal insulation laws and codes and ensuring that all buildings apply the required insulation standards to reduce heating energy consumption.

• Designers and engineers should incorporate natural ventilation strategies in their designs to reduce the need for cooling energy.

• These measures can be implemented early in the design stages or during building renovations or during operation and housing, so that they lead to savings in energy consumption, improved energy standards and thermal efficiency.

In the process of further research, it is necessary to improve the regulatory framework, design the construction of a group of houses of the same type by flow methods. The solution of the listed tasks should form the basis for research into the technology of erecting energy-efficient buildings in hot climates.

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Технология возведения энергоэффективных зданий в условиях жаркого климата

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Ключевые слова и фразы: теплопотери; технологические решения; хладопотери; энергосбережение; энергоэффективные здания.

Аннотация. Эффективность использования энергии является одним из важных факторов, влияющих на экономический и социальный рост во всех странах мира. На жилые здания приходится значительная доля от общего объема мирового потребления энергии. При этом энергоэффективность напрямую зависит от принятых при разработке проектной документации технологических решений и теплотехнических свойств ограждающих конструкций зданий и сооружений.

Анализ научных трудов российских и зарубежных ученых, занимавшихся проблемой энергосбережения, свидетельствует о глубоких и масштабных теоретических исследова-

ниях, проведенных в данной области. При этом все результаты исследований и рекомендаций относятся к снижению теплопотерь в условиях отрицательных температур и поэтому не могут быть использованы при проектировании и строительстве зданий в условиях жаркого климата.

Кроме того, в ходе проведенного анализа установлено отсутствие связи между теоретическими исследованиями и требованиями строительного производства. Данную задачу предстоит решить на примере климатических условий Ирака, исходя из имеющихся в стране технических и экономических возможностей, трудовых и материальных ресурсов.

В статье исследованы энергоэффективные элементы ограждающих конструкций зданий; показано влияние сочетания элементов ограждающих конструкций здания на тепло- и хладопотери; определено, что оболочка здания и ее теплофизические свойства напрямую связаны с количеством тепло- и хладопотерь.

Результаты проведенного исследования заключаются в определении и оптимизации показателей, влияющих на энергоэффективность зданий в условиях жаркого климата. Предложены конкретные значения соотношений окон и стен в помещениях, установлена зависимость между типом оконных стекол и энергопотреблением здания. На основе полученных результатов сформулированы рекомендации для дальнейших исследований по повышению энергоэффективности зданий в жарком климате. Рекомендуемые меры могут быть реализованы при разработке проектной документации нового строительства, а также при проведении ремонта зданий.

UDK 339

Rationale for Product Differentiation in In-House Budgeting at an Enterprise

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Key words and phrases: budget process; in-house budgeting; product life cycle; BCG matrix; marketing research; planning.

Abstract. The objectives of the research were to substantiate the differentiation of goods at the enterprise through the use of marketing theories in order to apply various approaches in the organization of in-house budgeting. In the course of the study, the scientific hypothesis about the advisability of differentiating goods when organizing intra-firm budgeting at an enterprise is confirmed. When identifying individual patterns, marketing research methods, quantitative and qualitative research methods and economic analysis were used. The results of the study made it possible to substantiate the need for differentiation of goods when organizing intra-firm budgeting at an enterprise.

Introduction

The relevance of the selected research topic is due to the fact that at the present stage, the effective work of most enterprises is largely predetermined by its competitive advantages in the market. At the same time, the market conditions of business dictate the need to interact with existing competitors on the market, on the one hand, and on the other hand, the expediency of a more rational use of all external resources and internal factors.

In this case, budgeting is an important aspect of increasing the efficiency of production and financial activities of an enterprise and allows you to optimize the entire system of using various resources. In diversified enterprises producing several types of products, which are relatively independent sources of profit, each type of product (business) must have its own budget. Ensuring effective management is possible only with a correct assessment of the performance results in each area [5]. One type of product (business) should not live off another. Although, based on the life cycle of each individual type of product, this is possible. Marketing theory assumes that any product on the market lives its life, which includes four main stages: launch or birth, growth, maturity and decline. Thus, if an enterprise is diversified, then each individual product may be at different stages of its development. When planning and budgeting, it is advisable to take this into account, since even pricing issues in this case will be resolved in a

rather peculiar way. And the system of intra-firm budgeting and its profitable production largely depend on the market price of a product.

Methods and materials

The life cycle of each individual type of product allows you to develop a promising development and budgeting strategy for it. A simple and convenient tool for comparing different strategies and alternatives is the matrix that was proposed by the Boston Advisory Group (**BCG**). In order to determine the prospects for the development of each individual type of product and the enterprise as a whole, BCG proposes to concentrate all goods produced at the enterprise in four main groups, based on the growth rate, volume of demand and the relative share of the product in the market. At the same time, the growth in the volume of demand sets the vertical size of the matrix, and the horizontal size corresponds to the ratio of the market share that belongs to its leading competitor [1].

The products located in the first square are called "dogs", since the market share of these products is minimal and there is a low growth rate over the years of research. Thus, these are goods with a limited sales volume, i.e. goods that have not yet won a wide range of consumers over a long period of production. The strategy for further budgeting of such goods, as a rule, boils down to their elimination or an attempt to penetrate special markets.

The field of the square "difficult children" includes goods on the one hand with a small share in the market, but on the other hand, there is an increased demand for these categories of goods. The budgeting strategy for such goods should provide for a significant investment of financial resources in terms of increasing production, since the goods have a significant demand in the market and in the future can move to the group of "stars", giving significant profit from sales in the future. Thus, at the expense of the profit received from the sale of goods belonging to the category of "stars", it is advisable to finance the development of goods from the category of "difficult children".

The goods that are in the field of "stars" occupy a leading position in the enterprise in terms of getting the maximum profit from their sale. They require a significant amount of resources to finance continued growth and tight management oversight of those resources. This strategy aims to increase or maintain market share by maintaining product differentiation in an increasingly competitive environment. If the pace of development of the industry slows down, then the "stars" move into the status of goods "cash cows".

The final square contains goods that are classified as "cash cows". Such products occupy a leading position in an enterprise in a relatively stable or shrinking industry. Due to the stability of sales of products, funds for maintaining market share are required much less than the enterprise makes a profit. However, it should be noted that this type of product is gradually leaving the market and requires replacement. In the future, such goods will be removed from production and, in terms of budgeting, do not require significant financial investments. Thus, based on the marketing strategy and the BCG matrix, each type of goods produced at the enterprise should have its own pricing and budgeting strategy [2].

Consequently, if the product is new and the demand for it in the market is just being formed, then it is advisable to stimulate the rapid growth of this demand on the basis of an active pricing policy. In this variant, you can choose a strategy of temporary understatement of prices.

When the product has reached its maturity and the demand for it in the market has already formed, then it is possible to stimulate the growth of sales volume only through skillful maneuvering of prices, somewhat overstating them, in order to obtain maximum profit for the

enterprise.

Moreover, if a product begins to age and the demand for it decreases, then it is advisable to extend the life of the product due to a sharp decline in prices.

When a product begins to "die", since newer products have pushed it out of the market, it is advisable to remove it from production, sharply reduce prices in order to get rid of the last leftovers and compensate for at least part of the costs incurred [4].

Results and discussion

It should be noted that the planning system at domestic enterprises had a number of significant shortcomings: the planning system was divorced from product sales; changes in prices for resources used in the production process were not predicted [3]; a costly mechanism prevailed in planning; the cost of production was not calculated per unit of product sold; the need of the enterprise for financial resources was not determined. These shortcomings can be eliminated only with the introduction of an intra-firm budgeting system at the enterprise.

At the same time, the budget represents an operational financial plan for a short-term period of time, usually up to one year, which reflects expenditures and receipts of funds [1]. This is the main planning document that is communicated to the responsibility centers of all types. Thus, the development of planned budgets in an enterprise is characterized by the term budgeting. The budgeting system, as a rule, is aimed at solving two main tasks: determining the volume and composition of financial expenses that are associated with the activities of individual divisions of the enterprise; ensuring that all expenses are covered with financial resources from various sources.

The very process of budgeting in the enterprise is continuous or rolling. Taking into account the planned financial indicators established for the year, a system of quarterly budgets is being developed, and within the framework of quarterly budgets – a system of monthly budgets [2]. The process of such rolling budgeting guarantees the continuity of the operation of the operational planning system for the financial activities of the enterprise, lays a solid foundation for the implementation of continuous monitoring of the results of these activities.

Conclusions

The introduction of a system of in-house budgeting at each specific enterprise will enable:
– to make more realistic forecasts of financial and economic activities;
– to identify timely the bottlenecks in enterprise management using multivariate analysis tools;
– to predict the economic consequences in time for possible deviations from the planned plan using financial models and make an effective management decision;
– to coordinate the work of on-farm structural divisions and services to achieve the set mission;
– to improve manageability by promptly tracking deviations of the fact from the plan and timely decision-making.

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Обоснование дифференциации товаров
с целью организации внутрифирменного бюджетирования на предприятии

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Ключевые слова и фразы: бюджетный процесс; внутрифирменное бюджетирование; жизненный цикл товара; маркетинговые исследования; матрица БКГ; планирование.

Аннотация. Целью научного исследования явилось обоснование дифференциации товаров на предприятии путем использования маркетинговых теорий для применения различных подходов при организации внутрифирменного бюджетирования. В процессе исследования подтверждается научная гипотеза о целесообразности дифференциации товаров при организации внутрифирменного бюджетирования на предприятии. При выявлении отдельных закономерностей применялись методы маркетингового исследования, количественные и качественные методы исследования и экономический анализ. Результаты исследования позволили обосновать необходимость дифференциации товаров при организации внутрифирменного бюджетирования на предприятии.

The Analysis of the Stages of the Formation of an Integrated, Automated Risk-Oriented QMS of an Industrial Enterprise Using the Example of OJSC "Magnitogorsk Metallurgical Plant"

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Key words and phrases: risks; risk management; quality management system; processes; risk-based thinking; digitalization of processes.

Abstract. The article discusses the analysis of the stages of development of an integrated, digital, based on the risk-oriented approach of the QMS of an industrial enterprise on the example of OJSC "Magnitogorsk Metallurgical Plant". The purpose of this study is to analyze the methods used by OJSC "Magnitogorsk Metallurgical Plant" in the digitalization of processes and the possibility of using these tools by other Russian enterprises. The main result of the study is the substantiation of the exceptional importance of digitalization of all stages of a modern enterprise and the impossibility of creating a risk-oriented QMS system without it. Research methods: method of analysis, synthesis, generalization, systematization.

The experience of introducing a risk management system as an essential element of the quality management system of an industrial enterprise using the example of the MCC Group (OJSC Magnitogorsk Iron and Steel Works, OJSC MMK) is informative for studying from the point of view of not only the methodology and principles of work, but the results achieved.

The table compiled by the authors summarizes the company's experience [1–3] in creating and implementing an integrated risk management system, which is based on the continuous development and improvement of the company QMS and an integrated risk management system as an integral part of it.

In 2018, the audit conducted by the auditors of the international certification body TUV NORD CERT included a simultaneous audit of 12 MMK Group enterprises for compliance with the requirements of ISO 9001: 2015, as a result of which certificates of conformity were confirmed in accordance with IATF 16949 and OHSAS 18001, ISO 9001, ISO 14001 and "the use of the elements of risk management formed within the framework of the comprehensive risk management system existing in the MMK Group was highly appreciated". The "high qualifications, competence and involvement of the personnel" were especially noted [4].

At present, risk management is integrated into all business processes of the MMK Group:

Table 1. Stages and procedure of creating integrated risk management system

Stage	Insurance	Comprehensive risk management system	Integration of the risk management system with current and strategic activities throughout all management levels	Digitalization
Period	1998	from 2003	from 2010	from 2016 – until now
Risk identification	Determination of risks when concluding insurance contracts	Identification of risks based on the creation of a risk map for the main business processes, taking into account possible losses	Risk identification is assigned to the deputy heads of departments (formerly ordinary employees)	Risks are identified in accordance with the goals of business processes and are recorded in the risk panels of business processes, the most significant are reflected in the risk map of the MMK Group. Specialized software for assessing and identifying risks is implemented
Assessment methods	Expert methods with the involvement of insurance companies	Development and documentation of qualitative and quantitative assessment methods using scenario analysis methods, VAR, stress testing, Monte Carlo	Since 2008, quantitative risk assessment has been improved – comparison of the risks and the cost of measures to reduce them. The budgeting system based on risk management and revision of the current QMS of production departments has been introduced	All identified risks are assessed in terms of their possible quantitative and qualitative impact on the business, as well as the likelihood of their occurrence, and are ranked according to the degree of significance
Management methods	Insurance of property risks, liability risks, personal. Elimination of the consequences of the occurrence of risk events	Documenting. Monitoring. Internal control. Setting risk limits. Carrying out preventive measures and plans to minimize the consequences	Creation of a working risk management system with a high level of integration of risk management procedures, while the role of the responsible person is to coordinate the departments and ensure their joint work	Identification and assessment of risks of current activities and individual projects and initiatives; development of measures to reduce risks; monitoring the implementation of risks; informing management about potential and actual risks
Organizational structure and risk management	The presence of a structural unit for risk management as part of the Finance Directorate	The presence of a structural unit for risk management as part of the Directorate for Strategic Planning and Property. Development and implementation of a risk management standard that provides for responsibility in the implementation of all management stages of at all management levels	Operational control is carried out by the risk management division. The Management Board and the Board of Directors review and approve the corporate governance risk reports. Committee of the Board of Directors for Strategic Planning and Corporate Governance considers and prepares recommendations to the Board of Directors on the approval of the risk report. The board of directors approves the risk report and the risk management policy	The functions, duties and responsibilities of the participants in the risk management system are regulated by internal regulatory documents, built in accordance with ISO 31000, the Code of Corporate Governance, COSO ERM 2017. The Board of Directors monitors the functioning of the system, analyzes the effectiveness of risk management and, if necessary, makes recommendations for improvement

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Table 1. Stages and procedure of creating integrated risk management system *(continue)*

Stage	Insurance	Comprehensive risk management system	Integration of the risk management system with current and strategic activities throughout all management levels	Digitalization
Period	1998	from 2003	from 2010	from 2016 – until now
Risk management culture		Development, approval and publication of the Risk Management Policy. Communicating the principles and principles of risk management to each employee, the formation of decision-making, taking into account the identification and assessment of risks	A new version of the OJSC MMK's Risk Management Policy (2011) was developed and approved by the Board of Directors of OJSC MMK. The main risks were identified and assessed (completion of work on consolidation of risks of the companies of the OJSC MMK Group and the formation of a risk map of the OJSC MMK Group. Internal control, internal audit, business process and risk management systems in 2014 were merged into a single Department of Internal Control, Audit, Risk Management and Business Processes	The Risk Management Group was created, the tasks of which include: development and development of methodology, formation of consolidated reporting on risks, organization of training for employees, consulting, methodological support and coordination of activities of departments within the framework of risk management. A methodological guide has been developed for training in the procedures for identifying and assessing risks, developing and monitoring the implementation of measures to reduce risks for those managers and deputy heads of structural divisions who are authorized to deal with the risks of business processes. A unified standard for MMK Group has been developed that regulates general rules and approaches, the procedure for interaction between the Group's organizations and the procedure for control in terms of risk management

risk identification, analysis and management are carried out at all levels and incorporated into the processes of making managerial, investment and operational decisions. Risk-based thinking aimed at preventing unwanted consequences allows the MMK Group to achieve its goals and integrate the MMK Group's risk management system with the strategy, goal and vision; roles are defined for each of the management bodies and divisions.

Currently, the digitalization strategy of the MMK Group is actively developing, according to forecasts made by analysts of the MMK Group and the international company Deloitte – the effect of digitalization will be more than $ 160 million by 2025 and will bring an additional economic effect in the amount of 4.5 % of EBITDA [6].

The risk management system integrated with the QMS at the MKK group has a lot of advantages. Analysts of the MKK group can see not only all the results of the work and the difficulties that arise immediately when they appear, but can also predict the onset of a risk

situation when they detect small deviations in the processes that practically do not affect the process at the initial stage. It should be emphasized that not a single digital product will become a tool that increases the efficiency of an company QMS if it "works autonomously" within one department or even a computer, therefore, when organizing the digitalization process, it is necessary to focus not on the number of implemented digital products, but also on their integration into the company QMS.

Within the framework of the Industry 4.0 concept implemented at the enterprise, which includes the implementation of RPA technologies (Robotic Process Automation), a comprehensive digitalization of business processes is being carried out;) and allowing to optimize the consumption of ferroalloys and additional materials in steelmaking, which annually saves the company about $4 million, or a project to create an optimization model of blast furnace production, the economic effect of implementation is $14.3 million annually.

An important area of digitalization at MMK Group has become the development of RPA software robots, which allow automating a number of routine processes. We launched a robot for collecting and organizing quotes for raw materials in 2020: it collects data from various sources into a single report on various groups of raw materials. In the commercial department of the company, a robot is successfully functioning, which is responsible for interaction with suppliers of scrap metal. It processes e-mail, independently searches through Russian Railways databases and generates reports for the company's specialized services. In 2020, more than 100 business processes have been automated and software is used in almost all areas of the MMK Group's activities: finance (use of the electronic platform Kontur. Factoring, both as a buyer and a supplier), procurement, accounting (use of electronic document management , as a priority in transactions, refusal of paperwork during 2021 [5]), marketing, work with personnel, logistics (automation of data exchange between the site and the company, setting up work via API, automation of confirmation of deliveries in subsidiaries) [6].

In 2020, the total investments of MMK Group in digitalization and research and development (**R&D**), rationalization activities amounted to about $ 4.1 million. Most of the investments are made in production functions and the main business of the company.

One of the key vectors of innovative development of the MCC Group is the digitalization of all areas of activity and the use of economically viable technologies Big Data, VR/AR, 3D printing, robotization of processes and production. To solve the issues of operational management of production in all production shops of the plant, fully functional MES systems have been introduced, which provide personnel with information and tools for analyzing production, technological, financial and economic chains. On the basis of MES, such large-scale projects have been implemented as the creation of a corporate dispatching and production management system, the creation of a corporate storage of technological data, a technology and quality management system, a planning system for financial, economic and production activities of an enterprise.

For the main participants in business processes, the system is a tool for automating repair programs that helps to reduce MRO costs, improve the safety and availability of equipment to perform its production function, and increase labor productivity. The "Mobile MRO" Application, implemented on the basis of Oracle EAM, provides transparency of the process of performing work by service and repair teams. The application implements the functions of issuing tasks, marking their completion, fixing detected defects and parameters of the equipment state. The use of radio frequency identification (**RFID**) tags allows you to control the execution of operations in the area where the equipment is located, and photographic recording enables to monitor the quality of work and improve discipline.

Digitalization in the field of interaction with clients includes the following projects.

"Mobile Seller Assistant". The "Mobile Seller Assistant" application enables to speed up the process of concluding a deal. It is designed to optimize the negotiation process by providing the customer online with clear and quick answers to questions about production capabilities, delivery times, and pricing conditions.

"IClient". The "iClient" mobile application is necessary to create a single information space between the customer and the Company, where the customer is fully informed about the status of the order. Buyers, using the mobile application, receive operational and complete information online.

The downside of high digitalization of processes will always be the risk of fraud on the part of third parties. MMK Group's risk management takes into account the possibility and consequences of actions with signs of fraud. The main factors of this risk are:

• the ability to make decisions that lead to economic damage due to the lack of correct regulation of business processes and control procedures in the regulatory documents;

• non-compliance by the employees of the company with job descriptions;

• inconsistency of the top-level information security requirements with emerging threats.

The experience of the MMK Group clearly shows that it is impossible to create a risk-oriented QMS of a modern enterprise without digitalization of all aspects of company activities. Only a quantifiable assessment of the results of all aspects of company activities, predictive analytics built through the involvement of all employees, makes it possible to transfer a risk-oriented approach from the category of theoretical reflections of involved experts to a daily working tool for assessing the risks of decision-making at all stages of the company performance.

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Анализ этапов формирования комплексной, автоматизированной, основанной на рискоориентированном подходе СМК промышленного предприятия на примере ОАО «Магнитогорский металлургический комбинат»

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Ключевые слова и фразы: процессы; риски; риск-менеджмент; риск-ориентированное мышление; система менеджмента качества; СМК; цифровизация процессов.

Аннотация. В статье рассмотрены этапы развития комплексной, цифровой, основанной на риск-ориентированном подходе системы менеджмента качества промышленного предприятия на примере ОАО «МКК». Целью данного исследования является анализ методов, используемых ОАО «МКК» при цифровизации процессов, и возможность применения этих инструментов другими российскими предприятиями. Основным результатом исследования является обоснование исключительной важности цифровизации всех этапов деятельности современного предприятия и невозможности создания риск-ориентрованной системы СМК без нее. Методы исследования: метод анализа, синтеза, обобщения, систематизации.

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Innovations in Tourism and Hospitality through Modern Information Systems and Blockchain Technologies

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Key words and phrases: innovation; digitalization; blockchain; automation; tourism; hospitality.

Abstract. The transformations that have taken place in the global economy in recent decades have significantly changed the tourism industry. The article discusses innovative tools in the field of tourism and hospitality based on modern information systems and blockchain technologies. The process of digitalization and globalization is considered, the competitive advantages of service personalization are outlined, and the prospects for the introduction of innovative forms of influence on consumer attitudes are assessed.

Introduction

Currently, the tourism industry is highly profitable and promising. In the world, this industry accounts for about 15 % of world gross income, 12 % of total world exports and 25–30 % of world trade in services.

Innovation now refers to a set of nationwide scientific, managerial, economic and commercial activities leading to innovation. In this case, it is important to understand that such an activity can be called innovative only if new knowledge, technologies, experience, techniques and methods are introduced into it to obtain a positive result, which is widely in demand in society. It is possible to define and designate the innovative activity of the enterprise as the cooperative work of all workers aimed at creating and introducing various kinds of innovations. Innovation activities are of a joint (systemic) nature, which forms the environment and subjects of innovative technologies.

Innovations in tourism can be called systemic events that have high-quality novelty, leading to positive changes in the industry. The innovation process is recognized through the tourism market and the degree of customer satisfaction and, mainly, through the adoption of joint decisions by tourist organizations and government bodies at different levels.

The purpose of the research is to explore innovative tools in the field of tourism and hospitality, identify the most promising areas of innovation. Assess the prospects for the introduction and further development of digital systems in the field of tourism and hospitality.

The research hypothesis is based on the assumption that currently there are a large number of promising information technologies, the competent use of which repeatedly improves the quality of services in the field of tourism and hospitality

Methods and materials

The following factors directly affect the introduction of innovations in tourism: the economic situation in the country, the social situation of the population, national legislation, as well as intergovernmental and international agreements. Therefore, the following reasons for innovation can be identified:

- supersaturation of a large number of classical directions;
- risk of losing significant market share in inbound tourism;
- increased competition and supply;
- expanding the field of application of information technologies, technological revolution;
- transition from supply-side economy to demand-side economy;
- finding and implementing a new product marketplace.

According to the World Trade Organization (**WTO**), in the tourism industry, innovation is developing in the following three areas.

1. Introduction of innovations related to the development of the enterprise and tourism business in the management system and structure, including reorganization, consolidation, takeover of competitors; personnel policy (personnel renewal, training); sound economic and financial activities (introduction of modern forms of accounting).

2. Marketing innovations can reach the needs of target consumers and attract the segment of customers that is not covered at a given time.

3. Periodic innovations are aimed at changing the consumer properties of a tourist product, its positioning on the market as an exclusive, which imply an increase in competitive advantages.

Global digitalization, which arose due to the fourth industrial revolution, gradually leads to fundamental changes in all spheres of social and economic life of society. One of the first consequences of the impact of global digitalization was felt by the tourism sector, as it is an information-rich industry that tries to quickly respond to all changes. The impact of digitalization on the field of tourism and hospitality is manifested both in terms of the introduction of digital technologies into the business processes of enterprises in the tourism industry, and by changing the traveler himself. The latest digital technologies, acting as a ground for digitalization of tourism activities, include:

- Big Data technology, blockchain;
- artificial intelligence;
- Internet of Things – IoT and IIoT – Industrial Internet of Things;
- mobile devices and more.

Recognition technologies are used to provide access to the room by scanning the retina and/or fingerprints, which provides additional amenities for the guest and improves the safety of staying in the hotel, uses such Marriott China technology. Thanks to this technology, it is possible to improve the quality of customer service by personalizing services, for example, NEC technology.

Results and discussion

Currently, one of the main competitive advantages of the tourism and hospitality business is considered the personalization of services, which cannot be achieved without digital technologies. To recognize the wishes and needs of the client, it is necessary to collect, process and structure a huge personal database related to his previous experience of traveling, staying in the hotel and others. This will help to form a virtual image of a tourist, using an artificial intelligence system to simulate his needs and using chat bots to provide remote consulting services. The advantage of servicing customers with artificial intelligence systems is the speed and accuracy of providing information to a tourist or guest. Artificial intelligence can quickly and accurately process information and offer various options for solving the issue. An example is the use of such systems in Hilton hotels to provide guests with a variety of tourist information that is personally selected.

One of the most promising digital technologies is big data processing Big Data, blockchain. This technology is already widely used in the tourism industry:

• to collect and monitor information on the movement of luggage between airports and airlines;

• to identify passengers by scanning fingerprints or retina;

• to arrange payment for various services, including electronic currency.

The main innovation in the field of electronic management is such Internet technologies, in which the responsible hotel employee personally completes the request for the web server, where he can get information about the requested hotel on the network.

The improvement and distribution of the management system process in the future will definitely lead to the fact that in the future there will be more such integrated systems for various hotels. In addition, it will be possible to use the services of paid subscription to new SAAS technologies (software as a service). It is assumed that seasonal hotels will become the main circle of consumers in order to be able to receive the necessary services at a convenient time for seasonal work.

In the face of ever-increasing competition, hotels need to look in real time for different ways to increase their attractiveness and availability of their services. The development of innovative distribution technologies in electronic booking systems, adjusted with hotel management systems and allowing online management of reservations through many sales channels, has made global changes in this area.

Having analyzed how hotel technologies are implemented, it is possible to identify the presence of technological gaps, the need for technological changes in the direction of integrated automation and the need to modernize and automate new technological innovations through the development of a technological standard for various accommodation facilities. Technology transfer implies the presence of components such as material, person and law. The human factor has a huge impact on the development and implementation of such technologies: the psychology of perception and the level of qualification of the working class of employees. The component of law determines the possibility of creating social and technological norms of introducing the possibility of creating social and technological standards of introducing modern hotel technologies.

1. Interactive TV Systems: in addition to the content, the systems consist of services that help various users to be aware of hotel offers, but also staff to know about the guest's preferences, for example, which films the guest ordered, what food and drinks he prefers, ordering them using the room service.

2. WiFi: this technology provides fast and wireless Internet access.

3. Energy Management System: this technology will allow the hotel to reduce costs by 30 %. The temperature in each room can be controlled through a central computer. Climate management in the room will improve the environmental environment.

4. Connectivity Panel: thanks to the technology, the client can connect its own device. A consumer can connect their laptop to a TV through an HDMI wire or listen to music from their smartphone through TV speakers or simple speakers.

5. RFID (Radio Frequency Identification): this is a door lock with radio frequency identification. If the client has a phone, then he will be able to get into the room and other rooms. Such technology is becoming very popular in most developed countries.

There is also a large selection of computer systems for use inside the hotel as an automated control system. Developers of modern management products can independently adapt their brainchild to any hotel.

The availability of technical safety equipment in the modern hotel is also a prerequisite for its successful operation. If the manager provides security guarantees, this is an indicator of a certain quality of service, a factor in attracting customers and the possibility of gaining their positive loyalty in the future.

The use of modern technologies in hotel services is an integral part of the development of the hotel business in a competitive environment. Modern technologies allow you to maintain a high level of service, expand the range of services provided in the hotel complex, improve the management system, strengthen control over the work of staff, as well as ensure a high level of security for guests.

One of the brightest recent innovations in tour operator activities is considered the "living price". Prices for tourist products are determined not by a subjective human factor, but by objective market laws. The "live price" is directly addressed to the consumer without intermediaries immediately at the time of his request. Such an innovation is characterized by the fact that tourists will be able to independently choose a tour, reducing their expenses to a minimum. It is a dynamic price list on the tour operator's website, any client can use it without even leaving home. Thanks to the operation of such a system, the company's turnover and the number of daily bookings can be doubled at least. The information of this system immediately gets to the consumer, avoiding intermediaries, commercial and aviation departments, which makes it the most relevant at the moment.

Conclusion

Thus, the main directions of innovative activities in tourism and hospitality were considered. The base of information technologies that are available for integration in the field of tourism and hospitality is growing rapidly and provides increasingly advanced tools. In the face of ever-increasing competition, business needs to look in real time for various ways to increase the attractiveness and accessibility of its services. The development of innovative distribution technologies and electronic systems soon can make global changes in the area under study.

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Инновации в туризме и гостеприимстве на основе современных информационных систем, блокчейн технологий

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Ключевые слова и фразы: автоматизация; блокчейн; гостеприимство; инновации; туризм; цифровизация.

Аннотация. Трансформации, произошедшие в мировой экономике в последние десятилетия, существенно изменили туристскую инфраструктуру. В статье рассматриваются инновационные инструменты в сфере туризма и гостеприимства, основанные на современных информационных системах и блокчейн-технологиях. Рассмотрен процесс цифровизации и глобализации, обозначены конкурентные преимущества персонализации обслуживания, оценены перспективы внедрения инновационных форм воздействия на потребительское отношение.

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Innovative Methods of Promotion Based on Loyalty Programs in the Space Tourism Industry

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Key words and phrases: innovation; promotion; strategy; loyalty program; clients; space tourism.

Abstract. The development of space tourism is a promising activity in the realities of the modern economic system. The article considers the problem of the development of space tourism in the Russian Federation and ways to overcome it through the effective use of innovative ways of promotion. In particular, the optimal method of increasing the attractiveness of tourist services based on the loyalty program is analyzed. It is concluded that the space tourism industry in the Russian Federation has a high potential for commercialization, if innovative promotion tools, including loyalty programs are used.

Introduction

Today, space tourism is a promising area of commercialization space activities, which is actively developing and definitely relevant. The space tourism market is one of the fastest growing. Today it is filled by no more than 15 %, in the next three years experts predict its growth by 10–20 %. An additional interest of entrepreneurs is the active state support for this industry. The main problem of space tourism is low lighting and a high price of services. Therefore, an important aspect of the success of a travel company that deals with space tourism is competent marketing activities, which should include advanced ways of promoting.

The paper aims to analyze innovative ways to promote tourism services in the space tourism industry. Identify future development prospects and consider current marketing strategies.

Materials and methods

In the realities of the modern economy, tourism organizations use various methods of promotion. At this stage of the development of space tourism, during the growing competition, various innovative methods of managing customer preferences are actively used. One of the

most promising methods is the loyalty program. Loyalty is the location of customers to a certain product and desire to buy the product again. Customer loyalty is one of the most important trading advantages of tourism activities.

An effective loyalty program means a marketing device with which it is possible to optimize the relationship of a travel company that provides a tourist product with customers.

Loyalty includes interactions that are based on long-term relationships and are associated with repeated circulation and a decision to regularly consume this or another tourist product from a certain supplier.

Often used loyalty programs in the tourism sector of space tourism can be divided into three types.

The first type is your own bonus program; it can also be funded; it is also called a local bonus program. It is the bonus points that the customer receives for the purchase of tourist products and other additional travel services of this company. By accumulating points in the future, it is possible to exchange them for a certain prize or award.

In most cases, the following procedure applies to the customer bonus card:
- for the purchase of a tourist product;
- if he brought a friend for the company;
- for full feedback on the company's website or comment on social networks.

The second type is a discount program. This is a discount program where customers receive fixed discounts during the purchase of travel products. It is important to note that the usual discount program offers only a one-time promotion for buyers.

There are also long-term discount programs, which are mainly part of loyalty programs and are used in the long term. The program is based on discount cards that have a validity period of up to several years. In order to receive a discount, it is necessary to indicate its number when booking a tourist product or present it to the manager. The discount range is mainly from 2 to 7 %.

The third type is a partner loyalty program. Or discount, and also it is called a coalition loyalty program. When the buyer or client is the owner of the discount card of the travel company and can receive a reward from several partner companies, possibly from other areas of activity.

Also, holders of bonus cards of other organizations can receive a discount when paying for travel products at a travel company, even if they are not regular customers, and only for the first time turned to its use.

Partners of the company include fitness clubs, restaurants, beauty salons, shops, and others. As a rule, this loyalty program is used in the largest tourism organizations.

Results and discussion

One of the examples of an original and effective promotion tool is the project loyalty program – Spacetrack, which aims to develop space tourism in the Russian Federation under the government support.

The program is several levels of loyalty: Neptune, Uranus, Saturn, Jupiter. The names are successfully linked to the direction of the tourist activity and help create a certain level of customer engagement. Each level implies a guaranteed discount on the purchase of services and goods of the company. Depending on the level of loyalty, the company offers bonuses in the form of additional services: hotel room selection, extended premium insurance, welcome drink, individual gift in the hotel room, space food set and more. In this example, the loyalty level is determined by the total customer cost of the additional service package.

Thus Spacetrack naturally combines several basic types of loyalty programs and together with a well-selected design effectively promotes its services.

Consumer loyalty is the result of the offer of market values by the company. In order to create and maintain the loyalty of the company, it is necessary to develop a strategy of loyal customers for sales and profits. Strategically, consumer loyalty plays a key role in the company, as well as demonstrates the company's ability to innovate. The management of consumer relations in retrospect was based on the activity of only the sales manager and his assistants, and the sales plans were commercially classified. After stabilizing consumer planning, strategic management moves to a mutual process of partnership development: at this stage, consumers are invited to cooperate.

Today, loyalty programs have a significant drawback, which is expressed in non-optimized costs. Often loyalty programs include an unreasonably large list of additional services, many of which are not key to benefiting the customer.

With the development of information technologies, in particular, it is worth mentioning the direction – automation based on machine learning, it becomes possible to reduce costs without reducing the effectiveness of the loyalty program. To do this, it is appropriate to use the method of segmentation and fine-tuning of the stock mechanics for a specific group of customers. You can automate the creation of target stocks using predictive analytics in combination with machine learning technology. Predictive analytics identifies patterns in purchasing behavior and predicts them based on past data. Thanks to machine learning, the system can handle huge amounts of data. The largest tasks are becoming realized, for example, in the space tourism industry it becomes possible to form an individual list of recommendations for services for each client.

According to forecasts, in the next 15–20 years, space tourism will become a leader in the tourism industry and in the new conditions, the use of effective promotion tools, based on machine learning, will become a mandatory component of a successful business.

Conclusion

Space tourism is undoubtedly a promising area of activity, but in modern realities, in order to achieve entire business indicators, it is necessary to use effective promotion tools and a competent marketing strategy. One of the most interesting tools today is the loyalty program.

Loyalty is a partnership, trust, reputation on the part of consumers, personal self-orientation relationships and adequate recommendations to other customers. This is how win-win is formed – a partnership strategy.

Customer loyalty is usually determined by several criteria:
- satisfaction level;
- intention to repeat the purchase;
- the consumer intention to buy another product (purchase a service) from this company;
- consumer intention to "switch" to a competitor;
- consumer intention to recommend this company to other consumers.

The loyalty program is an ideal tool for collecting the right information about customers in a certain amount. A well-designed customer database with detailed and relevant information about them is a real strategic weapon that can have a great impact on the success and development of the company in the future.

The strategy should be well thought out and developed. The self-described "incentive program" says that the main motive behind these programs is to repeatedly provide customers with benefits.

It should be borne in mind that modern tools in promotion work most effectively in conjunction with an information system based on machine learning, which helps to minimize the cost of promotion.

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Инновационные методы продвижения в индустрии космического туризма на основе программ лояльности

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Ключевые слова и фразы: инновации; клиенты; космический туризм; программа лояльности; продвижение; стратегия.

Аннотация. Развитие космического туризма является перспективным видом деятельности в реалиях современной экономической системы. В статье рассматривается проблема развития космического туризма на территории Российской Федерации и способы ее преодоления через эффективное использование инновационных способов продвижения. В частности, анализируется оптимальный метод повышения привлекательности туристкой услуги на основе программы лояльности.

Priorities of the Russian Energy Diplomacy in Latin America

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Abstract. The purpose of the study is to define the current priorities of the Russian-Latin American energy cooperation as a line of international economic interaction. The objectives are to determine the current priorities of the Russian-Latin American energy cooperation; to define its structure. The hypothesis is as follows: current priorities of the Russian-Latin American energy cooperation are fairly evenly distributed across all of its levels, both hierarchically and sector-wise. The research methods are theoretical and empirical, namely, scientific generalization, system analysis, deductive synthesis, logical analysis. Mathematical and statistical research methods were also used over the course of the study. The study resulted in a three-level structure of the Russian-Latin American energy cooperation. Certain cooperation priorities, along with their manner of distribution, are highlighted.

Over the 20th century, energy industry has become a multi-layered component of international relations, with its layers including economics, high technologies and national interests of individual states.

Currently, it is the third layer that is of particular importance for the Russian Federation, whose economy is starting to depend more and more on the carbon-based energy sectors [3].

To add to that, there is also the matter of the current global "energy transition", seemingly directed towards the renewable energy sources. Both of these trends, along with several other "worldwide turbulences" make for a distinct challenge for the Russian economy [2].

Perhaps, seeking to improve energy cooperation with countries outside of the Commonwealth of Independent States may provide the answer by means of a specific political/economic instrument, namely, energy diplomacy.

Thus, it becomes necessary to specify the take on the very notion of "energy diplomacy" itself. In this study, energy diplomacy is understood as implementing foreign energy policies via official representatives at various levels [1].

Over the course of the last three decades, a certain hierarchy has been formed within the Russian-Latin American energy cooperation structure, one that is applicable to all sectors of the energy industry. It comprises three groups of actors, namely:

- states;
- corporations (i.e., state corporations and pseudo-state enterprises included);
- enterprises.

Each of these actor-driven levels involves different kinds of energy cooperation activities, i.e.

1. The state level, which amounts to countries concluding agreements on joint efforts in various areas of interest, e.g.:
- mineral asset extraction;
- resource supply;
- technical maintenance of facilities;
- training of national personnel.

2. The corporate level, which implies:
- immediate implementation of bilateral (and multilateral) agreements on energy cooperation (see above);
- activities of various joint ventures.

3. The enterprise level, which involves concluding and fulfilling contracts on:
- equipment supplies and replacements;
- facility construction and renovation [5].

With the levels of the Russian-Latin American energy collaboration represented by different entities, the priorities of the collaboration in question differ as well:
- at the state energy cooperation level, nuclear energy is the priority energy sector;
- nuclear energy is also one of the priority sectors at the corporate level, along with thermal power;
- thermal power, together with hydropower, are the priority sectors at the enterprise level [4].

Thus, it can be concluded that the current priorities of the Russian-Latin American energy cooperation are fairly evenly distributed across all of its levels, both hierarchically and sector-wise.

However, in order for the Russian energy cooperation with the Latin America countries to be developed further (regardless of energy sectors chosen), it is also necessary to re-define cooperation priorities while maintaining the best practices that have already been established.

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Приоритеты российской энергетической дипломатии в Латинской Америке

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Ключевые слова и фразы: Латинская Америка; приоритеты сотрудничества; энергетическая дипломатия; энергетическое сотрудничество.

Аннотация. Цель: определить текущие приоритеты российско-латиноамериканского энергетического сотрудничества как сферы межгосударственного экономического взаимодействия. Задачи: выявить основные приоритеты российско-латиноамериканского энергетического сотрудничества; определить его структуру. Гипотеза: текущие приоритеты российско-латиноамериканского энергетического сотрудничества распределены достаточно равномерно на всех его уровнях как с иерархической, так и с отраслевой точек зрения. Методы: теоретические и эмпирические, в частности, научное обобщение, системный анализ, дедуктивный синтез, логический анализ. Также в исследовании использовались математические и статистические методы исследования. Результаты: предложена трехуровневая структура российско-латиноамериканского энергетического сотрудничества. Выделен ряд приоритетов сотрудничества, а также характер их распределения.

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State Regulation
of the Russian Labor Market

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Key words and phrases: forms of state regulation of the labor market; regulatory regulation; employment; benefits; unemployed; temporarily unemployed.

Abstract. In order to study the forms of state regulation of the labor market, a study of regulatory and legislative provisions in the field of employment regulation and benefits for the unemployed and temporarily unemployed has been conducted. The methods of normative analysis of legislation and statistical review were used. As a result of the work carried out, data were obtained that allow us to comprehensively characterize the legal and regulatory regulators of the state in the field of the labor market.

One of the most important conditions for improving the efficiency of the labor market is the scientific development of the problem of its regulation both in general theoretical and in specific aspects. It can be argued that the effective functioning of the labor market, progress in its development is possible only as a consciously regulated process on the part of the state.

The concept of "state regulation" has been applied for a century to a very complex and volatile state of society. At the same time, during different stages of time, they tried to give it a different form, emphasizing its close relationship with the "welfare society", "post-industrial" or "information" society, the formation of "market socialism", "capitalism with a human face".

The mechanism of state regulation of the labor market, which works as practice shows, is mainly spontaneously unable to solve the tasks facing it in a timely and effective manner – to provide national economies with the necessary labor force, redistribute it between industries and spheres of activity. The problem of personnel in such conditions becomes one of the main ones. At the same time, domestic economic science and practice is going through a new stage. From the almost complete denial of state regulation of the economy, which prevailed until quite recently, she was again forced to turn to the topic related to the strengthening of the regulatory influence of the state. Researchers of this problem emphasize that today it is necessary to revise the target settings of the actions of the authorities in the labor market. There is a need to expand the managerial functions of the state, its "return" to the labor market, a radical revision of the employment policy and the definition of its strategic guidelines is required to improve support for the unemployed and embed it in the process of increasing the economic activity of the population.

It is important to take into account that the state of the labor market is influenced not only

by regulations and government actions that have a direct impact on employment indicators, but also by the general context of state economic policy. Clarification of essential approaches to state regulation of the labor market at the present stage, in the author's opinion, is extremely important, both theoretically and practically, as it allows to form a clear and concise description of the most likely scheme of impact on the labor market.

State regulation is a system of influence on the processes of socio-economic and political life of society, carried out by state and international institutions, public organizations. The influence of the state is carried out through a system of legislative acts with the help of state and municipal authorities.

The regulation of the international labor market assumes a focus on compliance with the provisions contained in international legal acts: freedom of labor, free choice of occupation, profession and protection from unemployment.

The Constitution of the Russian Federation, as one of the basic human and civil rights, has enshrined the right to protection from unemployment, which finds expression in the normative acts adopted by the state.

The main directions of the state policy in the field of employment are fixed in the Law of the Russian Federation of April 19, 1991 No. 1032-1 "On employment of the population in the Russian Federation". The last few years have been characterized by the active adoption of amendments to this law and the specification of its provisions in by-laws.

However, the Employment Law defines the unemployed as citizens who do not have a job and earnings, are registered with the employment service in order to find a suitable job, are looking for work and are ready to start it (Part 1 of Article 3). Consequently, most of the support measures enshrined in it apply only to those unemployed citizens who have registered with the employment service.

At the same time, in recent years, in order to combat unemployment, the state has been quite intensively changing and supplementing labor legislation in general.

The Government of the Russian Federation has approved the procedure for registration of citizens in the employment service. It is established that initially a citizen registers in order to find a suitable job, but if it was not possible to find such a job for him, he can be registered as unemployed. The grounds for refusing to register a citizen as unemployed are fixed in a closed list (for example, if a citizen registered in order to find a suitable job twice within 10 days from the moment of registration refuses two options for a suitable job, including temporary).

It is also important to determine the criteria for a suitable job (it must correspond to the professional suitability and level of training of the employee, the conditions of the last place of work, the health of the applicant and the transport accessibility of the workplace), as well as the categories of unemployed who can be offered community service and temporary work, etc. The standard of the state service for assistance in employment and search of employees has been approved. In particular, the criteria for making a decision on the provision of public services, the composition, sequence and timing of the implementation of administrative procedures are fixed (for example, the time of rendering services for a first-time citizen should not exceed 20 minutes). Acts have been adopted to make it easier for citizens to find work by socializing them and providing them with psychological assistance. The procedure for informing about the state of the labor market, employment rights and protection from unemployment has been clarified. Thus, there are several ways to provide such information: at the request of a citizen, by phone, as well as by posting information on the Internet on the official website of the Ministry of Labor of Russia.

The procedure, terms and results of public services for the provision of social benefits to

unemployed citizens have been determined. In particular, it was established that there are no grounds for refusing to accept documents required for the provision of public services (Order of the Ministry of Labor of the Russian Federation No. 10n dated June 29, 2012 "On Approval of the Administrative Regulations for the Provision of Public services for the implementation of social benefits to citizens recognized as unemployed in accordance with the established procedure").

The procedure for interaction of employment services with both applicants and employers in the organization of paid public works has been regulated. The adopted standard establishes the requirements for the selection of types of public works and specific employers, and also details all stages of the procedure for sending an unemployed person to participate in public works. The standard on the organization of temporary employment was also adopted, concerning minors aged 14 to 18 years, certain categories of citizens aged 18 to 20 years, disabled people, persons of pre-retirement age and other groups of citizens experiencing difficulties in finding employment.

Many standards provide for the possibility of applying for public services in electronic form, including using a single portal of public services and means of electronic signature, which indicates the desire of the state to facilitate the passage of the employment procedure by unemployed citizens as much as possible.

The minimum amount in 2021 does not change and will be 1,500 rubles. In 2021, the maximum unemployment benefit will be 12,130 rubles – although the minimum wage has been increased to 12,792 rubles. That is, in 2020, the unemployed received one minimum wage, and in 2021 payments will be less than the minimum wage. It will be possible to receive 12,130 rubles only for the first three months after registration at the employment center.

The Institute of Remote Employment (Federal Law No. 60-FZ of April 5, 2013 "On Amendments to Certain Legislative Acts of the Russian Federation") was added to the labor legislation. At the discretion of the employee, an entry in the work book on remote work may not be entered, and, by agreement of the parties, the employee may be able to independently determine the mode of work and rest. The interaction between the employee and the employer was based on the exchange of electronic documents signed with an enhanced qualified electronic signature.

Prohibition on the use of discriminatory criteria for the selection of employees in job advertisements (gender, race, skin color, nationality, language, origin, property, family, social and official status, age, place of residence, attitude to religion, beliefs, membership or non-membership in public associations or any social groups). The rule prohibiting such discrimination in employment was introduced by the Federal Law of July 2, 2013. No 162-FZ "On Amendments to the Law of the Russian Federation "On Employment in the Russian Federation" and Certain Legislative Acts of the Russian Federation", which entered into force on July 14.

The legislator also paid attention to such a way of combating unemployment as promoting self-employment of the population (Part 8 of Article 7.1-1 of the Employment Law). Regions have the right to provide such measures as assistance to the unemployed in drawing up a business plan, conducting trainings and distributing educational literature on organizing their own business, financial support (including reimbursement of expenses for preparing documents for registration of organizations or sole proprietors, their notarization, payment of state duty and production of seals and stamps, etc.).

The organization of social payments to unemployed citizens (unemployment benefits, financial assistance, scholarships, etc.) still belongs to the powers of the Russian Federation, but this authority has been transferred to the regions for implementation with compensation for their expenses at the expense of subventions from the federal budget.

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Государственное регулирование российского рынка труда

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Ключевые слова и фразы: безработные; временно незанятые; занятость; льготы; нормативное регулирование; формы государственного регулирования рынка труда.

Аннотация. С целью исследования форм государственного регулирования рынка труда проведено исследование нормативных и законодательных положений в области регулирования занятости и льгот безработным и временно незанятым. Применялись методы нормативного анализа законодательства и статистического обзора. В результате проведенной работы получены данные, позволяющие всесторонне характеризовать правовые и нормативные регуляторы государства в области рынка труда.

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FOR NOTES