THE WORLD OF SCIENCE WITHOUT BORDERS

PROCEEDINGS
OF THE 5th ALL-RUSSIAN SCIENTIFIC AND PRACTICAL CONFERENCE (WITH INTERNATIONAL PARTICIPATION) FOR YOUNG RESEARCHERS

February 16, 2018
Tambov

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МИР НАУКИ БЕЗ ГРАНИЦ

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The 5th All-Russian Scientific and Practical Conference (with International Participation) for Young Researchers hosted by Tambov State Technical University on February 16, 2018 is focused on the development of education, manufacturing and research. Major topics include problems of humanities, social, and technical sciences in the modern world. The present book contains the papers submitted to the conference.

5 Всероссийская научно-практическая конференция (с международным участием) для молодых ученых, организованная Тамбовским государственным техническим университетом и проведенная 16 февраля, 2018 г., сфокусирована на развитии образования, производства и исследовательской деятельности. Основные темы включают проблемы гуманитарных, социальных и технических наук в современном мире.

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FOREWORD

The traditional annual conference for graduates and post-graduate students **“The World of Science without Borders”** is gaining momentum. This year we a holding the fifth event in a row and are pleased to note that the number of participants is on the steady rise. The geographical frontiers of this forum are expanding. It is great honor for us to welcome all the contributors, who are willing to share their research findings with their peers and to exchange ideas.

The mission of the conference is to remove the barriers on the way of disseminating innovative projects among young scientists of the whole world. The vehicle of transporting the "new blood" is the English language serving the purpose of removing all hurdles in the academic communication and firmly positioning Russian science on the globe.

Almost 105 papers have been included in this volume featuring the scope of research interests of students at Tambov State Technical University and partner institutions including young foreign scholars. This selection will be of interest for everybody who is keen on keeping in touch with the science of the young in Russia.

Radislav Milrood,
Professor of Department “International
Professional and Scientific
Communication”, TSTU

УДК 62-9
ББК 31.32

INVESTIGATION OF THE GEOLOGICAL PROPERTIES OF THE IMPREGNATOR

V. V. Voronov
Tambov State Technical University, Tambov, Russia
e-mail: morles@inbox.ru

Abstract

The rheological properties of the impregnator are presented. A study of the rheological properties of the Emukryl M impregnator was carried out on a rotational viscosimeter "Reotest 2". The obtained rheological curves indicate that the characteristic feature of the current of the impregnator Emukryl M is disobeying the Newton equation. Curves of the flow of the Emukril M do not obey the linear law, but pass through the origin.

It is established that the viscosity decreases with increasing temperature, and the rheological behavior of the dispersion is described by a power law. Based on the results of the experimental data, rheological constants were determined for various test modes.

Key words: abrasive tool, acrylic emulsion, impregnator, rheological curves, pseudoplastic fluid.

At present, special attention is paid to the ways of improving the efficiency and quality of abrasive processing associated with the improvement of the abrasive tool (AT). One of the methods of improving the operational properties of the abrasive tool is its impregnation [1, 2].

A rather wide range of impregnators has been studied. Among them, the most promising are organic compounds on a hydrocarbon base that ensure a low-energy intensity of the chemical interaction with the metal being processed [2].

When choosing an impregnator, the following requirements should be taken into account. The impregnator introduced into the pores of the abrasive tool should have the ability to improve the parameters of the grinding operation, provide lubrication in the abrasive process, do not reduce the quality of the treated part, do not corrode the machine, maintain stability in storage, meet the requirements of fire safety, minimally pollute air and sewage, do not have a harmful effect on the human organism [1, 2].

All of the above conditions are met by impregnators based on aqueous emulsions of acrylate type copolymers [3-8]:

– linear copolymer of ethyl acrylate and styrene in an aqueous medium (Emukryl C);

– casting copolymer of ethyl acrylate, methyl methacrylate, dimethacrylic ester of ethylene glycol and methylolmethacrylamide in an aqueous medium (Emukryl 2M);

– copolymer of ethyl acrylate, dimethacrylic ester of ethylene glycol and methylolmethacrylamide in an aqueous medium (Emukryl M).

Emukryl M, Emukryl 2M, Emucryl C are milk-white liquid with a mass fraction of non-volatile substances of 40%.

The study of the mutual influence of dynamically contacting abrasives, polymers and metals on their surface dispersion showed that these impregnators most fully meet the requirements listed above [9, 10].

At the same time, mass transfer processes when impregnating the AT with an impregnator play an important role in ensuring the quality of the finished product. Investigating the properties of the impregnator is important in terms of speeding up the impregnation process, as well as improving the uniformity of the impregnator distribution in the pores of the AT, better anchoring it on the pore surface, which prevents the migration of the polymer impregnator to the AT surface during drying.

Despite the fact that the impregnators listed above turned out to be well proven during the studies, a copolymer of ethyl acrylate, dimethacrylic ether of ethylene glycol and methylolmethacrylamide in an aqueous medium (Emukryl M) was recommended for further use. This is due to the fact that this impregnator is the cheapest and environmentally friendly, since it does not have a negative impact on the environment and human, unlike impregnators with the content of the styrene link in the copolymer.

Investigation of the rheological properties of the Emukryl M impregnator was carried out on a rotational viscosimeter “Reotest 2”. The viscometer is characterized by wide ranges of shear stress and shear rates. The test temperature can also be regulated in a wide range.

Variable parameters in the study of the rheological characteristics of the liquid impregnator Emukral M were the rotational speed of the working cylinder; temperature and time of the emulsion in the measuring chamber. During the experiment, the data that allow us to calculate the shear rate and shear stress and dynamic viscosity were obtained.

Of considerable interest is the stability of the emulsion at elevated temperatures. To this end, the impregnator was placed in a measuring cylinder, thermostated at a certain temperature, subjected to tests, then held for a certain period, and again subjected to tests at the same temperature. When changing over to a different temperature regime, the emulsion changed to fresh.

The following facts were revealed: at temperatures below 50°C, the curves obtained at different holding times were the same. A different situation was observed at temperatures above 50° C. Having obtained the rheological curve at the temperature of 50°C, the emulsion was kept in the cylinder for fifteen minutes and again subjected to testing. The newly obtained rheological curve was different from the previous one. With increasing temperature, this difference was expressed in a more visual form.

The shear stress decreases with time, although the shear rate and emulsion temperature remain constant. This phenomenon can be explained by the fact that when a certain temperature is reached, the emulsion begins to lose its stability, its structure breaks down, the polymer particles coagulate and adhere to the surfaces

in contact with the emulsion. The concentration of the polymer in the solution decreases, and this leads to a decrease in the shear stress. The data, obtained as a result of rheological studies, approach the curves for Newtonian liquids. The formation of the polymer film can be observed on the surfaces of the working cylinders of the viscometer. At T = 55 °C, separate polymer clumps are observed. At T = 60 °C, the presence of polymer film has a pronounced character. The thickness of the film increases in dependence on the residence time of the emulsion in the working gap of the device. An attempt to carry out this experiment on cylinders with a smaller radial clearance was unsuccessful due to the fact that the processes of coagulation and cohesion of particles proceeded with greater intensity.

The obtained rheological curves indicate that the characteristic feature of the current of the impregnator Emukryl M is disobeying the Newton equation. Curves of the flow of the Emukril M do not obey the linear law, but pass through the origin. Such a fluid is calledpseudoplastic. It is established that the viscosity decreases with increasing temperature, and the rheological behavior of the dispersion is described by a power law. Based on the results of the experimental data, rheological constants were determined for various test modes. It is noted that for an anomalously viscous liquid, such as Emucryl M, with increasing aging time at temperatures above 55 ° C, the viscosity greatly depends on the prehistory, the magnitude of the tangential stresses and time. The latter is explained by the fact that the emulsion begins to lose its stability, the emulsifying layer is destroyed, and the polymer particles begin to coagulate.

On the basis of the data obtained, it can be concluded that the impregnation of the abrasive tool should be carried out at temperatures up to 30 °C, and the subsequent heating of the impregnated AN to temperatures above 50 °C can be used to fix the emulsion in the pores of the AN in order to prevent it from changing.for further drying of the AT [8, 11].

Thus, knowledge of the rheology of polymer impregnators is necessary in solving practical problems associated with the creation of the process for impregnating AT to design, calculate and optimize the design and performance characteristics of the impregnation equipment [7, 8] and the drying of abrasive tools [11].

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ИССЛЕДОВАНИЕ РЕОЛОГИЧЕСКИХ СВОЙСТВ ИМПРЕГНАТОРА

В. В. Воронов
Тамбовский Государственный Технический Университет, Тамбов, Россия
e-mail: morles@inbox.ru

Аннотация

Исследуются реологические свойства импрегнатора. Исследование реологических свойств импрегнатораЭмукрил М проводили на ротационном вискозиметре «Реотест 2». Полученные реологические кривые свидетельствуют о том, что характерной особенностью течения импрегнатораЭмукрил М является неподчинение уравнению Ньютона. Кривые течения Эмукрила М не подчиняются линейному закону, но проходят через начало координат.

Установлено, что с ростом температуры вязкость падает, а реологическое поведение дисперсии описывается степенным законом. По результатам экспериментальных данных были определены реологические константы для различных режимов испытаний.

Ключевые слова: абразивный инструмент, акрилатная эмульсия, импрегнатор, реологические кривые, псевдопластичная жидкость.

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ББК 31.2

REACTIVE POWER COMPENSATION IN ELECTRICITY NETWORKS

V. Yu. Loktev, K. V. Markina
Tambov State Technical University, Tambov, Russia
e-mail: KsuMarkina96@yandex.ru

Abstract
The main focus of reducing energy losses and increasing the efficiency of electrical systems is reactive power compensation. This article considers the problem of reactive power compensation. Optimal reactive power compensation in power supply networks of companies includes a range of questions which are directed on increase of efficiency of operation of electrical and involves methods of selection and calculation of compensating devices.
Key words: active power, capacitor banks, reactive power, transformers, electrical appliances.

The problem of reactive power compensation arose together with the practical use of alternating current. Most of the losses of active energy defined network flows of reactive power and their reduction can be achieved by increasing the degree of reactive power compensation.

A large number of consumers of electricity are electrical machines (transformers, asynchronous motors, equipment for arc welding) in which an alternating magnetic flux linked with the windings. During the flow of alternating current in the windings the reactive EMF is indoctinated causing a phase shift (φ) between voltage and current. The parameter that determines the consumption of reactive power, cosφ is calculated by the formula:

$$\cos\varphi = \frac{P}{S} = \frac{P}{\sqrt{(P^2+Q^2)}} \qquad (1),$$

where P is active power, S is the total power, Q is reactive power, cos is the coefficient of reactive power consumption.

Thus, the reduction of cosφ so the increase in the consumption of reactive power, therefore we have committed to increasing cos.

The presence of the mains reactive power lowers the power quality.

Also, there is an increase in fees for electricity, which is a serious problem, leading to additional costs.

The use of installations of reactive power compensation allows reducing the amount of reactive power consumption, achieving energy saving and economic effect.

Contactors or thyristors can be used as a switching element in the capacitor units. Contactor capacitor bank is the most widely spread because of the easier implementation and lower cost compared with the thyristor (static) condenser units.

At the place of connection, there are the following schemes of reactive power compensation:

– the general scheme (used at the stage of the enterprise launch);
– the group scheme (used to supply with electricity a group of the same type of consumers);
– the individual scheme (capacitor installation is installed in close proximity to the consumer with low $cos\varphi$.)

The individual compensation scheme is preferable but not always applicable. Usually the entity operates many electrical installations with a low power factor, and providing them with all of the individual capacitor banks is not possible.

Thus, the mixed compensation scheme is used. The reactive power of the largest consumers is compensated partially through individual capacitors with constant capacity, and a variable remainder of their reactive power is compensated with the help of automatic capacitor bank connected to the input of the enterprise [1].

The complete capacitor banks are widely used for the reactive power compensation in industrial, municipal electric networks of 0.4(10)/0.4 kV. The main components of capacitor banks are capacitors, regulators of reactive power, electromagnetic and thyristor contactors, filters and inductors.

Discreet automatic power control of capacitor banks depending on the change in the reactive power consumption mode to minimizes power losses from possible under- or the overcompensation of reactive power.

The main functions of a modern regulator reactive power are automatic determination of correction angle between phase voltages and currents, calculation of power compensation and the inclusion of the minimum necessary number of stages.

The installation of the capacitor banks with automatic control of reactive power optimizes the compensation mode for both maximum and minimum load.

Even a step-by-step power regulation system of the capacitor bank eliminates the exact compensation of the inductive load. The application of a static thyristor contactor can solve the problem of the exact compensation of the inductive load on the enterprise, but it is very expensive and requires the installation of harmonic filters.

An application of controlled reactor together with capacitor bank is much cheaper and more effective.The performance of controlled reactor allows monitoring the changeable and variable loads. For example, induction motor of the rolling mill in reverse mode consumes 5...7 times higher current compared to the normal mode of operation. Moreover, this current is almost completely inductive. To prevent abrupt voltage lags in the entire network of the plant it is advisable to use a powerful capacitor bank. [2].

Consequently, the network is insensitive to in-rush current at the reverse. However, in the normal mode of operation, the battery capacity is redundant, and the network is loaded with an excessive current of the capacitor bank. A controlled reactor can be used for compensation of this current, which is calculated by the formula:

$$Q_S = \pm(Q_L - Q_C) \qquad (2)$$

This control system can significantly reduce the cross section of the supply wiring and the use of lighter devices in the supply network, leading to significant savings from the installation of the controlled reactor.

On the basis of the capacity consumption, the reactive power to be compensated is calculated from the actual current value (initial power factor $tg\varphi_1$) to the target value (target power factor $tg\varphi_2$) [3]. The total capacity of compensating devices is determined as follows:

$$Q_{CD} = P \cdot (tg\varphi_1 - tg\varphi_2) \qquad (3)$$

where P is the active power of the load.

The specific capacity of the compensating device is calculated by the formula:

$$k_{SC} = \frac{Q_{CD}}{S_{ts}} \qquad (4)$$

where S_{ts} is the predetermined transformer capacity.

The main focus of reducing energy losses and increasing the efficiency of electrical systems is reactive power compensation.

Both at the design stage and during the operation of power supply systems, the right choice of compensating devices can help to relieve the load on the distribution line and transformers, to reduce losses of electricity from the flow of reactive power and to increase the power quality.

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КОМПЕНСАЦИЯ РЕАКТИВНОЙ МОЩНОСТИ В ЭЛЕКТРОСЕТЯХ

В.Ю. Локтев, К.В. Маркина

Тамбовский Государственный Технический Университет, Тамбов, Россия

e-mail: KsuMarkina96@yandex.ru

Аннотация

Основным направлением уменьшения потерь электроэнергии и увеличения эффективности работы электроустановок является компенсация реактивной мощности.

В данной статье рассмотрена проблема компенсации реактивной мощности. Оптимальная компенсация реактивной мощности в электросетях предприятий включает в себя комплекс вопросов, которые направленны на увеличение экономичности работы электроустановок и подразумевает методы выбора и расчета компенсирующих устройств.

Ключевые слова: активная мощность, конденсаторные установки, реактивная мощность, трансформаторы, электроприборы.

УДК 621.311.26 (075.8)
ББК 31я73

LOW-TEMPERATURE FLUIDIZED BED FOR UTILIZATION OF BIOGENIC WASTE

N. S. Muratova, D. V. Klimov
Tambov State Technical University, Tambov, Russia
e-mail: muratova-nat@rambler.ru

Abstract
We have studied greenhouse gas emissions from the combustion of biogenic waste in a boiler with a low-temperature fluidized bed. We compared the values of the emission levels obtained during the experiment, with the values established by the EC Directive 2001/80. In the course of the work, the need was noted for the use of additional dust and gas cleaning equipment for the incineration of sunflower husks and the litter-litter mass of poultry farms.
Key words*:* biomass, fluidized bed.

Introduction

The actual share of biomass in the world energy industry today reaches 10% (excluding peat).This is more than the share of other renewable energy sources combined.

Biomass is an environmentally friendly fuel. It can make real competition for fossil fuels in Russia. Secondary biogenic wastes, such as agricultural waste, solid household waste, sludge from sewage treatment plants in large cities, are of interest to potential consumers. This interest is economically justified. Utilization of these wastes through direct combustion allows the company to obtain additional profit from the sale of heat and electricity in the presence of cogeneration. At the same time, companies avoid fines from environmental pollution.

Results of the experiment

The technology of low-temperature (about 850^0C) fluidized bed [2] when burning solid biogenic waste allows us to obtain thermal and electric energy with minimal losses. At this temperature level there is also no danger of melting ash, slagging the furnace and reducing greenhouse gas emissions of CO_2, H_2O and NO_x, CO.

Ash, which is formed when burning solid biogenic waste, can serve as a commodity product. Emissions of gas products with the correct organization of the purification system meet the requirements established by EC Directive 2001/80 (Table 1) and domestic GOSTs.

We conducted research on burning several types of biogenic waste (straw, litter-litter, sludge) in a fluidized bed boiler. A 0.5 MW boiler, on which experiments were conducted, is equipped with a wet flue gas cleaning system. The “wet” cyclone SIOT №2 is used in the installation. It works in a "choking" mode. The use of a "wet" cyclone provides a sharp reduction in the emission of harmful emissions into the environment and increases the efficiency of the boiler.

Table 1. Emission limit values of the directive EC 2001/80 [2].

Heating capacity boiler installation, MW	Emission rate, mg/m^3			
	solid particles	carbon oxide (CO)	nitrogen oxides (NO_2)	sulfur dioxide (SO_2)
from 0,1 before 0,3 incl.	600	7500	Not installed	Not installed
over 0,3 2	300	1000		
2 25	150	750	500	800
25 50	100	500	500	600
50 100	50	500	400	200

Pre-biogenic waste was granulated. This made it easy to automate the process of their delivery and combustion. In the boiler, biogenic waste from agriculture was burnt - straw pellets (hazard class 5 according to the degree of environmental impact) and granulated litter-marking mass of poultry (class 4 hazard).

The efficiency of the purification system was estimated from the results of temperature measurements, air excess factor, carbon monoxide, nitrogen monoxide, oxides of nitrogen and sulfur oxides, as well as dust content in the flue gases at the boiler plant outlet before and after the "wet" cyclone with a gas analyzer MRU “VarioPlus” and dustmaker S 305 7 L1Y7-SR Sintrol.

The results of the analysis of combustion products showed compliance in comparison with the limits set by the EC Directive 2001/80 (in particular, the ash concentration in the flue gases of the combustion plants should not exceed 100 mg / m^3 (with CO_2 - 7%)). Wet cleaning of gases allows providing these values. The dust content in the flue gases before the “wet” cyclone is 0.5 g/m^3. After a “wet” cyclone, the dust content decreased to 0.1g/m^3, that is, decreased by 5 times.

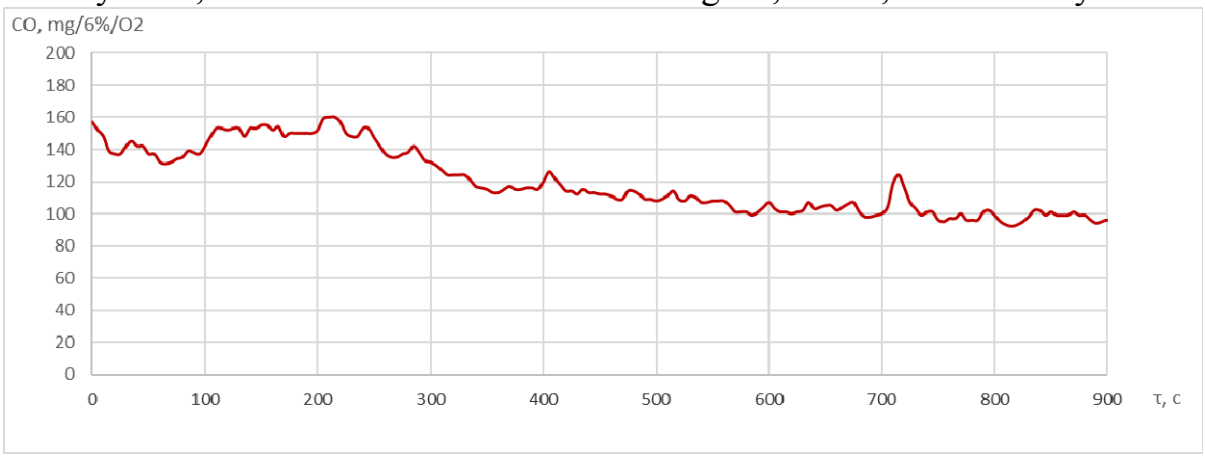

Fig. 1. Concentration of carbon monoxide in flue gases during incineration of straw pellets in a boiler [3].

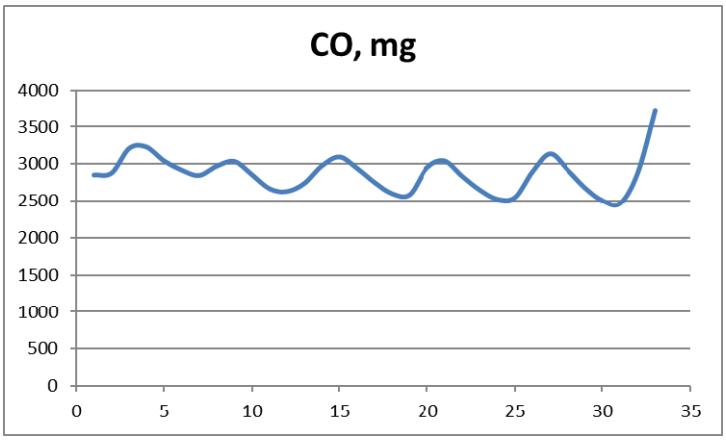

Fig.2. Concentration of carbon monoxide in flue gases during combustion in a boiler with a COP of litter-lump mass

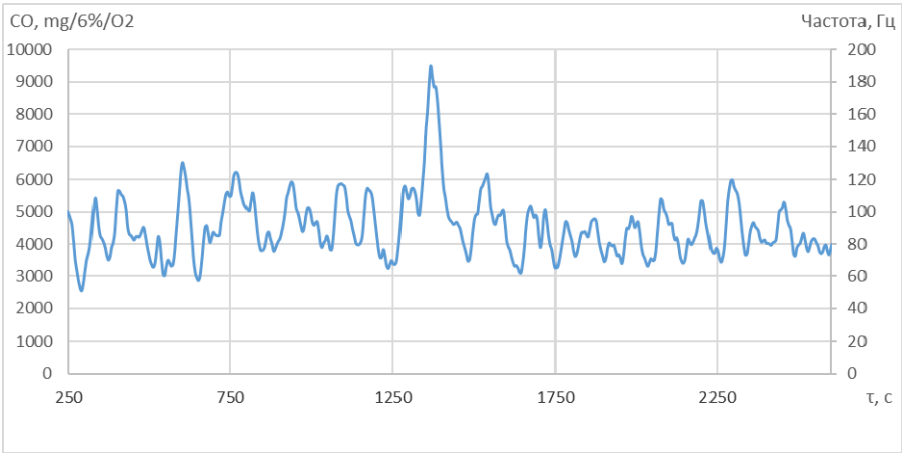

Fig. 3. Concentration of carbon monoxide in the flue gases when the pellets from sunflower husk are burned in the boiler.

The analysis of the concentration of carbon monoxide in combustion products (Figure 1-3) showed that EC Directive 2001/80 corresponds only to the burning of straw pellets. For litter-laden mass and granules from sunflower husks, an additional degree of purification is required, for example, using a lime solution in a "wet" cyclone instead of water.

Conclusion

When burning biomass it is necessary to:

1) apply primary measures to reduce the level of pollutant emissions, the main of which is to reduce the moisture level of the fuel, such as granulation or drying;

2) adjust the control of the combustion process taking into account the influence on the emissions of such parameters as the combustion temperature, the residence time of the fuel particles in the furnace, and the excess air ratio;

3) consider regulating the supply of secondary air for fuel afterburning;

4) apply effective dust and gas cleaning equipment to comply with EC 2001/80.

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НИЗКОТЕМПЕРАТУРНЫЙ КИПЯЩИЙ СЛОЙ ДЛЯ УТИЛИЗАЦИИ БИОГЕННЫХ ОТХОДОВ

Н.С. Муратова, Д.В. Климов
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: muratova-nat@rambler.ru

Аннотация

Нами исследованы выбросы парниковых газов при сжигании биогенных отходов в котле с низкотемпературным кипящим слоем. Мы сравнили значения уровня выбросов, полученные в ходе эксперимента, со значениями, установленными директивой ЕС2001/80. В ходе работы была отмечена необходимость использования дополнительного пылегазоочистного оборудования при сжигании лузги подсолнечника и подстилочно-пометной массы птицефабрик.

Ключевые слова: биомасса, кипящий слой.

УДК: 62
ББК: 30

MATHEMATICAL MODELLING OF THE ELEMENTS OF ARTIFICIAL LUNGS SYSTEM

K. S. Vasilevskiy
Tambov State Technical University, Tambov, Russia
e-mail: kvasilevskiy@1-engineer.ru

Abstract
This article describes the problems of the existing mathematical model of the installation "Artificial lungs", and the options for improving the existing model from the perspective of conformity to the real object of simulation. The need to introduce several variables in the model to solve this problem was identified in this work.
Key words: "Artificial lungs", mathematical model, human respiration, automation of respiratory system.

According to the Directive of "Fundamentals of the State Policy in the Field of Chemical and Biological Security of the Russian Federation", the main objectives in the field of basic science development are development and implementation of personal protective equipment (PPE) [1]. Developing new equipment and improving the existing equipment is impossible without testing the protective equipment in real conditions. These tests are conducted in conditions of PPE personal use, or they may be conducted with the help of special systems imitating human breathing. Such systems were called "Artificial lungs" (AL).

One of the main PPE is a self-contained self-rescuer (SCSR) with fixed oxygen. SCSRs are used in different extreme situations: on ground and underground, in space and in transport, on water and underwater.

The mechanism of SCSR is based on protecting human visual and respiratory organs from the environment and supporting breathing by means of breathing mixture regeneration.

Currently, AL systems are the main devices for determining SCSR characteristics; that is why there is no need for using volunteers.

The AL system can be defined as a program apparatus complex, which imitates several physiological and psychophysiological processes operating in a human body.

Now, there are several AL systems produced in Russia and abroad. However, it is not possible for them to change the shape of respiratory curves, that is why they cannot imitate different psychophysiological processes and make a respiratory quotient value less than 1 using math- and software of the complex [2].

In order to make tests more efficient, it is necessary to implement different shapes of respiratory curves and respiratory quotient values to the AL system.

It is important to implement load changes to the AL system by means of

changing modes with permanent breathing characteristics: in this case the system will support such characteristics which are typical for a person and real conditions.

Thus, in order to study characteristics mentioned above it is necessary to create a mathematical model of external respiration which takes into account the body response to various conditions, including mutual influence of a human and PPE.

The change of external respiration, especially some of its characteristics, occurs due to the several factors that can be divided into the following categories:

1. Factors the influence of which is related to the change of internal and external respiration.
2. Factors the influence of which is related to the change of conditions under which gas exchange occurs [3].

The second category can be divided into subcategories as well:

1. Factors that influence gas diffusion gradient in the lungs;
2. Factors that influence breathing capacity and gas volume [3].

In case of increasing energy requirements, we can see a much bigger number of body reactions that is why oxygen consumption and carbon dioxide production increase as well. A respiratory quotient (the ratio of absorbed oxygen to produced carbon dioxide) equals to 1, which can be seen only when pulmonary ventilation goes to 70 lpm [3].

The change of breathing resistance has an impact on body's energy consumption needed for one breathing cycle.

The change of breathing mixture pressure has an impact on breathing gases partial pressure, which influence on gas diffusion occurring in the lungs.

Dead space (DS) is a part of respiratory volume equal to airway volume. A definite amount of breathing mixture goes to the lungs during inhalation, and some part of this amount stays in the airway and do not participate in gas exchange. In this case, it is necessary for a person to consume energy for transferring "dead" gas volume.

For instance, the increase of dead space due to the use of PPE will lead to the increase of energy consumption for each inhalation, and in this case, the shape of respiratory curve is going to change.

Body position influences on lung vital capacity (LVC) is the volume of maximal inhalation.

The change of oxygen concentration in breathing medium and the following change of partial pressure in alveolar space can be characterized in this way: in case the oxygen partial pressure increase *(Pom)* more than 60 mm of mercury, the change of pulmonary ventilation is not critical [2].

The significant change of ventilation can be seen in case of a drop in oxygen partial pressure to a value less than 40 mm of mercury, so we can say that a dramatic drop in oxygen partial pressure does not lead to the sudden change of DS.

The change of carbon dioxide partial pressure in alveolar space from 40 mm of mercury to 45 mm leads to a dramatic change of pulmonary ventilation from 7 to 25-30 lpm, which means that a body is highly sensitive to carbon dioxide, and

the main changes of external respiration occur due to the increase of carbon dioxide production but not due to the increase of oxygen consumption [2].

The change of a person's psychophysiological state (fear, confusion, etc.), leads to the change of respiratory curve shape: breathing rhythm increases from 10-16 min to 25- 30 min^{-1}, and depth of breathing increases as well.

The mathematical model of human external respiration, which takes all those factors into account, can be used for imitational tests of system's modes, and it can also be used as a predictive model included in the AL management system.

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МАТЕМАТИЧЕСКОЕ МОДЕЛИРОВАНИЕ ЭЛЕМЕНТОВ УСТАНОВКИ «ИСКУССТВЕННЫЕ ЛЁГКИЕ»

К.С. Василевский

Тамбовский Государственный Технический Университет, Тамбов, Россия

e-mail: kvasilevskiy@1-engineer.ru

Аннотация

В статье рассмотрены проблемы существующей математической модели установки "Искусственные легкие", а также варианты ее совершенствования с точки зрения соответствия реальному объекту моделирования. Выявлена необходимость введения в модель дополнительных переменных для решения данной поставленной задачи

Ключевые слова: "Искусственные легкие", математическая модель, дыхание человека, автоматизация дыхательной системы.

УДК 658.5
ББК 30ф

IMPROVEMENT CAPABILITY INDICATOR IN THE IMPROVEMENT SYSTEM OF ENFORCEMENT PROCEEDINGS IN THE BAILIFFS' DEPARTMENTS OF THE FEDERAL BAILIFF SERVICE OF THE RUSSIAN FEDERATION

S.V. Ponomarev, A.S. Myasin, E.A. Novikova
Tambov State Technical University, Tambov, Russia
e-mail: novka220395@mail.ru

Abstract
Suggestions have been made for the possible increase of the enforcement proceedings efficiency in the bailiffs' departments of the Federal Bailiff Service (FBS) of the Russian Federation as well as ways of its realizations using qualimetric scales of the score and methodology of "Improvement capability indicator" assessment based on using three indicators (that is the analogy of the failure mode effect analysis (FMEA) methodology).
Key words: bailiff, Bailiffs' department, document, enforcement proceedings, software.

Introduction

There are some problems of enforcement proceeding in the bailiffs' departments. They will be studied in this paper based on the third approach that was suggested in S.V. Ponomarev's paper [1].

In the paper [1], three approaches to the application of qualimetric scales to assess the "improvement capability indicator" in the quality management system were considered:

1) interpretation of the "Improvement capability indicator" using a single indicator;

2) interpretation of the "Improvement capability indicator" using a combination of two indicators;

3) interpretation of the "Improvement capability indicator" using three indicators based on the analogy of FMEA-methodology [2].

Suggestions to improve the efficiency of enforcement proceedings

The process of enforcement proceedings in the Federal Bailiff Service of Russia regarding the Tambov region is carried out in accordance with the relevant instructions and guidelines [3]. The algorithm of the enforcement proceedings process [4] is presented in Fig.1. The explanation of the algorithm is given below.

The initial stage of the process is the provision of the enforcement document (ED) to the bailiff service by the recoverer. The courts, the State Road Traffic Safety Inspection (SRTSI), the Federal Tax Service (FTS), and the Pension Fund of the Russian Federation (PF), the Social Insurance Fund (SIF) and the Notaries can be recoverers. The enforcement document can be presented in the written or electronic form.

Depending on the type of documents presentation, some difficulties can arise, for example, an electronic document compiled by the recoverer in

Michurinsk will be sent to the Federal Data Processing Center (FDPC) in Moscow via Tambov, where the ED will be checked for compliance with requirements and then will be returned to the bailiff's office in Michurinsk via Tambov. If the electronic document is sent directly to the necessary department, the process will require less time. The problem of the ED in the written form is that a document can be lost, so the recoverer and the bailiff will not learn about it.

Then the documents are registered in the bailiffs' department and are checked for compliance with requirements. If the document meets the requirements, a bailiff will begin the enforcement proceedings (EP), otherwise the recoverer will be notified about the error in the ED. The notification is not specified. The next stage is a proper notification of the debtor with a notice that the debtor can comply with the requirements of the ED voluntarily within 5 days. Otherwise, the ED requirements will be met compulsorily, and then EP will be finished. If the debtor is not notified, the bailiff will take measures to find him. If the result of the debtor's search is negative, the EP will be finished.

For a detailed study of the enforcement proceedings process algorithm and suggestions of the possible improvement of this process, a team of experts was formed. The information and results are listed in Table 1.

The team identified 5 sub-processes in the EP process, the improvement of which will increase the efficiency of the EP and the level of satisfaction of the recoverers. The list of these sub-processes is given below:

- provision of the ED to the bailiff service by the recoverer;
- the process of informing the recoverer;
- the process of sending the ED to the bailiffs department;
- proper notification of the debtor;
- compulsory enforcement proceedings.

After the analysis of these sub-processes the following opportunities for their improvement were revealed:

1) sending the ED directly to the structural department of the FBS without addressing the Federal Data Processing Center (FDPC)

2) informing the enforcement proceedings parties about the enforcement proceedings using electronic communication means;

3) making up the enforcement document by the courts, PF, SIF in the electronic form and their subsequent sending to the structural departments of the FBS using secure communication means;

4) detailing of the error in the notification to the recoverer after checking it regarding its compliance with requirements;

5) automation of the process of enforced money recovery from the debtor accounts in the established amount.

After identifying the potential ways to improve the process, the team:

- identified the ways to implement the "possibility" of improvement and the planned outcomes of the improvement;
- calculated the values of the improvement possibility priority numbers (IPPN) using the third approach of the paper [1] for each sub-process.

Scores were obtained for three indicators:

SS - the significance score of the suggested improvement positive effects,

SR – the score of the potential improvement probability realization,

CAS - the score of control accessibility and process management after the introduction of the improvement.

After determining the scores of the SS, SR and CAS indicators, the values of priority numbers of the improving possibility (IPPN) were calculated as the product of the scores values of these three indicators:

IPPN=SS*SR*CAS.

The results of the team work are given in Table 1.

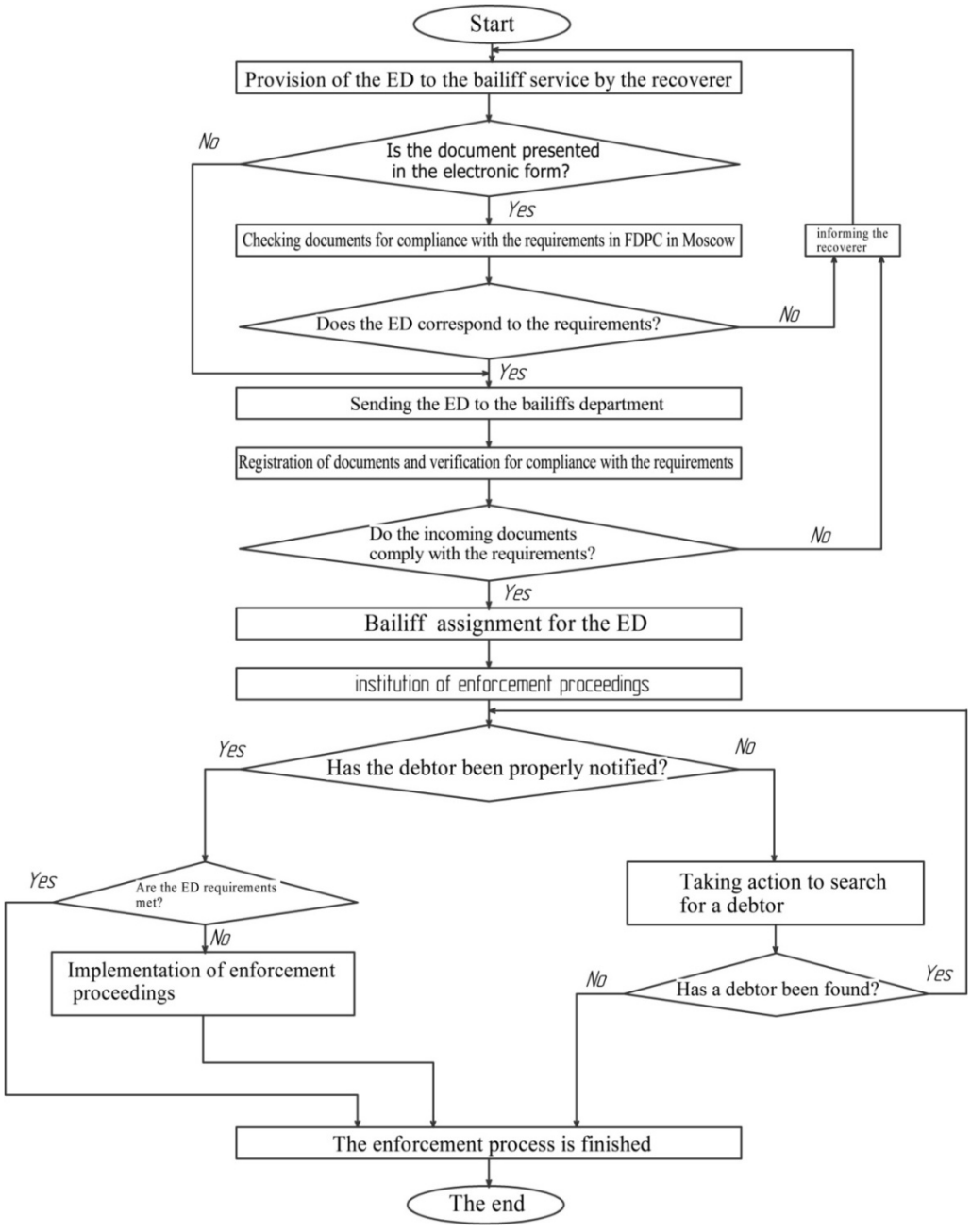

Fig. 1- Diagram of enforcement proceedings process

Table 1 - Results of the team work

Data:	FBS RF regarding the Tambov region Studied process: enforcemen tproceedings		Head: PhD in Engineering, professor Ponomarev S.V. Team members: Head of the Informatization Department and Information Security Myasin A.S., student of the group MMK-11 Novikova E.A.				
Process step	Possible improvement	Areas of application	Planned improvement result	SS	SR	CAS	IPPN
1	2	3	4	5	6	7	8
Provision of the ED to the bailiff service by the recoverer	Making up the enforcement document by the courts, PF, SIF in the electronic form and their subsequent transfer with the help of secure communication channels to the structural departments of the FBS	Organization of interdepartmental conferences, protocols, interdepartmental orders, technical assignments, software development.	1 Reduction of the time for receiving the ED by the bailiff service 2 Reduction of delivery time of the ED 3 Savings of money that is spent on paperwork 4 Elimination of ED losses in the written form	10	9	8	720
Informing the recoverer	Detailing of the error in the notification to the recoverer after checking documents	Software updating for processing documents	Reducing the amount of errors	6	8	6	288
Sending the ED to the bailiffs department	Sending the ED directly to the structural department of the FBS	Orders, conferences, the ED verification, statistical information about the ED	1. Unloading of communication channels 2. Saving money for the purchase of communication channels	10	8	9	720
Proper notification of the debtor	Informing the parties about the enforcement proceedings using electronic communication means	Proper notification of parties, obligatory registration on the site of the State Service (www.gosuslugi.ru), notification of the EP parties with the help of SMS-messages, sending documents about the progress of the EP to the personal accounts on the State Service site (www.gosuslugi.ru)	1. Reduction of the ED losses that are sent in the written form 2. Reduction of the time spent on documents delivery	8	5	4	160
Compulsory	Automation of	Development and	1. Saving money	8	7	8	448

enforcement proceedings	the process of enforced money recovery from the debtor's accounts in the established amount	subsequent consolidation the law, obliging the citizens of the Russian Federation to periodically monitor their debts through the site of the State Service, development and subsequent consolidation of the law, about the automatic withdrawal of money from debtor's accounts.	resources due to the reduction of workplaces in the FBS. 2. Reduction of enforcement proceedings time				

Conclusion

Thus, having suggested the possible efficiency increase of enforcement proceedings in the bailiffs structural department of the FBS of Russia, the team have revealed that the most effective improvement is the «formation of enforcement document by the courts, PF, SIF in the electronic form» at the stage « provision of the ED to the bailiff service by the recoverer» as well as the «sending the ED directly to the structural department of the FBS» at the stage «sending the ED to the bailiffs department» since the values of priority numbers of the improving possibility for this stages have the highest value IPPN=720.

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ИСПОЛЬЗОВАНИЕ ПОКАЗАТЕЛЯ «ИНДИКАТОР ВОЗМОЖНОСТИ УЛУЧШЕНИЯ» ПРИ ПОДГОТОВКЕ ПРЕДЛОЖЕНИЙ ПО ПОВЫШЕНИЮ ЭФФЕКТИВНОСТИ ИСПОЛНИТЕЛЬНОГО ПРОИЗВОДСТВА В СТРУКТУРНЫХ ПОДРАЗДЕЛЕНИЯХ СУДЕБНЫХ ПРИСТАВОВ ФССП РОССИЙСКОЙ ФЕДЕРАЦИИ

С.В. Пономарев, А.С. Мясин, Е.А. Новикова
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: novka220395@mail.ru

Аннотация

С применения балльных квалиметрических шкал и методики оценки показателя «Индикатор возможности улучшения», базирующихся на использовании трех показателей по аналогии с FMEA-методологией, подготовлены предложения по возможному повышению эффективности исполнительного производства в структурных подразделениях Федеральной службы судебных приставов (ФССП) РФ, а так же способы реализации предложений и планируемый результат.

Ключевые слова: Исполнительный документ, отдел судебных приставов, судебный пристав-исполнитель, исполнительное производство, программное обеспечение, Федеральный центр обработки данных.

УДК 614.2
ББК 51.12

TELEMEDICINE IN RUSSIA

A.A. Noskov
Tambov State Technical University, Tambov, Russia
e-mail: noskovalex123zxc@rambler.ru

Abstract
The article deals with the concept of "telemedicine", its current state and prospects of development. IT-based medical consultations have been applied in Russia for a decade; however, the introduction of the federal law in 2017 will stimulate the further development of this field.
Key words: doctor; patient; telemedicine; development.

The term "telemedicine" has multiple meanings and interpretations. The most complete definition is as follows: telemedicine is the provision of health services in a situation where distance is a critical factor, health workers using information and communication technologies to exchange the necessary information for the diagnosis, treatment and prevention of diseases and injuries, research and evaluation, and also for the continuing education of health workers in the interests of improving public health and the development of local communities [1].

An important objective of telemedicine is the organization of interaction between patients of health care institutions and highly qualified specialists, rendering professional assistance to the population using communication facilities.

This technology is not new, but it is quite developed. The implementation of the federal target program "Children of the North" [3] has contributed to the creation of a modern telecommunications system with access to remote northern regions. In this regard, it can be assumed that the further development and modernization of the northern telemedicine network are possible when conditions are created to maximize the internal potential of the northern regions and attract investments from non-state sources.

Telemedicine can solve many problems:

• increased access to medical treatment: the proportion of patients actively using self-monitoring methods has increased to 90%;

• reduction in the frequency of hospitalizations and requests for emergency medical care;

• improvement of the quality of life, the psychological condition and social adaptation of patients;

• decrease in mortality among patients with cardiovascular diseases by 20-25% in comparison with the routine technology of organization of medical care;

• increasing satisfaction of patients with medical services;

• increasing the patients' awareness of their diseases;

• improvement of the quality of medical care, timely correction of drug therapy, high effectiveness of drug treatment;

• improvement of economic efficiency of medical care [2].

However, there are some shortcomings of telemedicine. The universal integration of telemedicine into health care should be comprehensive, systemic, including:

• the use of specialized equipment to collect, transform and disseminate medical information;

• availability of a telecommunications network to provide communication between providers and consumers of medical information;

• application of software that links all the elements of the system into a single complex;

• availability of medical staff providing professional and technical support, effective use of telemedicine in solving medical problems [2].

Telemedicine can become cost-effective if it turns into a queuing system at the federal level [3]. Federal Law No. 242-FZ of July 29, 2017 “On Amendments to Certain Legislative Acts of the Russian Federation Regarding the Application of Information Technologies in the Sphere of Health Care”, which was introduced this summer, has changed the status of medical services using communication facilities. The law presumes online consultations resembling a doctor’s appointment, prescribing prescriptions and sending them directly to pharmacies, and conducting consultationsby specialists from different medical institutions.

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ТЕЛЕМЕДИЦИНА В РОССИИ

А.А. Носков

Тамбовский государственный технический университет, Тамбов, Россия

e-mail: noskovalex123zxc@rambler.ru

Аннотация

В статье рассматривается понятие "телемедицина", задачи и ожидания. Врачебные консультации с помощью IT-технологий ранее применялись в России, однако подписание федерального закона стимулирует дальнейшее развитие данной области

Ключевые слова: врач; пациент; телемедицина; развитие.

УДК 62-9
ББК 30.9

MODERNIZATION PROCESS OF THE WHEELED PAIR RV2SH FORMATION AT THE ENTERPRISE OF "TAMBOV VRZ"

A. S. Rodionova, A. G. Divin
Tambov State Technical University, Tambov, Russia
e-mail: nastyrodionovada@mail.ru

Abstract
The introduction of automatic control of parameters of process of pressing wheel sets RV2SH on the axle, reducing the percentage of inconsistencies in the process of forming a wheel pair. In addition, it is proposed to introduce the system of control charts fitting through the application of software module Lab VIEW.
Key words: chart insertion, control system, force, virtual instrument.

Introduction

Problems of formation of car wheel pairs have not been solved yet. Cases of shift of wheels on the axes indicate that the applied process of wheelsets assembly with the help of mechanical press is not satisfactory. To increase the strength of the pairing, eliminate significant drawbacks of mechanical pressing of wheels on the axis of wheel pairs of carriages, we need new technology. The technique has longitudinal press fit (mechanical press, hydraulic press assembly with the radial and lateral flow of oil a high pressure in to the zone of elements), connection the transverse press-fit connection with the guaranteed tightness (thermal assembly, the assembly using the cold press glue joints) [4]

The more common hydraulic connection is hydropressured by connection made by pumping liquid mineral oil under high pressure into the interface zone of connections with the guaranteed tightness. In this case it is possible to obtain compounds with the high bearing capacity, but much less tensive compared to a mechanical pressing. When the hydraulic assembly is eliminated, there is negative influence of residual thermal stresses and there can be assembly and disassembly of joints without the damage to surfaces in the form of scuffing, scratches, and reducing the required press (espressomachines) efforts, eliminating the need to use bulky high-power presses. [3]

The object of the analysis is the modernisation of the process of pressing wheelsets RV2SH an axle at the enterprise PLC "Tambov VRZ".

The process of forming a wheel pair with the upgraded device

Joint stock company "Vagonremmash" is a modern Russian production company that has a long history of development. The wheel RV2SH was designed for the use in trucks of freight cars with the design speed of 120 km/h designed for railway track of 1520 mm.

The assembling of wheelsets by the press method is carried out on a special hydraulic press, equipped with recording device for recording a press-fit diagram and two pressure gauges. Before pressed elements of the pair of wheel pair must be checked and matched in size, the wheels should be matched to the steel grade.

When pressing wheelsets it is necessary to maintain the specified pressure and the final force of pressing. The pressure values are taken using differential pressure gauges that convert pressure in a uniform signal. The values received with the help of the data acquisition board are received on a PC equipped with LabVIEW software module. Next, we construct a diagram of the insertion process, according to the final efforts of the pressing of the length pairing, the movement of the plunger. The value of the final effort of pressing should be in the range of 39-58 vehicle when the surface roughness of the holes of the wheel hub Rz ≤ 20. The value of the tightness of the wheels and hubs of the disks on the axis should be from 0.10 to 0.25 mm

Operation of the automated system is carried out with the help elaborated and simple programming of the graphic interface LabVIEW. Laboratory Virtual Instrument Engineering Workbench (development environment laboratory virtual instruments) is powerful and flexible graphic programming environment that is widely used in industry, education and research laboratories as a standard tool for data acquisition and control devices. LabVIEW is a multiplatform environment that can be installed on computers with operating systems of the Windows family, MacOS or Linux.

LabVIEW includes the following libraries:

- the collection and exchange of data;
- communication with the device according to the standard RS-232;
- data analysis;
- presentation of data;
- storage of processed data on carriers of various types.

Advantages Of LabVIEW:

- fully-fledged programming language;
- easy and intuitive programming;
- opportunities for the collection, processing, data analysis, instrument control, report generation and data exchange through network interfaces;
- driver support for over 2000 devices;
- high speed of execution of programs.

LabVIEW finds application in the most diverse spheres of human activity. In accordance with its name, it was originally used in research laboratories, and at present it is the most popular is software package both in the laboratories of fundamental science and in industrial laboratories. Almost any user, not being a programmer, is able to create complex program which has beautiful and convenient software for data collection and management of objects interface in a short time. [2]

The proposed program received signals from the sensor movement of the plunger and the differential pressure gauge is transmitted to the acquisition Board that sends information to the software module LabVIEW. Then the diagram describing the pressing process is presented.

Diagrams of derived values. In the case of derivatives with a negative sign, it is possible to judge about the unsuitability of the process. In this case there is the indicator that signals the violation process, which stops the program.

The value of the final effort of pressing should be in the range of 380-570 kN (39-58 TC) when the surface roughness of the holes of the wheel hub Rz ≤ 20. The normal form diagram fitting should have a smooth increasing convex upwards curve along the entire length from beginning to end fitting in accordance with Fig. 1.

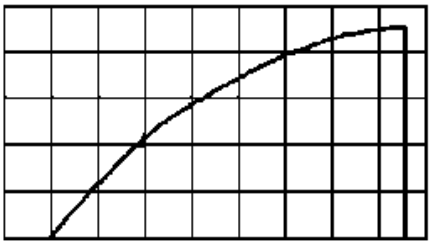

Fig. 1 - Normal form of the diagram of the insertion axis

Generated on each wheelset the indicator draws two diagrams of pressing: for left and right wheels. The quality of pressing wheelsets is controlled by indicator diagrams. The main controlled parameters of the chart are pressing: a finite quantity of effort, length of pairings, the shape of the curve fitting [1].

The automated system equipped with alarm that is triggered when the deviation of the operating parameters of the insertion process from normal values, signals the end of the process of formation of wheel pairs (template control overmoldingwalkes to the middle axis), and also registers a figure fitting in the form of a data file to provide traceability.

Conclusion

The resulting works were proposed the most advantageous for the production method of modernization of the process of formation of wheel pairs through the application software module LabVIEW. The use of the automated system of control and management can detect the violations of the process at this stage of formation of wheel pairs, and thus to increase the reliability of its products.

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МОДЕРНИЗАЦИЯ ПРОЦЕССА ФОРМИРОВАНИЯ КОЛЕСНОЙ ПАРЫ РВ2Ш НА ПРЕДПРИЯТИИ АО «ВРМ» «ТАМБОВСКИЙ ВРЗ»

А.С. Родионова, А.Г. Дивин

Тамбовский государственный технический университет, Тамбов, Россия

e-mail: nastyrodionovada@mail.ru

Аннотация

Предложено внедрение системы автоматического контроля параметров процесса запрессовки колесной пары РВ2Ш на ось, позволяющие снизить долю несоответствий в процессе формирования колесной пары. Кроме того, предлагается внедрить систему контроля диаграммы запрессовки, на основе применения программного модуля LabVIEW.

Ключевые слова: система контроля, виртуальный прибор, диаграмма запрессовки**,** усилие.

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ББК34.5-5-05

THE ADVANTAGES OF THE AUTOMATION METHOD FOR DRINKS PRODUCTION

N. V. Tushentsov
Tambov State Technical University, Tambov, Russia
e-mail:nixon94tmb@yandex.ru

Abstract
The advantages of automation in such areas as: brewing, vodka production, winemaking, production of non-alcoholic and low-alcoholic beverages are considered. The stages of development of each of these directions are analyzed.
Key words: automation, instrumental, drinks, beer, wine, vodka.

In recent years, automation in the drink industry is experiencing a real boom, taking root in an increasingly wide range of industries. It cannot be said that such technologies are a kind of "know-how" of the last time. Already in the Soviet times, automation was used in a number of industries, but before the production of drinks, as they say, they didn't get around. Some experiments were carried out on the introduction of automation in the dairy industry, and that is all. In the recent history of the Russian beverage industry, brewing plants have become pioneers in automation. for the first time in the production of beer the production opportunities coincided with the vital need. In brewing, there are lots of recurring processes, which require exact follow-up of the recipe and compliance with the mass of parameters. In addition, the modern brewery is a very high-performance enterprise, which daily produces many thousands of liters of foam drink and, accordingly, requires high optimization of all processes, while maintaining a constant level of quality. In Russia, the first experiments of automation of breweries brought transnational corporations, these plants acquired. At the same time, automation of brewing was already tested in the West for a long time and showed excellent results in the production of the same Germany. Thus, foreign companies came to Russia with ready-made schemes for modernization of production facilities, established contacts with equipment suppliers and engineering companies, not to mention the significant financial opportunities that all these companies fully possess.

A little later about the optimization of technological processes, through the introduction of automation systems, manufacturers of alcohols began to think. High quality alcohol is impossible without a clear maintenance of all parameters of technological processes, which is difficult to achieve manually. Thanks to automation, modern alcohol manufactures achieve a low content of impurities in the finished product, an order of magnitude higher than the obsolete standards of Soviet GOST standards.

In the vodka industry, automation came even later. Ready-made schemes for automating the technological cycle of Russian vodka production, for obvious reasons,

did not exist abroad. In addition, Russian "vodka makers" themselves initially sought primarily to install high-speed bottling lines at their enterprises, and not to improve technology. With the development of the market, when the consumer began to pay more attention to the contents of the vodka bottle than to the container itself, the producers of strong alcohol also realized the need for automation of production. Vodka producers, striving to improve the quality of the product, win recognition to consumers, it became clear that even from a very high-quality alcohol, with inaccurate compliance with the recipe and violation of production parameters, low-quality vodka may turn out. At the moment, almost all the leading companies in the vodka market have equipped their production with automation systems. Large projects in this area are also being implemented at newly built plants and on all the well-known industry veterans.

As for the production of non-alcoholic and low-alcohol drinks, automation has come to this area for quite natural reasons. From the technological point of view, these production processes are quite simple; the number of processes and operations is limited and can easily be standardized. In addition, the leading players of low-alcohol and non-alcoholic markets have large-scale production capacities, namely, with large volumes of output, automation becomes really necessary.

The technological processes in winemaking are much more difficult to standardize. In this area, the skill of the winemaker is still appreciated much more than the accuracy of computer systems. Nevertheless, engineering companies that modernize wineries offer their customers the means of partial automation, control and management of technological processes, which greatly simplifies the work of winemakers. At the largest wineries, in particular, automatic systems for monitoring and regulating the temperature regime are installed. This "option" is very important for obtaining high quality wine materials, because it is very difficult to precisely control and regulate the fermentation temperature without using such systems. High efficiency elements of automation demonstrate in the field of filtration, as well as various treatments for wines. In particular, therefore, automation is in demand by secondary winemaking enterprises. Long enough winemakers began to use automation in the production of champagne. The continuous method of producing sparkling wines developed during the USSR included a number of automated processes.

It is worth noting that automation has begun to be particularly widely used in most industries in recent years due to the development of computer technology and the element base. Moreover, the huge sets of standard modules manufactured by the world's largest companies, thanks to unified standards, allow them to be applied in the widest areas - from metallurgy to the same beverage industry. All the processes to be regulated and controlled are monitored by special sensors, the sensor data is transferred to the control unit of all processes. A computer module is a logical controller that transmits commands to actuators-various pumps, valves, control valves. An important factor in the spread of automation was the significant reduction in the cost of the above elements, due to the development and improvement of

technologies. Thus, automation systems, which used to be unique “piece” developments, are now available to many, including small businesses. In addition to the hardware itself, programming capabilities have reached a whole new level.

The developed languages have emerged for writing programs that are used in automation systems. For example, one of the world leaders in this field - the transnational giant Siemens uses the programming language of its own development - Step 7. Currently, a new version of this language is widely implemented, including in Russia, Step-7. High-level programming languages make it convenient to create a software product that is oriented to each specific enterprise and its technological chain, allow creating a user-friendly interface, visual means of visualization of technological processes.

Speaking about the advantages of automation of any plant, and beverage manufacturers who implemented such systems in their production facilities, and suppliers of these systems often speak of a high level and, most importantly, the stability of the quality of the product. Indeed, this function of automated systems is the most obvious. Well-tuned machines, computers and sensors ~~are~~ mistake~~n~~ much less often than humans. In this regard, automation is particularly in demand in those areas where high accuracy of technology compliance is required. In brewing and winemaking, for example, such an automated system is in the monitoring the temperature of fermentation. In vodka production, thanks to automated sorting systems, the problem of stable and accurate preparation of a water-alcohol solution of the required strength completely disappears. The same can be said about the production of low-alcohol beverages, the formulation of the vast majority of which includes alcohol. A wide application of automation was obtained in the technological processes associated with the metering in the flow of the exactly specified amount of ingredients. In addition, the high quality of the product is directly related to the hygiene of process equipment and pipelines, through which raw materials and finished products are fed. To solve this problem, the vast majority of large enterprises - beverage manufacturers today installed automated cleaning systems - CIP (Cleaning In Place). CIP allows speeding up significantly the washing process of various technological circuits, which makes it possible, for example, to spill different types of drinks on the same line, moving quickly from one batch to another. Even more important is the fact that a properly configured CIP system does not allow errors by opening and closing certain valves and taps, directing the flow of cleaning liquid and water along a strictly specified "route". All data coming from special sensors is taken into account by the electronic system, which, in accordance with the control parameters, regulates the water temperature, the washing speed, the concentration in the detergent solution of the reagents. If you do a manual washing, the worker can forget to close the necessary faucet and the washing solution will get into the container with the drink. And such an accident can cost the company even more expensive than the installation of CIP.

The use of automated systems as an emergency “insurance” is another important automation function. If the flow of any liquid is sent to a container under

the control and control of sensors and electronic systems, you cannot be afraid of overfilling and overfilling - the automation will not “forget” to turn off the pump when the liquid reaches a certain level. By the way, there are the level control sensors and the temperature control sensors that are most popular when introducing a fairly inexpensive partial automation system.

Automation of production, allowing tracking the direction of flow and the number of pipelines of raw materials and finished products, performs one important function from an economic point of view - control and accounting. Thus, it is possible to avoid the typical Russian “disease” - thefts in production.

Another advantage of automation, which is worth mentioning, is speaking about the economic feasibility of its implementation - the reduction ~~in~~ the number of employees in the production. Particularly indicative is the efficiency of automation of production processes when considering the “dry cycle” of production - packaging of finished products in boxes. A few years ago, manufacturers tried to save on the purchase of various stackers and shapers boxes, preferring to hire additional personnel who carried out these operations manually. At first glance, it is really cheaper to hire 10 people and pay them a salary of 100-150 dollars a month than immediately lay out 30-50 thousand dollars for the corresponding equipment. But this is only an apparent saving. First, for any serious enterprise, ten people on the packaging cycle is not enough, and secondly, in recent years the average level of wages at Russian enterprises has grown significantly, and, accordingly, the expenses for maintenance of brigades have increased. In addition, manual packaging requires more space in the workshop, and the cost of renting production facilities is also increasing. And if we take into account the instability of our alcohol market and the regularity of the forced downtime of dozens of enterprises associated with various legislative initiatives, the advantage of automation in this production cycle becomes obvious. An idle machine does not require much money to keep it, in contrast to staff who need to pay vacation benefits and vacation pay. At the stages of the technological cycle, the introduction of automation does not give such a significant reduction in personnel, as in the “dry cycle”, but the savings are still quite obvious. The author of the material was visited at highly automated enterprises, which, with considerable productivity, were managed by only two or three operators engaged in controlling technological processes.

Of course, with all the advantages of automation, the introduction of such systems in production should be taken more than seriously. In order to fully experience the effect of the modernization of the enterprise, it is necessary to select carefully the company-designer and supplier of systems. The "golden rule" of any serious engineering company working in this field is that each project is unique and that the customer's representatives should directly participate in its development. After all, no one, except specialists working on the creation of a drink, thoroughly understands all the subtleties of its production. And one more important point: despite the fact that automation in recent years is becoming more accessible, the introduction of such systems requires serious material costs. It is necessary to calculate the

effectiveness of automation of each stage of the technological chain, because the operation that is performed once a month is still cheaper to perform manually. In addition, the correct selection of the engineering company and automation means, undoubtedly, must be carried out with all possible attention. Having trusted the control and management of technological processes of automation it is necessary to be completely confident in the reliability of the system. There are cases when, due to the failure of an important block of an automated system, large enterprises stood idle for several days, suffering enormous losses.

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ПРЕИМУЩЕСТВА АВТОМАТИЗАЦИИ ПРОИЗВОДСТВА НАПИТКОВ

Н.В. Тушенцов

Тамбовский государственный технический университет, Тамбов, Россия

e-mail:nixon94tmb@yandex.ru

Аннотация

Рассмотрены преимущества автоматизации в таких областях как: пивоварение, водочное производство, виноделие, производство безалкогольных и слабоалкогольных напитков. Проанализированы этапы развития каждого из этих направлений.

Ключевые слова: автоматизация, напитки, технологический процесс, алкоголь

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THE SOLUTION OF PROBLEMS OF TECHNOGENIC SAFETY IN THE DESIGN OF FIRE PROTECTION OF A PETROL STATION

A. A. Erokhina, E.V. Troegubova
Tambov State Technical University, Tambov, Russia
e-mail: nastya-twin156@yandex.ru

Abstract
Currently, the number of cars and the number of petrol stations (gas stations) in our country is increasing considerably. For petrol stations, fire danger has increased due to the availability of large amounts of stored combustible motor fuel – gasoline, kerosene, diesel fuel, gas mixtures. The relevance of this research is due to the extreme importance at the stage of designing gas stations correctly. We need to assess the fire and explosion hazards, to identify possible causes of accidents, to identify hazards and to choose reasonable methods and means of fire protection. In this paper, we developed organizational and technical measures to ensure fire safety by using systems of fire prevention, fire protection, as well as complex organizational and engineering activities.
Key words: petrol station, fire safety, design.

It is extremely important to assess correctly the fire and explosion hazard of the facility at the design stage of the gas station, identify possible causes of accidents, identify hazardous factors and scientifically justify the choice of methods and means of fire protection.

An important factor in conducting this work is knowledge of the processes and conditions of combustion and explosion, the properties of substances and materials used in the construction of gas stations, methods and means of protection from fire and explosion.

It is impossible to ensure a high level of protection of a petrol station from fire without the development of a fire safety system consisting of a fire prevention system, fire protection system, and a complex of organizational and engineering measures.

A large number of legal, regulatory and organizational acts have been adopted in the Russian Federation containing requirements for the organization of fire protection and industrial safety of facilities. The legal basis of technical regulation in the field of fire safety is the Constitution of the Russian Federation, generally recognized principles and norms of international law: the Federal Law “On Technical Regulation”, the Federal Law “On Fire Safety”, and the Federal Law “Technical Regulations on Fire Safety Requirements”.

According to the normative documents [1], each protection object should have a fire safety system designed to exclude the possibility of a fire and ensure the safety of people, as well as property protection at fire.

The fire safety system of the protection facility consists of [2] a fire prevention system, a fire protection system, a complex of organizational and technical measures aimed at ensuring fire safety.

The purpose of this work is to consider the problems of man-caused safety in the design of the fire protection of a petrol station.

It is known that a traditional petrol station is an object whose technological system provides refueling of vehicles only with liquid motor fuel [3]. At the same time, this object is characterized by an underground arrangement of reservoirs, as well as their separate placement with fuel dispensers (fuel dispensers)

The fire protection system includes an automatic fire extinguishing system, an automatic fire alarm system, an alert and evacuation control system for people in case of fire, as well as an external fire-fighting water supply.

At the first stage of the design, a substantiation of the fire-prevention distances between buildings, structures and external installations, which provide fire safety of the construction object, is carried out.

The development of a fire prevention system in the design of a gas station involves the following ways to eliminate the conditions for the formation of a combustible medium and the formation (or introduction) of ignition sources in it:

- all equipment used at the petrol station must have appropriate certification and technical and operational documentation;
- the layout of the petrol station, taking into account the location of buildings and facilities on its territory, should exclude the possibility of spreading the emergency fuel spill both on the territory of the gas station and outside it;
- fuel dispensers must be equipped with a shut-off valve for instantaneous operation when the fuel dispenser is ignited, and immediately stop the supply of gasoline to the dispenser;
- fuel dispensers must provide automatic blocking of fuel supply at the nominal filling of the fuel tank of the vehicle;
- at a petrol station, the fuel dispenser must be protected from damage by vehicles;
-greening of the territory of a petrol station should be carried out by shrubs that do not produce flakes, fibrous substances or pubescent seeds during flowering;
- operations for receiving, storing and dispensing fuel, emptying and desliming (removal of bottom water), and leakproofness tests should be carried out only in a closed manner (with the exception of filling fuel tanks of vehicles);
- cleaning of tanks from the remains of stored fuel, degassing and purging during their repair should be mechanized and fire and explosion proof;
- the inter-wall space of reservoirs for storage of gasoline and diesel fuel must be filled with tosol-40 (coolant with a freezing point of -40 ° C) and monitor its level;
- it is necessary to monitor the current value of the fuel level in the tanks, as well as provide protection against overflow;

- it is necessary to ensure the recycling of fuel vapors from the storage tank to the tank, which is designed to prevent emissions of petrol vapors into the atmosphere during fuel drainage;

- the emergency fuel drain tank should be located underground and be equipped with deaeration, emergency spill response systems, a limit level sensor, and level and stripping level pipelines;

- anticorrosion protection should be performed with tanks and pipelines;

- emergency shutdown buttons in explosion-proof design must be installed in the building and on the site for an emergency power failure of the petrol station complex.

Elimination of the conditions of formation in a combustible environment of ignition sources at filling stations is possible to provide in the following ways:

- covers, plugs and joints of flanges, nipples, fittings and the like located on the fuel equipment of the filling station should be provided with gaskets made of non-sparking materials resistant to oil products and the environment under operating conditions and connected to ensure tightness;

- the installation of covers of technological shafts or wells in which there is equipment, should exclude the possibility of falling into them of atmospheric precipitation and sparking when opening and closing the covers. The fixing of the caps must ensure the release of excess pressure with the possible ignition of fuel vapors inside the shafts and wells (self-flipping cover with the exclusion of the possibility of its detachment);

- illumination of the canopy above the fuel dispenser of the petrol station must be done with built-in luminaires of explosion-proof design.

In the process of justifying design solutions for outdoor fire-fighting water supply, as well as in determining the driveways and entrances for firefighting equipment, the following measures were developed. In particular, the general plan of the site of the petrol station has been developed, taking into account the existing terrain, roads and projected communications, as well as conditions for the safe movement of vehicles, an efficient transport interchange providing the maximum capacity of the station. In addition, during the development of the general plan, an independent road access to any filling island with a fuel dispenser and an island with an installation for pumping tires and a vacuum cleaner, a minimum extension of communications and utilities, and permissible turning radius of vehicles are also provided.

At the petrol station automatic fire alarm system, powder fire extinguishing system, warning and evacuation control system for people in case of fire and loudspeaker warning are provided.

Automatic fire alarm systems are planned to be installed in the service building of passengers and drivers. Taking into account the technical characteristics of the well-known fire detectors and the features of the projected premises in accordance with [4], the project proposed to use the following equipment:

- smoke detectors of smoke optic-electronic type SD 212- 45, which react to smoke in the room;

- fire manual detectors FMD, giving an alarm signal on the means of fire alarm when exposed to a person;

- a sound device for fire alarm inside and outside the building.

In order to ensure the fire safety of the projected petrol station, a list of organizational and technical measures is proposed, which includes:

1. Organization of fire protection.

2. Certification of substances, materials, products, technological processes, buildings and facilities of the facility with respect to ensuring fire safety.

3. Involve the public in the consideration of fire safety issues.

4. Organization of training of the personnel of the filling station for fire safety rules. Training of personnel should include fire safety rules and instructions on fire safety measures, characteristics of fire hazard of buildings and structures, fire prevention and fire protection systems, properties of stored and used substances and materials on the site in terms of their fire hazard, rules for the maintenance and use of fire-extinguishing media, actions in the event of fire.

5. Development of instructions for the use of fire hazardous substances and materials and compliance with fire fighting regulations, as well as the operation of personnel in the event of a fire.

The fire-fighting regime in the territory of the projected petrol station is provided by traditional measures. In particular, temporary fire-dangerous work is regulated, the procedure and terms for the fire-brigade training and fire-technical minimum training sessions are established, and those who are responsible for their execution.

In addition, manufacturing, administrative, storage and auxiliary premises and external facilities are equipped with plates with information on the category of premises for explosion and fire danger, class of explosive or fire hazardous areas, employee responsible for fire safety, instructions on fire safety measures, phone numbers of the call of fire protection and responsible for the management of works on containment and elimination of fire hazardous situations and fires on the part of the operating organization.

6. Development and wide application of posters focused on increasing fire safety.

7. Development of personnel activities at a fire and the organization of people’s evacuation.

At the next stage, calculation of the automatic powder fire extinguishing installation for the projected facility was made. At the same time, the number of powder fire extinguishing modules PFEM - 2.5 “Buran” was determined for the main and auxiliary premises of the station.

A set of design, volume-planning and engineering solutions to create a fire safety system for a gasoline station is substantiated and developed.

Automatic fire extinguishing systems, automatic fire alarm and a system of warning and management of people's evacuation during a fire are developed. Selection of the necessary equipment was carried out.

Organizational and technical measures to ensure fire safety of filling stations were developed.

Thus, it is impossible to ensure a high level of protection of a petrol station from a fire without the development of a fire safety system, which includes a fire prevention, fire protection and a complex of organizational and engineering measures.

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РЕШЕНИЕ ПРОБЛЕМ ТЕХНОГЕННОЙ БЕЗОПАСНОСТИ ПРИ ПРОЕКТИРОВАНИИ ПРОТИВОПОЖАРНОЙ ЗАЩИТЫ АВТОЗАПРАВОЧНОЙ СТАНЦИИ

А.А. Ерохина, Е.В. Троегубова
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: nastya-twin156@yandex.ru

Аннотация

В настоящее время одновременно с увеличением количества автомобилей в нашей стране существенно выросло и число автозаправочных станций (АЗС). Для автозаправочных станций характерна повышенная пожарная опасность вследствие наличия на них больших объемов хранимого легковоспламеняемого моторного топлива – бензинов, керосина, дизельного топлива, газовых смесей. Актуальность настоящей работы объясняется чрезвычайной важностью уже на стадии проектирования автозаправочных станций корректно провести оценку их пожаро- и взрывоопасности, установить возможные причины аварий, определить опасные факторы и обоснованно выбрать способы и средства защиты от пожара. В работе разработаны организационно-технические мероприятия по обеспечению пожарной безопасности на проектируемом объекте, состоящей из системы предотвращения пожара, противопожарной защиты, а также комплекса организационных и инженерно-технических мероприятий.

Ключевые слова: автозаправочная станция, пожарная безопасность, проектирование.

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DETERMINATION OF THE TOTAL PARAMETER OF POLLUTION OF SOILS BY HEAVY METALS

I. I. Khvostov
Tambov State Technical University, Tambov, Russia
e-mail: van.khvostov@mail.ru

Abstract
Road transport is one of the main sources of pollution of biosphere, namely air, water, vegetation and fertile soil. The number of cars is steadily increasing; so is the traffic intensity; this leads to an increase in the total emission of toxic substances. Heavy metals, reaching a maximum concentration in the body, begin to poison the body, causing various negative consequences.
Key words: heavy metals, automobile transport, soil pollution.

One of the major sources of heavy metals in soil is transport. As a result, there is an automotive emission pollution of roadside ecosystems. Usually this contamination is polymentic in nature. Soil contamination by several HM (heavy metals) is measured by the largest total parameter of pollution.

Using the data in table, total soil pollution (Zsp) at different distances from the road calculated by the formula

$$Zsp = \Sigma Kcmc\text{-}(n) \text{ -}1;$$

where (n) is the number of certain ingridients, K_{cmc} is koeffecient of metal concentration equal to private by dividing mass percentage of (i)-th substance in contaminated and background soils. The data entered in table 2

Next a growth rate of Cd, Pb, Zn in the soil, was estimated depending on the distance from the road

$$Var = \frac{C_{cp} - C_{bc}}{T}$$

where V_{ar} is a speed of accumulating rate HM, mg/kg per year, C_{bc}-the background content of pollutans HM in soil, mg/kg, C_{cp}- is content of heavy metals in contaminated soil, T- is the period of time during which occurred the contamination of soil (have 30 years) is occured (table 4).

Then, we calculated how many years it takes the ecosystem to reach the TAC (tentative allowable concentration) at a constant speed of accumulation of HM in soil:

$$T = \frac{C_{TAC} - C_{cp}}{V_n}$$

where C_{TAC} is tentative allowable concentration of HM in soil, mg/kg, T is time to reach TAC HM in soil.
The received data are shown in Table 3.

Table 1.Contents of heavy metals in soil of roadside ecosystems mg/kg

The distance from the road m	CD	PB	Zn	CU	NI	Co	CR
5	1.23	22.0	44.9	19.8	44.9	13.8	22.5
10	1.15	20.6	44.3	18.8	43.3	13.3	22.5
15	1.15	19.9	43.6	18.8	43.3	12.8	20.0
20	1.00	19.3	43.5	17.8	43.3	12.8	20.0
30	0.70	13.5	42.8	17.8	41.6	12.8	20.0
40	0.70	13.5	39.9	17.3	41.6	12.3	17.5
60-200 background	0.45	13.5	39.0	17.3	41.6	11.3	17.5
With the JDC	2.00	130	220	132	80	Notinstalled	100

Table 2. Concentration ratios of HM in soil and total contamination indicator

The distance from the road M	Concentration ratios (Kcmc)							Zsp
	CD	PB	Zn	CU	NI	Co	CR	
5	2.73	1.63	1.15	1.14	1.07	1.22	1.28	4.22
10	2.55	1.48	1.13	1.08	1.04	1.17	1.28	3.73
15	2.25	1.47	1.11	1.08	1.04	1.13	1.14	3.22
20	2.22	1.42	1.11	1.02	1.04	1.13	1.14	3.08
30	1.55	1	1.09	1.02	1	1.13	1.14	1.93
40	1.55	1	1.02	1	1	1.08	1	1.65

Table 3. Time to reach TAC HM in soil

The distance from the road m	Time to reach TAC HM in soil (t)					
	With (d)	PB	Zn	CU	NI	CR
5	9	127	296	448	106	155
10	12	154	331	754	215	1 55
15	12	172	383	754	215	320
20	18	190	392	2284	215	320
30	52	-	466	2284	-	320
40	52	-	2011	-	-	-

Table 4. Accumulation Rate of (C) , Pb , Zn in the soil, depending on the the distance from the road (for 30 years)

The distance from the road M	Speed of accumulation in the soil (Var) (for 30 years)		
	With (d)	PB	Zn

5	0.026	0283	0196
10	0.023	0236	0176
15	0.0 23	0.213	0.153
20	0.0183	0.193	0.15
30	0.0 083	0	0.126
40	0.0 083	0	0.03

According to the source data and the calculations, the following results were received: total concentration of heavy metals in soil decreases in addition value (K_{cmc}) dis not exceed the norm (< 16) and the environmental assessment of soil condition was satisfactory.

The calculated velocity and time of TAC showed that in 30 years the contamination by heavy metals would not exceed the norm.

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ОПРЕДЕЛЕНИЕ СУММАРНОГО ПОКАЗАТЕЛЯ ЗАГРЯЗНЯЮЩИХ ВЕЩЕСТВ ТЯЖЕЛЫМИ МЕТАЛЛАМИ

И. И. Хвостов
Tambov State Technical University, Tambov, Russia
e-mail: van.khvostov@mail.ru

Аннотация

Автомобильный транспорт является одним из основных источников загрязнения, которое происходит во всем пространстве нашей биосферы, а именно: воздух, вода, растительность и плодородная почва. Количество автомобилей неуклонно растет, интенсивность движения увеличивается, поэтому это приводит к увеличению общего объема выбросов токсичных веществ. Тяжелые металлы, достигающие максимальной концентрации в организме, начинают отравлять организм, вызывая различные негативные последствия.

Ключевые слова: тяжелые металлы, автомобильный транспорт, загрязнение почвы.

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ББКК 663.054

CALCULATION OF EMISSIONS FROM THE GALVANIC SECTION

G. S. Kozadaeva
Tambov State Technical University, Tambov, Russia
e-mail: galya.kozadaeva@mail.ru

Abstract
Galvanic baths are the most dangerous parts of machine-building enterprises for the environment and man. Such areas have a serious impact on the environment: about 84% of all sewage sludge is due to rinsing galvanic baths, in such areas a large amount of solid waste is generated, and toxic substances (heavy metals) are released into the atmosphere.
Key words: galvanic baths, emissions, ecology.

Introduction

When covering metals, the following types of coatings can be used: chrome, zinc, nickel, tin, copper, etc. The application of metal coatings consists of 3 stages: 1 - preparation (mechanical treatment, degreasing, etching, polishing) 2 - formation of the corresponding coating 3 - finishing operations (painting, varnishing, polishing)

The maximum one-time emission is determined by the formula:

$$G = S*q*k_y$$

where: S is the area of the baths, sq.m

q is a specific allocation of pollutants, g/(s*m^2)

k_y is the bath cover ratio. In the presence of a surfactant in the solution, k_y = 0.5, in the absence of a surfactant, k_y = 1.

Gross output is determined by the formula:

$$W = G * T * 3600 * 10^{-6}$$

where T is the operating time of the equipment, h/year

Initial data

The name of the process is degreasing.

Bath composition: Trisodium phosphate - 25-45 g/l

Calcined soda - 25-45 g/l

The area of the bath is 0.875 sq.m.

k_y = 1

Working time: 8h/day

125days/year

Specific allocation of pollutants.

Sodium phosphate - 0.004 g/(s*m^2)

Sodium carbonate - 0.004 g/(s*m^2)

Calculation results

(3132) Sodium Phosphate

G = 0.004 * 0.875 * 1 = 0.0035 g/s

W = 0.0035 * 8 * 125 * 3600/1000000 = 0.0126 t/g
(0155) Sodium carbonate
G = 0.004 * 0.875 * 1 = 0.0035 g / s
W = 0.0035 * 8 * 125 * 3600/1000000 = 0.0126 t/g

Initial data

Process name – is galvanizing.
The composition of the bath: zinc oxide - 60-100 g/l
sodium hydroxide 250 - 500 g/l
iron chloride - 1-1,2 g/l
Potassium-sodium tartrate - 10-15 g/l
Bath area - 1,75sq.m.
k_y= 1
Working time: 8h/day
125days/year
Specific allocation of pollutants
zinc oxide 0.001 g/(s*m^2)
sodium hydroxide 0.055 g/(s*m^2)

Calculation results

(0207) zinc oxide
G = 0.001 * 1.75 * 1 = 0.00175 g/s
W = 0.00175 * 8 * 125 * 3600/1000000 = 0.0063 t/g
(0150) sodium hydroxide
G = 0.055 * 1.75*1 = 0.09625 g/s
W = 0.09625 * 8 * 125*3600/1000000 = 0.03465 t/g

Initial data

Name of the process – is nickel plating.
The composition of the bath: nickel sulphate - 300-400 g/l
Nickel dichloride -20 - 30 g/l
boric acid - 30-35 g/l
The bath area is 0.91 m^2.
k_y = 1
Working time: 8 hours/day
125 days/year
Specific allocation of pollutants
nickel soluble salts (in terms of nickel) - 0.0002 g/(s*m^2)
Boric acid - 0.0005 g / (s * m 2)

Calculation results

(0165) nickel soluble salts (in terms of nickel)
G = 0.0002 * 0.91*1 = 0.000182 g/s
W = 0.000182 * 8*125 * 3600/1000000 = 0.000655 t/g
(0308) Boric acid
G = 0.0005 * 0.91 * 1 = 0.000455 g/s
W = 0.000455 * 8 * 125 * 3600/1000000 = 0.001638 t/g

Initial data

The name of the process - is decorative decoating

The composition of the bath: lead borftoristy - 180-220 g/l

tinborofluoride 30-40 g/l

hydrofluoric acid 35-45 g/l

The bath area is 0.91 m^2

$k_y = 1$

Working time: 8h/day

125days/year

Specific allocation of pollutants

tinborftluoride 0.00023 g/(s*m^2)

boric acid 0.0005 g/(s*m^2)

hydrofluoric acid (in terms of nonboriferous fluoride) - 0.00007 g/(s*m^2)

Calculation results

(0344) tin borofluoride

G = 0.00023 * 0.91 * 1 = 0.0002093 g/s

W = 0.0002093 * 8 * 125 * 3600/1000000 = 0.000753 t/g

(0308) boric acid

G = 0.0005 * 0.91 * 1 = 0.000455 g/s

W = 0.000455 * 8 * 125 * 3600/1000000 = 0.001638 t/g

(0311) hydrofluoric acid (in terms of nonboriferous fluoride)

G = 0.00007 * 0.91 * 1 = 0.0000637 g/s

W = 0.0000637 * 8 * 125 * 3600/1000000 = 0.000229 t/g

Conclusion

Total from source:

Code	Name of pollutant	Maximum one-time emissions, g / s	Gross emissions, t / year
0150	Sodium hydroxide	0.0962500	0.346500
0155	Sodium carbonate	0.0035000	0.012600
0165	Nickel soluble salts (in terms of nickel)	0.0001820	0.000655
0207	Zinc oxide	0.0017500	0.006300
0308	Boric acid	0.0009100	0.003276
0322	Sulfuric acid	0.0061250	0.022050
0344	Tin borftorous	0.0002093	0.000753
3132	Sodium Phosphate	0.0035000	0.012600
0311	Hydrofluoric acid (in terms of nonboro fluoride)	0.0000637	0.000229

Having made the calculation and placing it in the table, we see that at this site the pollutant emissions are minimal and do not exceed the established MPC, and therefore this site does not threaten human life and ecological catastrophe.

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РАСЧЕТ ВЫБРОСОВ ОТ ГАЛЬВАНИЧЕСКОГО УЧАСТКА

Г.С. Козадаева
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: galya.kozadaeva@mail.ru

Аннотация

Гальванические ванны — являются наиболее опасными участками машиностроительных предприятий для окружающей среды и человека. Такие участки оказывают серьезное влияние на экологию: около 84% всех загрязнений стоков происходит из-за промывки гальванических ванн, на таких участках образуется большое количество твердых отходов, происходит выброс отравляющих веществ (тяжелых металлов) в атмосферу.

Ключевые слова: гальванические ванны, выбросы, экология.

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ББК 39.12

WAYS AND METHODS OF REDUCING EMISSIONS OF HARMFUL SUBSTANCES BY AUTOMOBILE TRANSPORT

S. I. Kotenev, E. S. Makeev
Tambov State Technical University, Tambov, Russia
e-mail: kotenev.igor@yandex.ru

Abstract
Ways of reducing the impact of harmful emissions on the human body are considered, and measures to achieve this goal are proposed.
Key words: car, ecological safety, harmful emissions, safety of vehicles.

Introduction

The development of civilizational processes has led to the aggravation of many problems of humanity, one of which is the ecological one. Negligent attitude to the problem of environmental pollution can lead to irreversible consequences in the ecological situation of the whole world in the near future. One of the key components of regional problems in the field of ecology is transport. Dustiness and gas contamination of air are related to the man-caused danger.

The effect of harmful emissions on the human body

Carbon monoxide is the presence of harmful or explosive gaseous substances in tangible concentrations in the air. The pollution air is a phenomenon characteristic for practically all the cities of the world. And the exhaust gases of cars which produce dangerous substances for health, cause this situation during the exhaust, carbon monoxide gas is released which is dangerous for human health in high concentrations. High concentrations of this gas lead to fatigue, drowsiness, headaches, dizziness and other symptoms. As a result of inhalation of gases, a number of serious dangerous diseases occur, in particular, a heart attack, lung diseases. For the most part, drivers who often drive cars and get stuck in traffic jams suffer from gas contamination. They are very close to working engines of machines constantly exposing themselves to a multitude of risks. And all people living in large cities and especially in homes in close proximity to busy streets, risk their health daily. Motor gasoline, for example, evaporates at room temperature at the speed of 400 g / h from the surface of $1m^2$. Of all the petroleum products, it gives the greatest amount of poisoning. The concentration of gasoline 3 - 4 g / m^3 after 2 ... 3 min causes coughing, tears, unstable gait; concentration of 30-40 g / m^3 leads to poisoning with loss of consciousness after 3 ... 4 inhales. The greatest danger is represented by hydrogen sulphide and ammonia, which accumulate on livestock farms and dwellings, etc. Sometimes the concentration of these gases is so great that a person who descends into an empty collection box without protective equipment loses consciousness after 1 to 2 inhales. In addition, ammonia vapors explode at the concentration of 16 - 27%, gasoline - 0.76 - 5.03%.

Ways of reducing harmful substances in the exhaust gases of cars

1. Economy of fuel.

The less fuel we burn, the less emissions there will be into the atmosphere. Absolute leaders here are the Japanese. Their best cars consume 5 liters of petrol per 100 km of mileage and even less.

2. Increase in fuel quality.

- use of gasoline low-sulfur varieties of oil for the production in order to completely eliminate SO_2-emissions and in the use of lead in motor fuel;

- additives to fuel substances that help burn off harmful emissions or dissolve organic fractions which reduce emissions of aromatic hydrocarbons.

3. Neutralizers of exhaust gases.

They first appeared in the early 1970s. Carbon monoxide and unburnt particles were burned in the exhaust system of the machine. Initially, these were two-component oxidation-type devices that dealt only with CO. Then three-component catalysts appeared which also extracted nitrogen oxides. This system is connected to the exhaust system of the car. At temperatures of 600-800 ° C (heated by high-frequency currents), the gases are burned off.

4. Diesel fuel.

The German engineer Rudolf Diesel (1858-1913) constructed an engine different from the carburetor that immortalized his name. 15% of foreign cars are equipped with this engine. Structurally, it is similar to a gasoline engine. It operates on a four-cycle cycle, but it does not have a spark ignition system. In a gasoline engine, a mixture of fuel and air is formed in the intake system and enters the engine in the finished state, ignited by the spark plug. In the diesel at the suction stroke, pure air enters the cylinder. There it is compressed (compression stroke) and heated to the ignition temperature (700-800 ° C). And only at this moment fuel is injected into the combustion chamber under high pressure (10-30 MPa) through the injector. The injection is carried out by a high-pressure fuel pump - one of the most complex and responsible engine units. This makes it possible to use heavier oil fractions and work on lean mixtures, in which CO emissions are 20-30 times less, hydrocarbons - 2-10 times less (depending on speed and braking).

Conclusion

In order to save a car for the mankind, it is necessary to minimize harmful emissions. Measures are taken all over the world and they give certain results. Cars that are currently produced in industrialized countries emit harmful substances 10-15 times less than 10-15 years ago. In all developed countries there are standards for harmful emissions. In 2000 stricter norms were introduced. So, instead of restrictions on smokiness, rationing of solid particles is introduced, on the surface of which aromatic hydrocarbons dangerous to human health and, in particular, carcinogenic benzopyrene are adsorbed. The list of substances, the content of which must be under control, is constantly expanding.

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ПУТИ И МЕТОДЫ СНИЖЕНИЯ ВЫБРОСОВ ВРЕДНЫХ ВЕЩЕСТВ АВТОМОБИЛЬНЫМ ТРАНСПОРТОМ.

С. И. Котенев, Е. С. Макеев
Тамбовский государственный технический университетб Тамбов, Россия
e-mail: kotenev.igor@yandex.ru

Аннотация

Рассматриваются пути снижения воздействий вредных выбросов на организм человека, и предлагаются конкретные меры для достижения этой цели.

Ключевые слова: автомобиль, безопасность автотранспортных средств, вредные выбросы, экологическая безопасность.

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ББК 39.12

MATHEMATICAL MODELING OF THE BIOLOGICAL PROCESS OF SEWAGE TREATMENT

V. V. Teplyakov, A. N. Senatorova
Tambov State Technical University, Tambov, Russia
e-mail: vovatgtu@ya.ru

Abstract
The article deals with the mathematical modeling of the process of biological wastewater treatment. All calculations were carried out with the use of the C ++ application program.
Key words: activated sludge, aeration tank, biological oxygen demand (BOD), biomass, chemical oxygen demand (COD), mathematical model, recycle.

The energy crisis caused by the reduction of fossil fuel reserves and the environmental situation, forcing mankind to take up the issue of the efficiency of the use of energy resources. A review of literature sources showed that a change in the hydrodynamic regime of the aeration tank from mixing to displacement and controlled air supply increases the energy efficiency of the treatment facilities.

Modeling the processes of biological purification has a long history, if we consider that the first model for describing the rate of growth of microorganisms was developed by Mono in 1942. He used a unicellular pure culture and a homogeneous substrate in his work, assuming the rate of growth is limited by the concentration of substrate S:

$$\mu = \hat{\mu} \cdot S/(K_S + S), \quad (1)$$

where $\hat{\mu}$ is the maximum specific growth rate of the crop; K_S - is a semi-saturation constant equal to the concentration of the substrate at which the process speed is equal to $\hat{\mu}/2$.

Over the past decades, knowledge in the field of enzymatic processes has been constantly improving; models of biological treatment - Eckenfelder, McKinney, Godie, Lawrence and McCarthy and others, new constructions of apparatus - tubular, disk, membrane, etc. have been developed. Processes using recycles, new ideas emerged in the application of mathematical models, not only at the design stage of treatment plants, but also for their management in the normal functioning.

The Mono kinetics has been criticized, but it is used by many authors.

A simplified scheme of treatment facilities is shown in Fig. 1.

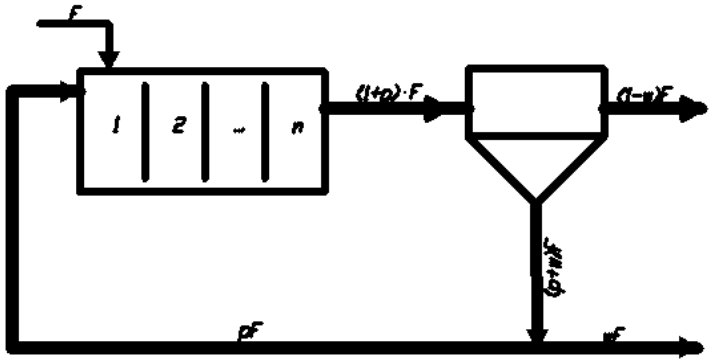

Fig.1. Simplified scheme of treatment facilities: F - water flow, p - recycling fraction, ω - fraction of sludge selection, 1,2 ... n- number of sections.

When developing a mathematical model of the wastewater treatment process, the following assumptions are made:

- aero tank is a sequence of reactors of ideal mixing;
- the kinetics of biochemical processes is described by the Mono model.
- the limiting factors of the process are the concentration of the substrate and the concentration of dissolved oxygen in the reactor;
- The concentration of microorganisms in purified water is negligible (ideal sedimentation tank).

Taking into account the accepted assumptions, the equations of the mathematical model of the process of biological sewage treatment have the following form.

1. Microorganisms of activated sludge, X:

$$\frac{dX_i}{d\tau} = \mu \cdot X_i + \frac{F}{V_i}(X_{i-1} - X_i); \tag{2}$$

2. Chemical oxygen demand (COD) or substrate for activated sludge, S:

$$\frac{dS_i}{d\tau} = -\frac{1}{Y} \cdot \mu X_i + \frac{F}{V_i}(S_{i-1} - S_i); \tag{3}$$

3. Growth rate of microorganisms

$$\mu = \mu_{\max} \cdot \frac{S_i}{K_s + S_i} \cdot \frac{C_i}{K_c + C_i} \tag{4}$$

4. Dissolved oxygen, C:

$$\frac{dC_i}{d\tau} = \frac{F}{V_i}(C_{i-1} - C_i) - K_{O_2} \cdot \mu X_i + \frac{S_p}{V_i} \cdot K_{mp} \cdot (C^* - C_i) \tag{5}$$

5. The surface of the mass change (bubbles in the liquid layer)

$$S_p = \frac{G_{ai} \cdot h}{1200 \cdot W_a \cdot R_b} \tag{6}$$

In equations (2) - (6), F is the flow rate of the suspension, liter / h; V_i is the cell volume, liter; Y is the growth factor of microorganisms of activated sludge, mg/mg;

μ is a maximum specific rate of biomass growth, 1/hour; K_s, K_c is an oxygen saturation constants for heterotrophs and nitrifiers, mg/liter; K_{O_2} is a volumetric mass transfer coefficient for oxygen, mg/l; C^* is a concentration of saturation of dissolved oxygen, mg / liter; R_b is an air bubble radius, mm; W_a is a speed of air bubble ascent, m / s; G_a is an air consumption, m^3/h; h is a height of the slurry layer, m; S_p is the surface of the mass change (bubbles in the liquid layer), m^2.

When testing the model, the following results were obtained:

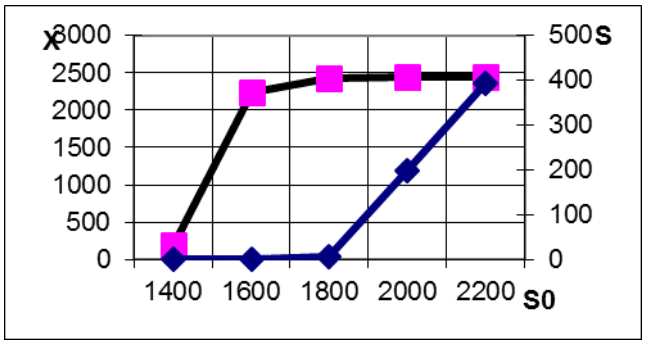

Fig.2. Graph of the dependence of the biomass concentration and BOD on outlet from the reactor from the BOD at the inlet

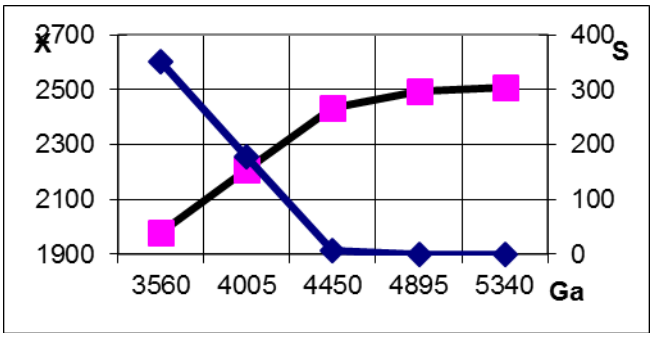

Fig.3. Graph of the dependence of the biomass concentration and BOD on reactor outlet from air flow

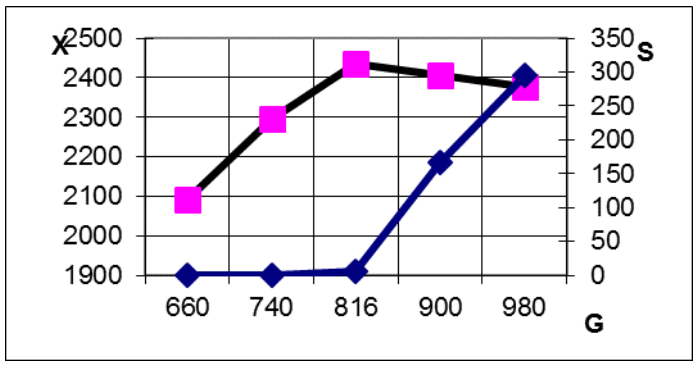

Fig.4. Graph of the dependence of the biomass concentration and BOD at the outlet from the reactor on the consumption of wastewater

A mathematical model of the aero tank-sedimentation system is developed suitable for research and decision-making in the reconstruction and design of treatment facilities. The application in practice of the results of mathematical modeling obtained by us makes it possible to reduce the energy consumption of a biological wastewater treatment plant by at least 20 percent.

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МАТЕМАТИЧЕСКОЕ МОДЕЛИРОВАНИЕ ПРОЦЕССА БИОЛОГИЧЕСКОЙ ОЧИСТКИ СТОЧНЫХ ВОД

В. В. Тепляков, А. Н. Сенаторова
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: vovatgtu@ya.ru

Аннотация

Статья посвящена математическому моделированию процесса биологической очистки сточных вод. Все расчеты выполнялись с использованием прикладной программы С ++.

Ключевые слова: математическая модель, резервуар аэрации, химическое потребление кислорода (ХПК), биологическое потребление кислорода (БПК), рецикл, биомасса, активный ил.

УДК 621.396.44
ББК 32.884.1

FEATURES OF PROPAGATION OF RADIO WAVES IN WIRELESS COMMUNICATION SYSTEMS

R. Matveev
Tambov State Technical University, Tambov, Russia
e-mail: matryu@mail.ru

Abstract
When transmitting information in wireless communication systems, it is important to ensure a minimum level of signal loss and distortion. For this, it is necessary to understand the causes of signal loss in order to take measures to minimize them. In this article, we consider the main features of propagation of radio waves in communication systems and factors leading to signal losses and distortions.

Key words: radio communication, radio waves, data transmission, communication systems, signals, modulation, polarization.

In communication theory, communication is an important concept. Typically, the communication channel is understood to mean that portion of the communication system that includes the information source, the coding and modulation device, the sending device, the physical channel (signal propagation medium), the receiver with the information processing devices, and the information receiver. The analysis of the communication channel includes the budget of the channel - calculation of the signal energy losses associated with the physical processes occurring in the devices and the propagation medium. The budget is a method of estimation, allowing determining the reliability of the transmission of the communication system.

The reliability of information transmission in radio communication is determined by several factors, among which one can distinguish the signal-to-noise ratio, as well as signal distortions caused by intersymbol interference. In digital communication, the error probability depends on the normalized ratio E_b / N_0, where E_b is the energy of the bit, and N_0 is the spectral power density of the noise. Consequently, a decrease in the signal-to-noise ratio can be associated with a decrease in signal power, as well as an increase in the noise density or the power of signals interfering with the useful signal. These mechanisms are called, respectively, loss (attenuation) and noise (interference). The attenuation of the signal may be due to the absorption of signal energy, the reflection of a part of the signal, or scattering. Sources of noise and interference can be thermal noise, galactic noise, atmospheric and industrial noise, cross and interfering signals from other sources.

Let me list some reasons for the losses.

1. Losses related to the limitation of the channel band.

2. Inter-symbol interference.
3. Modulation losses.
4. Intermodulation distortion.
5. Polarization losses.
6. Spatial losses.
7. Interference of the adjacent channel.
8. Atmospheric and galactic noises.
9. Own receiver noise.
10. Losses in the antenna-feeder path.

In the transmission of short pulse signals through the communication channel, there are distortions associated with the presence of several paths of signal propagation from the transmitting antenna to the receiver, with a change in the time characteristics of the channel and other causes. When transmitting a short pulse, the received signal can look like a sequence of pulses.

One of the characteristics of such a multipath channel is the signal scattering time. The time variation of the propagation conditions of a signal can lead to a change in the amplitudes of the individual received pulses, the relative delay of these pulses, and even the number of pulses. Examples of the received multipath channel signal are shown in Fig. 1.

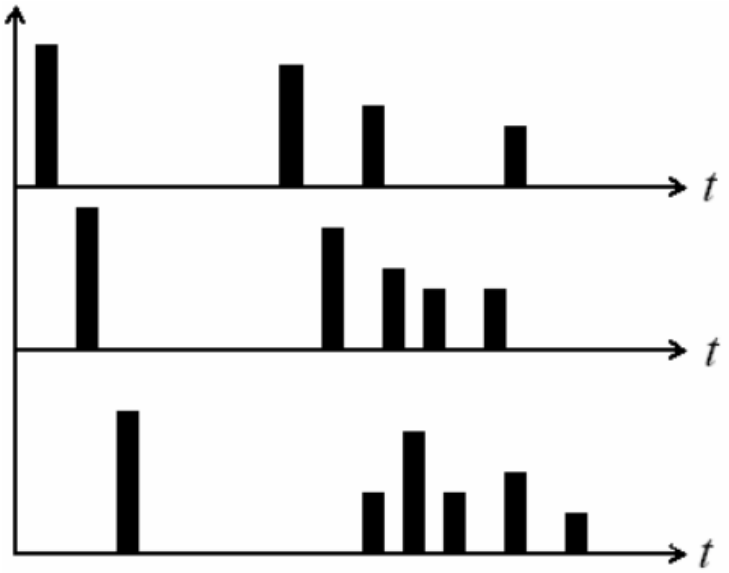

Fig. 1 - Examples of a received signal for a multipath channel

In the multipath channels, changes in the phases of the signals are observed. At certain phase ratios, signals coming along different trajectories can be mutually compensated, while in others - amplify. The observed variations in the amplitude of the received signal due to channel nonstationarity are called fading. In the channels of cellular communication, fading of signals of two types is observed-large-scale and small-scale. Large-scale fading is determined by the presence along the route of distribution of objects such as hills, forests, buildings, advertising shits, etc. Statistics of large-scale fading allows approximately calculating the losses in the path as a function of distance. In this case, the power of the received signal decreases with

distance in a power law, and the deviations from the mean value are determined by the log-normal distribution. Small-scale fading is a significant variation in the amplitude and phase of the signal at scales of the order of the wavelength. Small-scale fading manifests itself as an extension of the signal in time (temporal scattering) and nonstationary behavior of the channel.

The main physical processes that determine the nature of signal propagation in mobile communication systems are reflection, diffraction and scattering.

Reflection of radio waves occurs when there is a smooth surface on the track with dimensions much larger than the wavelength of the radio frequency signal. In mobile communication systems, the reflection of radio waves can occur from the earth's surface, walls of buildings, furniture or equipment inside the premises.

Diffraction of radio waves is observed in the presence of an object between the transmitter and receiver with dimensions exceeding the wavelength and preventing direct propagation of the signal. As a result of diffraction, the radio waves can reach the receiving antenna in the absence of line of sight between the transmitter and the receiver. In urban conditions, radio waves are diffracted at the edges of buildings, cars and many other objects.

Scattering occurs when there is a rough surface or objects whose dimensions are small in comparison with the wavelength. In city conditions, the scattering of radio waves can occur on lampposts, road signs, trees, etc.

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ОСОБЕННОСТИ РАСПРОСТРАНЕНИЯ РАДИОВОЛН В БЕСПРОВОДНЫХ СИСТЕМАХ СВЯЗИ

Р. Матвеев
Тамбовский государственный технический университет, Тамбов, Россия
e-mail:matryu@mail.ru

Аннотация

При передаче информации в беспроводных системах связи важно обеспечить минимальный уровень потерь и искажений сигнала. Для этого необходимо понимать причины потерь сигнала, чтобы принять меры по их минимализации. В настоящей статье рассмотрены основные особенности распространения радиоволн в системах связи и факторы, приводящие к потерям и искажениям сигнала.

Ключевые слова: радиосвязь, радиоволны, передача данных, системы связи, сигналы, модуляция, поляризация.

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ББК 32.850.4

THE ANALYSIS OF THERMOPHYSICAL METHODS OF NONDESTRUCTIVE CONTROL WITH THE PULSE HEATING USE

A. P. Negulyaeva
Tambov State Technical University, Tambov, Russia
e-mail: a.negulyaeva@bk.ru

Abstract
In this article, the existing thermophysical methods and their monitoring systems for thermal physical characteristics with the use of pulsed radiation for heating the investigated objects are considered. The advantage of such methods is the implementation of nondestructive testing, which makes it possible to use them to determine the thermophysical properties of not only building materials, but also finished structures. A proposal to improve the considered noncontact energy efficient microwave method of nondestructive testing is made; it consists in carrying out heating with simultaneous movement of the meter along the investigated object.
Key words: microwave radiation, nondestructive testing, pulse heating, thermophysical control.

Introduction

Determining of the thermal properties of building materials and finished structures is an important task in the implementation of non-destructive testing and technical diagnostics. The parameters of the quality characteristics of building materials and finished structures are such parameters of the investigated object as thermal activity, thermal diffusivity and thermal conductivity. Thermal diffusivity is a physical quantity characterizing the rate of the substance temperature change (equalization) in nonequilibrium thermal processes. Thermal diffusivity is a physical quantity characterizing the rate of change (equalization) of the matter temperature in nonequilibrium thermal processes. To determine them, it is necessary to heat the object under investigation with a heater or a pulsed heat source. At pulse heating there is no a heater. This excludes the results dependence on the contact thermoresistance between the heater and the investigated object surface, and on the intrinsic heat capacity of the heater, which distorts the temperature field.

Therefore, among other things, noncontact methods of thermophysical control with the pulse heating use have a number of advantages, such as the measurements accuracy, the efficiency, the distance, the application field breadth. This explains the rapid growth of the development and research of similar methods at the present time.

Contactless SHF Method for Nondestructive Testing of Thermal Characteristics of Construction Materials

In [1], the method for nondestructive testing and the realizing system was developed and presented. This method is designed to determine the thermophysical characteristics, such as thermal activity, thermal diffusivity, thermal conductivity. To do this, through the horn antenna, which is connected to the microwave generator, the investigated object is heated through a circular region. It is assumed that the investigated object is

semibounded in thermal terms. After the thermal action start, an excess temperature at the circle center is measured with a noncontact infrared sensor. Heat flow is measured from the circle surface with a wattmeter. Then the microprocessor calculates the desired thermophysical characteristics from the data obtained from a contactless sensor, a microwave generator and a wattmeter. The calculated data is output to the indicator. The calculations are performed using algorithms that are based on the analytic relations presented in [1].

The advantage of this method is the mathematical calculations simplicity, which makes its practical implementation accessible.

Noncontact Energy Efficient Microwave Method of Nondestructive Testing of Thermal Physical Characteristics of Building Materials and Products

In the method [2], the investigation object of is a semibounded solid in thermal terms. The investigated object surface heating is carried out by radiation from a microwave generator, which is focused into a given length line using a lens is located in a horn antenna. After pulsed microwave exposure the excess surface temperatures of the object under investigation are monitored with thermocouples is located at two points. To calculate the required thermophysical characteristics, the data from the thermocouples through the commutator, the normalizing precision amplifier, and the digital-to-analog converter are fed into the microprocessor, which is connected via the digital-to-analog converter to the microwave generator. The data enters the indicator through the I / O port

This method advantage is that it takes into account the heat produced attenuation dependence nonlinearity over the depth of the investigated object, which generates the heat propagation two-dimensionality. This makes it possible to reduce the methodical error and improve the thermophysical characteristics determinations accuracy.

Determination of Thermophysical Characteristics of Materials by Infrared Thermography

The method [3] is based on the well-known Parker method, which makes it possible to determine thermophysical characteristics by means of pulsed heating. In [3], the object under investigation is heated with a halogen lamp KG-220/1000. The heating region has the form of a disk. The temperature of the object is measured on the reverse side with the Thermovision-570 thermal imager. Thermograms are recorded to determine the sought thermophysical characteristics. Then the thermal diffusivity of the investigated object was determined. In this method we used the program ThermoCalc-2D, which allows us to investigate two-dimensional thermal fields in a multilayer disk with an internal defect by a numerical method.

Conclusion

The analysis of methods and systems for determining the materials thermophysical characteristics allows drawing a conclusion that this trend is relevant and has great prospects for implementation and practical application. Methods that use microwave radiation have a higher accuracy than infrared thermography methods. In addition, the results of the analysis allow us to conclude that there is a need to improve existing and create new methods and implementing systems for monitoring the thermophysical

characteristics of building materials and finished structures.

In order to control the quality of building materials and finished structures, the method [2] was adopted as a basis. The disadvantage of this method is a small area of research. According to the data obtained at one point, a conclusion is drawn about the thermophysical characteristics of the entire facility. To eliminate this disadvantage, it is proposed to use a moving meter with specified velocities and directions together with a microwave radiator for the investigated object. This will allow more accurate determination of the thermophysical characteristics of the material as a whole, at any point, at any time.

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АНАЛИЗ ТЕПЛОФИЗИЧЕСКИХ МЕТОДОВ НЕРАЗРУШАЮЩЕГО КОНТРОЛЯ С ИСПОЛЬЗОВАНИЕМ ИМПУЛЬСНОГО НАГРЕВА

А. П. Негуляева
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: a.negulyaeva@bk.ru

Аннотация

В данной статье рассмотрены существующие теплофизические методы и реализующие их системы контроля теплофизических характеристик с использованием импульсного излучения для нагрева исследуемых объектов. Преимуществами подобных методов является осуществление неразрушающего контроля, что делает возможным их применение для определения теплофизических свойств не только строительных материалов, но и готовых конструкций. Сформулированы предложения по усовершенствованию рассмотренного энергоэффективного бесконтактного микроволнового метода неразрушающего контроля, заключающегося в осуществлении нагрева с одновременным перемещением измерителя по исследуемому объекту.

Ключевые слова: импульсный нагрев, неразрушающий контроль, СВЧ-излучение, теплофизический контроль.

УДК 65.011.56
ББК 32.859

METHODS FOR OPTIMIZING THE OPERATING MODES OF ENERGY-INTENSIVE EQUIPMENT

D.O. Nikitenkov
Tambov State Technical University, Tambov, Russia
e-mail: dmitry.nikitenkov@mail.ru

Abstract
This article presents a system of optimal energy-intensive enterprise management.
Key words: vulcanizer, mixer, electric drive, electric, energy consuming.

The enterprise engaged in the production of polymer materials uses a variety of equipment. The main production equipment of tire plants includes mixers and vulcanizers. They are the main consumers of electricity. The amount of failures depends on their mode. It can be concluded to that to improve the quality of products and reduce their cost, it is necessary to use the best energy-efficient management of the enterprise.

However, energy-intensive facilities in practice are often complex, for example, a typical mixer consists of three electric drives - the main drive, lubrication systems and thermal control systems. Each of these electric drives has its own operating features, so the main electric drive is subjected to constant changes in the load, the moment the electric drive is turned on. The activation time of the electric drive of the thermal control system depends on the temperature in the mixing chamber.

The solution of the optimal control problem for such an object can be represented in the form of an aggregate solution of individual problems. A special feature of the electric drive of the mixing plant in terms of energy-saving control is the frequent and significant change in the load on the drive part, which leads to an increase in the cost of electricity. For the implementation of optimal control under these conditions, the forecasting of load changes is performed.

When solving a problem, an object model that takes into account continuous changes in the load is represented by a differential equation with a discontinuous right-hand side in the form of m stages.

Other mixers and vulcanizers are described in a similar manner. Then, the start-and-stop times of mixers and vulcanizers are formed to minimize equipment downtime. We should also take into account the time difference at the start of energy-intensive objects in order to reduce the load on the network.

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МЕТОДЫ ОПТИМИЗАЦИИ РЕЖИМОВ РАБОТЫ ЭНЕРГОЕМКОГО ОБОРУДОВАНИЯ

Д.О. Никитенков
Тамбовский государственный технический университет, Тамбов, Россия *e-mail: dmitry.nikitenkov@mail.ru*

Аннотация
В данной статье представлена система оптимального энергоемкое управления предприятия.
Ключевые слова: вулканизатор, смеситель, электропривод, электрический, энергопотребляющий.

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ББК 32.859

REVIEW OF METHODS OF TERTIARY PROCESSING OF INFORMATION IN ATC

A.I. Rogachev
Tambov State Technical University, Tambov, Russia
e-mail: roga-inna@yandex.ru

Abstract
This article presents an overview of the methods of functioning of the goniometric channel of the information-measuring system, taking into account the use of weight coefficients in tertiary information processing.
Key words: aircraft, model, information-measuring systems, tertiary information processing, goniometer channel.

In modern automated air traffic control systems, information processing processes occur. They ensure the safety of air traffic. The beginning of these processes is to obtain complete information about the coordinates and characteristics of the air target. This information in automated air traffic control systems is obtained with the help of special means. They are part of the subsystem for collecting and processing radar information. It is obtained from posts, information processing centers, aviation complexes of radar survey and guidance. The information is shown in Fig. 1. In automated air traffic control systems, primary, secondary and tertiary information processing is carried out.

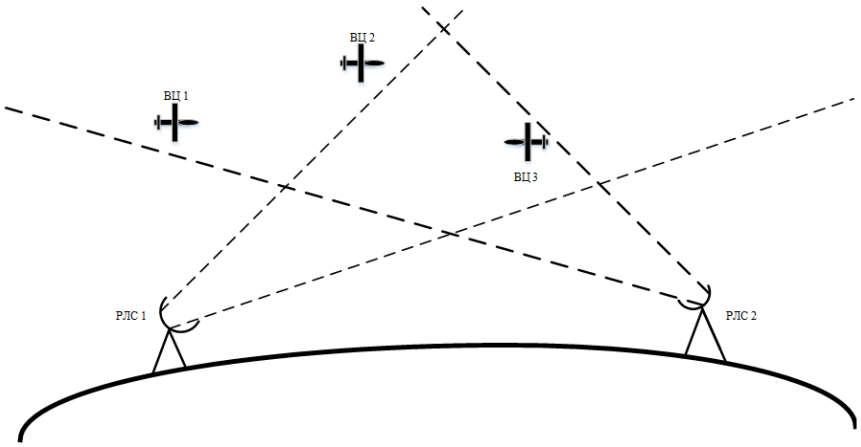

Fig. 1 - The process of obtaining information about air targets

Tertiary information processing is a mathematical process. It processes the previously received information from several sources. When creating radar systems, there is a crossing of control zones and the appearance of duplication of the capture of the target. The reason for this is the systematic errors of the meters. The main task of tertiary processing is to decide how many goals are in the system's responsibility area.

All information sources process information autonomously and independently of each other. In the process of identifying the goal marks, the number and distribution of reports by purpose is established.

Usually identification takes place in two stages. First, a rough identification or comparison of marks occurs. Then the allocation of marks is carried out to make a more precise decision for identification.

At present, various methods of tertiary information processing have been developed. They differ at the stage of averaging the coordinates of the target.

1. The method of equal weight of data.
2. The method of different weight of data.
3. The method of different weights with spatial adjustment.

The method of equal weight of data consists in calculating the average of the arithmetic parameters of the target by the formula

$$X_n = \left(\sum_{i=1}^{m} X_{ni} \right) / m, \quad (1)$$

where m is the number of marks from one target; X_{ni} is *n*-th (i) coordinate and parameter *i*-rad target.

The method of equal weight is quite simple. However, it does not take into account the errors of the meters of each radar.

The method of varying weight of data takes into account the errors of the meters of each radar:

$$\sigma_n = \left(\sum_{i=1}^{m} \sigma_{ni} \right) / m, \quad (2)$$

σ_{ni} is RMS of the *n*-th (i) coordinate and parameter of the i-th target radar.

The method of different weights with spatial adjustment takes into account the movement of the target

$$X_n = \left(\sum_{i=1}^{m} b_{ni} X_{ni} \right) / \left(\sum_{i=1}^{m} b_{ni} \right). \quad (3)$$

The weight coefficients b_{ni} can be calculated by the formula

$$b_{ni} = \frac{1}{\sigma_{ni}^2}, \quad (4)$$

where σ_{ni}^2 is dispersion of *n*-o (d) coordinate and parameter i-radar target.

In conclusion, the importance of tertiary information processing can be noted. It makes it possible to improve the accuracy of determining the coordinates of aircraft. This is important for controlling airspace. Improving the performance of radar data processing systems increases the throughput of automated air traffic control systems at a given level of safety.

In this paper, a method has been developed for the functioning of a goniometer channel of an information and measuring system, taking into account the use of weight coefficients in tertiary information processing. The choice of models of state

and observation is justified, simulations on a computer are carried out and the results of the algorithm investigation are presented.

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ОБЗОР МЕТОДОВ ТРЕТИЧНОЙ ОБРАБОТКИ ИНФОРМАЦИИ ВАС УВД

А. И. Рогачев
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: roga-inna@yandex.ru

Аннотация

В данной статье представлен обзор методов функционирования угломерного канала информационно-измерительной системы, с учётом использования весовых коэффициентов в третичной обработке информации.

Ключевые слова: воздушные суда, модель, информационно-измерительные системы, третичная обработка информации, угломерный канал.

УДК 620.179.118.7.05
ББК 30.3

WIRELESS TELEMETERING NETWORK FOR MONITORING OF QUALITY CHARACTERISTICS OF METAL-FLUOROPLASTIC WEB MATERIAL

D.V. Tikhonin
Tambov State Technical University, Tambov Russia
e-mail: resbn@jesby.tstu.ru

Abstract
The article deals with the application of wireless telemetering network to control metal-fluoroplastic quality characteristics of the web material.
Key words: metal-fluoroplastic web material, wireless telemetering network, quality characteristics.

Continuous monitoring of quality characteristics of metal-fluoroplastic web material in its production process requires the collection of information from devices control and transfer it to the microprocessor unit for further processing and sharing information between devices and control database. The use of cable communications to collect data from various devices is difficult to control because the production line of metal-fluoroplastic web material can take more than 40 m in length.

To implement a method of control material of metal-fluoroplastic quality characteristics [1] in the course of its manufacture the using of wireless telemetering systems for collecting data and exchanging information is offered (Fig. 1).

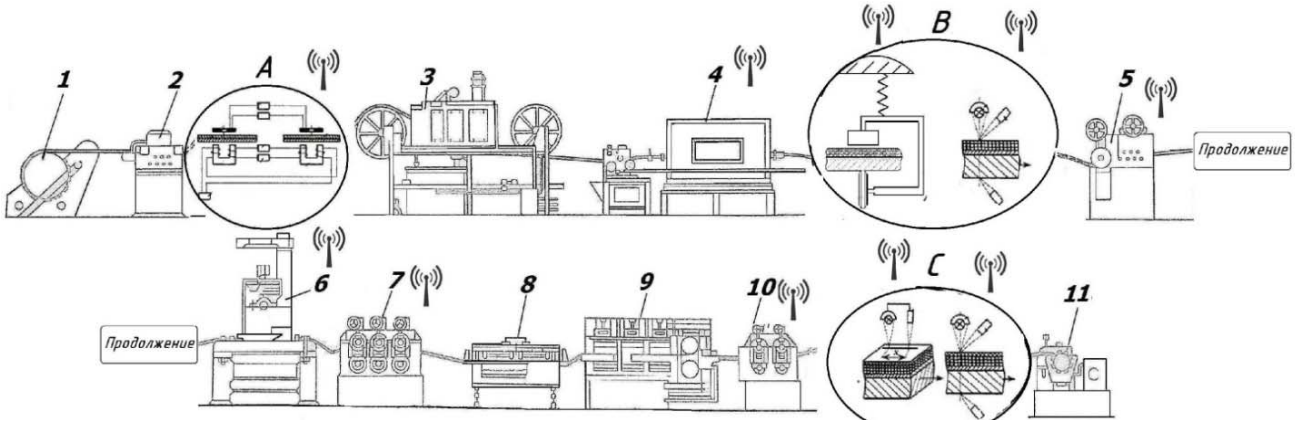

Fig. 1- Diagram of the implementation method of monitoring quality characteristics of metal-fluoroplastic web material: 1 - de-coiler; 2 - the leveling rolls; 3 - unit for washing and cleaning; 4 - device applying a uniform layer of spherical particles for sintering furnace, bronze and bronze on bimetal; 5 - capstan mechanism; 6 - device for the application of porous bronze layer of Teflon paste; 7 - shafts for pumping paste in porous layer; 8 - oven for drying; 9 - PTFE sintering furnace; 10 - shafts for ultimate calibration; 11 - winding mechanism; A-layer thickness bimetal control device; In-three-layered material thickness control device (bimetal with bronze armature); porosity control device-bronze frame, thickness of the fourth layer PTFE and concentration of its components.

For the transmission and reception of intelligence with control device quality characteristics in specified time intervals, and adjustments in the manufacturing process of metal-fluoroplastic web material must have receiving device (destination device) to communicate with the microprocessor device (Coordinator), which performs functions as on networking and routing-keeping.

To date, the most promising method of building industrial telemetry systems using wireless networking is IEEE 802.15.4 (ZigBee) [2]. This standard has the following characteristics: transmission distance between neighboring nodes ZigBee indoors is up to 20-30 m; channel bandwidth is 250 kbit/s; interference technology ZigBee is higher than that of wi-fi, bluetooth, because a split frequency range on 16 channels (5 Mhz each). Metal-fluoroplastic production line for strip material analysis of two IEEE 802.15.4 network topologies star and multicellular network (Fig. 2) depending on the level of the received signal, which showed that the maximum distance between the quality characteristics of the control device and the coordinator, does not exceed 20 metres. Therefore, wireless network topologies to diagram, shown in Figure 1, the selected Star typology.

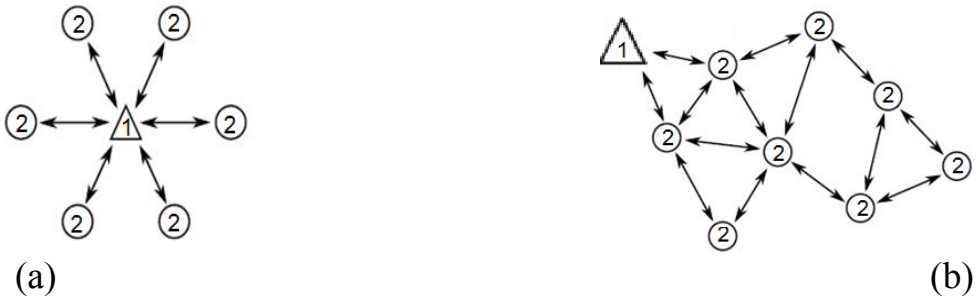

Fig. 2 - Network topology, IEEE 802.15.4: a – "Star" b - multicellular network; 1 - Coordinator; 2 - target device.

Thus, the use of wireless telemetry network based on standard (ZigBee) will receive information from the control device quality characteristics, enhance decision-making and avoid the production of defective products.

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БЕСПРОВОДНАЯ ТЕЛЕИЗМЕРИТЕЛЬНАЯ СЕТЬ ДЛЯ КОНТРОЛЯ ХАРАКТЕРИСТИК КАЧЕСТВА МЕТАЛЛОФТОРОПЛАСТОВОГО ЛЕНТОЧНОГО МАТЕРИАЛА

Д.В. Тихонин
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: resbn@jesby.tstu.ru

Аннотация
В статье рассмотрено применение беспроводной телеизмерительной сети для контроля качественных характеристик металлофторопластового ленточного материала.

Ключевые слова: металлофторопластовый материал, телеизмерительная беспроводной сеть, характеристики качества.

УДК 621.3.049.77
ББК 31.2

THE STUDY OF STRENGTH OF WELDED JOINT DEPENDING ON TEMPERATURE OF TABLE FOR ULTRASONIC BONDING

I. S. Armyaninov, A. P. Korolev, I. S. Filatov
Tambov State Technical University, Tambov, Russia
e-mail: ivan.armyaninov1995@gmail.com

Abstract
In this work, we have investigated the dependence of the strength of welded joint to temperature on table. The bonding was carried out with gold wire in diameters of 20, 25, 30 and 50 microns. For the study, we used the technology of ultrasonic microwelding.
Key words: microspore, micro welding, microelectronics, interconnect technology.

Introduction

When creating microcircuits one of the main problems is the establishment of good electrical contact between the track of circuit board (substrate) and crystal. This connection at the moment can only provide microwelding.

Fig. 1 shows the dependence of the strength of welded joint to temperature of table.

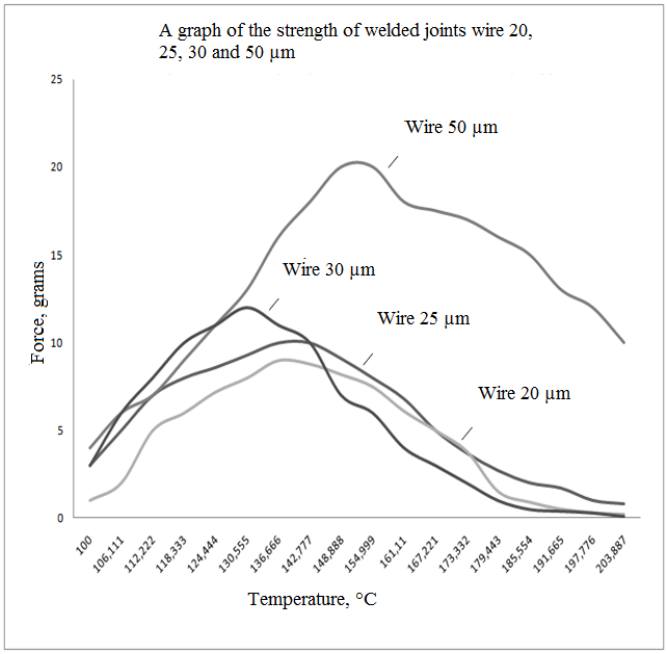

Fig. 1 - A graph of the strength of welded joints wire 20, 25, 30 and 50 microns from the temperature

Methods & materials

The tested compounds were made in the apparatus for ultrasonic welding of the microwire connections of Kulicke&Soffa 4700AD company (Fig. 2). Tests on the

strength of the resulting encoding provide for the installation of the name of the firm TPT H52 dynamic search. Visual inspection of welded joints were made on a digital optical microscope Hirox.

Fig. 2 shows the installation for ultrasonic welding of the microwire connections of Kulicke&Soffa 4700AD company.

Fig. 2 - Installation for ultrasonic welding of the microwire connections of Kulicke&Soffa 4700AD company

For gold wire insights the ultrasonic welding method "ball – wedge" is suited best. The main advantages of the method are the great strength of welded joints with less heating of the table and capillary and usability than other types of bonding.

It should be noted that this method is not ideal also. The disadvantage of the “ball – wedge” is the lack of study, which may be low yield in the production of microcircuits.

The work solved one of the tasks in the assembly of integrated circuits, and it was experimentally proved that the temperature of the product affects the quality of compounds, so studies have been conducted on the effect of this parameter. The quality control of welded joints was carried out in two stages. First, a visual inspection of the connection geometry the common requirements was done, then the mechanical pull test. The quality of the compounds was checked on visual compliance Industrial Standarts Russian Federation 11 073.013–83, part 4, as well as the requirements on the mechanical tensile strength. It was proved that the heating temperature of the product affects the quality of the connections therefore studies and experiments on the effect of this parameter were carried out.

Conclusion

The temperature of the table, on which fee (substrate) is set before welding wire is selected for each of the cross-sectional dimension of the gold wire according to the welding conditions. In the selection of the welding mode such characteristics as clamping force, the process of welding, and power was changed. For wire with a

diameter of 20 μm, we selected the welding the temperature range from 133 to 146 ° C corresponds to. For wire with a diameter of 25 microns corresponds to a temperature range from 136 to 145 ° C corresponds to. For wire with a diameter of 30 microns a temperature range from 125 to 133 ° C corresponds to. For wire with a diameter of 50 microns corresponds to a temperature range from 143 to 157 ºC corresponds to. But it is worth noting that the excess speed of air flow in clean rooms may lead to changes in the electrophysical characteristics of the welded joint.

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ИССЛЕДОВАНИЕ ПРОЧНОСТИ СВАРНОГО СОЕДИНЕНИЯ ОТ ТЕМПЕРАТУРЫ СТОЛИКА ДЛЯ УЛЬТРАЗВУКОВОЙ МИКРОСВАРКИ

И.С. Армянинов, А.П. Королев, И.С. Филатов
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: ivan.armyaninov1995@gmail.com

Аннотация

В данной работе была исследована зависимость прочности сварного соединения от температуры столика. Микросварка производилась золотой проволокой диаметрами 20, 25, 30 и 50 мкм. Для исследования применялась технология ультразвуковой микросварки.

Ключевые слова: микросборка, микросварка, микроэлектроника, технология межконтактных соединений

УДК 62-522.2
ББК 34.447

DESIGN AND OPTIMIZATION OF FORMING CHAINS ON THE BASIS OF HYDRAULIC CONNECTIONS IN MACHINES WITH COMPLEX MOTIONS OF FORMING

V.A. Vanin, E.V. Romanova, V.S. Grigoryan
Tambov State Technical University, Tambov, Russia
e-mail: katrin-mintm@mail.ru

Abstract
The possibility of constructing internal (forming) kinematic chains of copying and milling machines of various technological purposes in the form of hydraulic connections based on a stepping hydraulic drive with the purpose of increasing the accuracy, reducing the metal capacity, creating a rational machine design using the modular construction principle is considered.
Key words: kinematic chains, hydraulic stepper drive.

When designing metal-cutting machines with precise kinematic connections, the necessary condition is the choice of the optimal variant of the kinematic chain at the design stage.

The structure of the kinematic chains determines the constructive complexity of the machine, the methods of its adjustment, has a significant effect on the rigidity, accuracy, and vibration resistance of the machine.

Rational construction of chains of metal-cutting machines can be carried out using a modular principle based on hydraulic links in the form of a discrete stepper hydraulic drive with executive power stepping hydraulic motors.

The main feature of this class of drives is that the hydraulic stepper motor (HSM) used as a power executive element, as a control device - a generator of hydraulic impulses that converts the energy of the working fluid into hydraulic impulses and distributes them in a certain sequence along the working chambers of the HSM, and the output shaft of the stepper hydraulic motor executes control discrete signals with high accuracy and high power amplification.

When used in internal kinematic chains as a power element of stepper hydraulic motors, the connection between the workpiece and the tool is realized due to the fact that the flow of working fluid through the working slots of the distributing (switching) device is converted into a certain sequence of hydraulic pulses that are distributed to the power chambers of the stepping motor, each of them corresponds to a certain angle of rotation of the output shafts of the HSM, proportional to the number of pulses, and the rotational speed proportional to the frequency of their repetition.

Using the properties of frequency regulation of the speed of the executive elements of the hydraulic stepping drive, it is possible to apply hydraulic connections on the basis of a stepper hydraulic drive to construct kinematic internal chains of

metal-cutting machines having complex branched multilink mechanical reconfigurable mechanical circuits of considerable length.

In Fig. 1 is a block diagram of a copying and milling machine with hydraulic form-building connections for the processing of complex parts with a control system from a block of hydraulic distributor, built on the basis of a two-spool valve with an end face distribution of the working fluid.

The machine includes a tool 13 making rotational movement from the electric motor Д through a tuning unit i_v, a workpiece 11, mounted on the machine table 14 and performing a complex executive motion.

A complex executive form-building movement composed of elementary rectilinear motions - longitudinal motion П2 (setting feed) and transverse П3 (tracking feed) is effected by an internal (shaping) connection between the longitudinal movement of the longitudinal table 19 and the cross slide 14 with the workpiece 11. The forming bonds are made in the form hydraulic connections on the basis of a stepping hydraulic drive with executive steping hydraulic motors.

The longitudinal movement P2 of the longitudinal table 19 is carried out from the stepping hydraulic motor 9, kinematically connected to the table by means of the lead screw 12 of the longitudinal movement of the table.

The transverse movement P3 (tracking feed) of the upper slide 14 with the workpiece 11 necessary to reproduce the desired shaped surface of the workpiece is provided by an internal (shaping) connection between the longitudinal support 19 and the upper slide 14 with the workpiece and is effected from the stepping hydraulic motor 15 connected kinematically to the upper slide by means of a lead screw 16 for transverse feeding.

The control of the stepping motors 9 and 15 of the drives of the longitudinal movement of the longitudinal slide (setting feed) and the transverse feed of the cross slide 14 (tracking feed) is carried out from the blocks of the end hydromotors 17 and 18, which consist of three identical (in terms of the number of channels of the stepping hydraulic motors) hydraulic distributors with anend face distribution of working fluid, made on the basis of a double-spool valve.

The hydraulic internal (shaping) circuit is adjusted to the required gear ratio using the hydraulic pulse generator 3, which is a set of coding disks fixed to a common axis and receiving rotation from a separate hydraulic motor 4. The outer surface of each of the coding disks is designed in such a way that the protrusions when rotating the discs either overlap the nozzle, or leave it free, with one projection overlapping only one slot. With this arrangement of the slots in the generator casing relative to the protrusions of the rotating coding disc, one of the slits is always overlapped by the projection of the disc, and after two remaining non-overlapped slots, the working fluid enters the drain.

In the absence of a control signal (pressure impulse), the distributor is in the left position under the influence of the supply pressure. When the control pressure reaches the value of the corresponding trigger point, the distributor starts to move from its extreme left position, and when the distributor is straining, the supply

pressure acts on the entire area of the small end face and flips the distributor to the right. The left end opens the pressure nozzle, and the right end closes the drain. The working fluid for obtaining the control pulses for the hydraulic distributors with the end distribution of the working fluid comes from the pump installation 1 through the choke block 7 through the pipeline 6. The supply pressure to the input of each of the hydraulic distributors is fed through an adjustable choke of the throttle block of the pump installation 8, and then, depending on the position of the end hydraulic distributors along one of the channels enter the working chambers of the stepping hydraulic motors 9 and 15 of the billet drive in the longitudinal and transverse directions.

The use of a hydraulic stepper drive in the construction of internal (shaping) kinematic chains in the form of hydraulic connections in place of mechanical chains:

- provides structural homogeneity of internal kinematic chains for machines of various technological purposes, in which, during operation, it is required to provide a rigid functional connection between the tool and the workpiece.

- expands the possibilities of using a stepper hydraulic drive to perform complex interlocking form-building movements in machine tools.

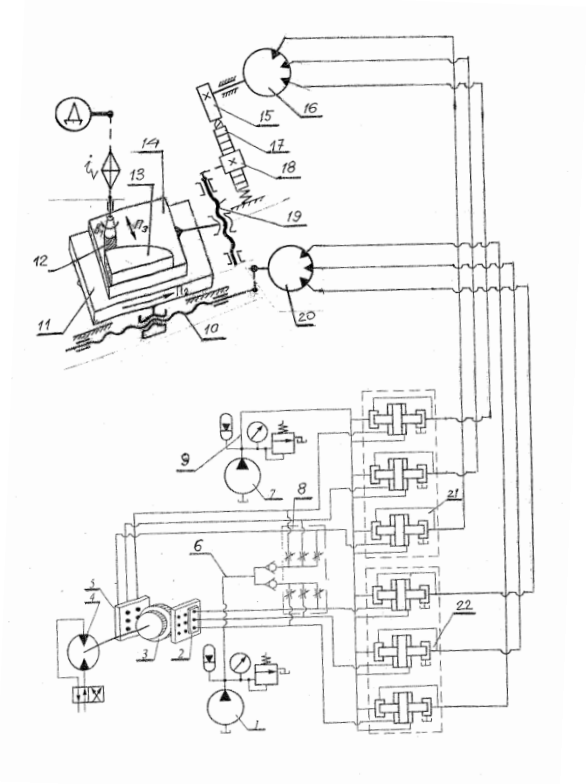

Fig. 1- Block diagram of a copy-milling machine with internal hydraulic connections

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ПОСТРОЕНИЕ И ОПТИМИЗАЦИЯ ФОРМООБРАЗУЮЩИХ ЦЕПЕЙ НА ОСНОВЕ ГИДРАВЛИЧЕСКИХ СВЯЗЕЙ В СТАНКАХ СО СЛОЖНЫМИ ДВИЖЕНИЯМИ ФОРМООБРАЗОВАНИЯ

В. А. Ванин, Е. В. Романова, В. С. Григорян
Тамбовский Государственный Технический Университет, Тамбов, Россия
e-mail: katrin-mintm@mail.ru

Аннотация

Рассмотрена возможность построения внутренних (формообразующих) кинематических цепей копировально-фрезерных станков различного технологического назначения в виде гидравлических связей на основе шагового гидропривода с целью создания рациональной конструкции станка используя модульный принцип построения.

Ключевые слова: кинематические цепи, гидравлический шаговый привод.

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ББК 39.9

MODELING FOR DETECTING DAMAGED SECTIONS OF THE FRAME

A. V. Gartsuev, D.V. Doroshin
Tambov State Technical University, Tambov, Russia
e-mail: gartsyev95@yandex.ru

Abstract
It is very important to inspect the appearance and occurence of the frame damage in a timely manner. In this case, computer simulation uses a three-dimensional model of the frame and data on the operational loads of the machine. Evaluation of the stress-strain state of the frame allows determining the zones with loads close to the limiting ones. Further, the hazardous areas are defective with the help of equipment. Detection of defects (cracks) at the initial stages of their development is very important for a qualitative repair process.
Key words: cracks, defective, frame, strength, three-dimensional model.

Introduction

It is necessary to be able to determine the defects of frames received during operation. A detailed examination of the sections of the frame for the purpose of detecting defects is possible using computer simulation, taking into account the data on the machine's operational loads. Having identified defects, it is possible to repair the car frame in a timely and qualitative manner.

At present, it is rather difficult, and in some cases it is impossible to predict in advance the appearance and development of the frame damage.

The purpose of this article is to localize and investigate the damage of sections of frames using computer modeling.

After carrying out preparatory operations related to cleaning and external inspection, which are offered for carrying out by known methods, the sections of the frame that require more detailed study are determined (Defection is a detailed study of the section of the frame for the purpose of revealing defects).

For this, a three-dimensional model of the structure (frame) and data on the workload of the machine is used. The evaluation of the stressed-deformed state of the frame is performed on its three-dimensional model; it is divided into spatial solid-state finite elements (FE) in the form of tetrahedra with six degrees of freedom in each node. The FE surfaces are modeled by polynomials based on parabolic functions. The subdivision element has dimensions of 30-50 mm with decreasing zones of stress concentrators. The element model includes 260409 finite elements. The model takes into account the attachment of springs and casing, which are stress concentrators, as well as the construction of the manipulator (Fig. 1).

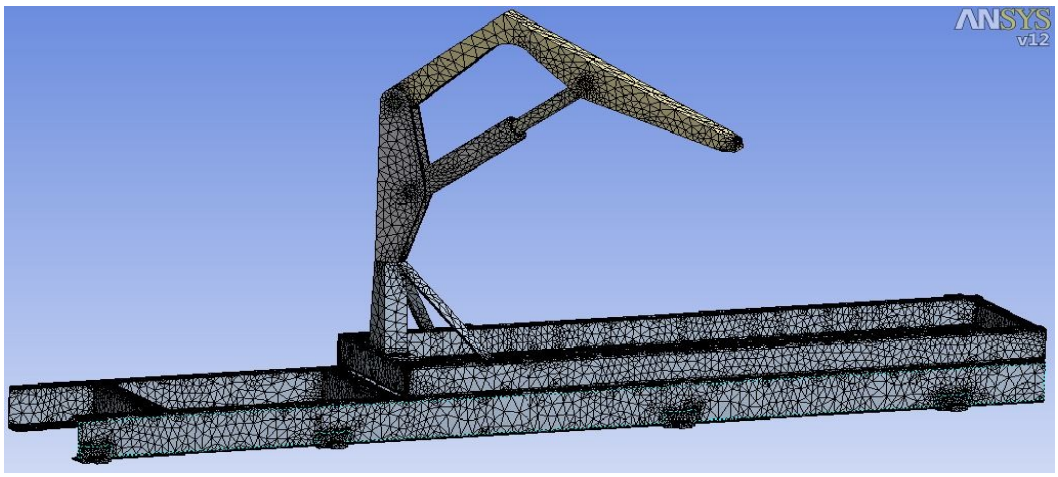


Fig. 1 - Elementary model of the car frame with a manipulator

For all structural load combinations, the frame was fixed in the zones of the spring supports; the front wall restricts movement in the longitudinal direction transverse to the longitudinal axis of the vehicle. The scheme for fixing the frame and loads is shown in Fig. 2.

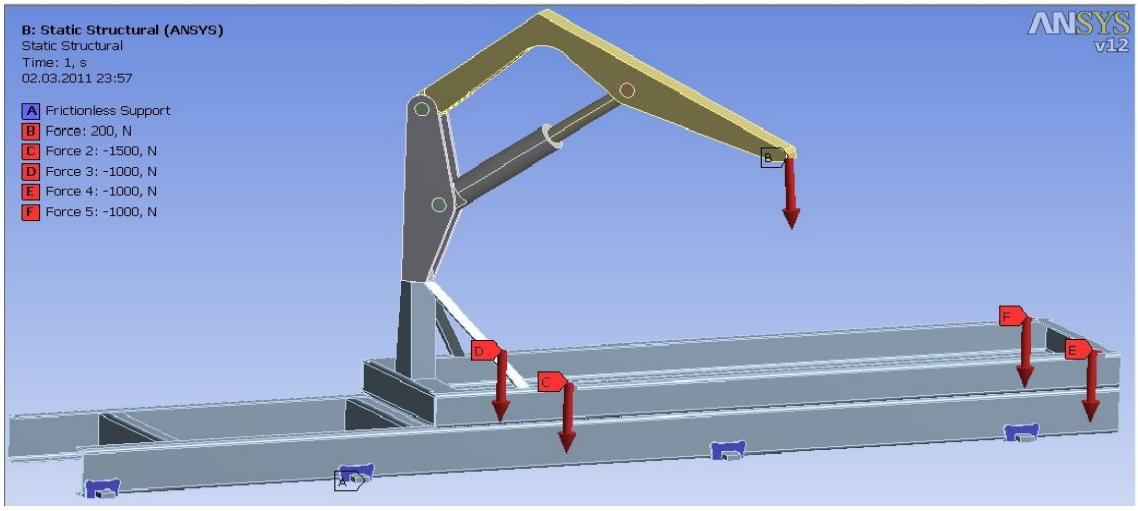


Fig. 2 - Diagram of interaction forces of the frame with suspension and applied loads

Evaluation of the stress-strain state of the frame is performed when modeling different operating modes: driving the car on uneven roads, turning the car with full load, lifting and turning the boom of the hydraulic manipulator with static loads of the car with the weight of the load (6.5 tons) and the full load of the boom of the hydraulic manipulator. The results of the calculations can be presented graphically and displayed as an array of data for the indicated points at any point in the frame model.

The graphical result is displayed as another color of the surface of the frame model. The color indicates a certain range of values of the investigated parameter. A fragment of the calculation result using stress fields is shown in Fig. 3.

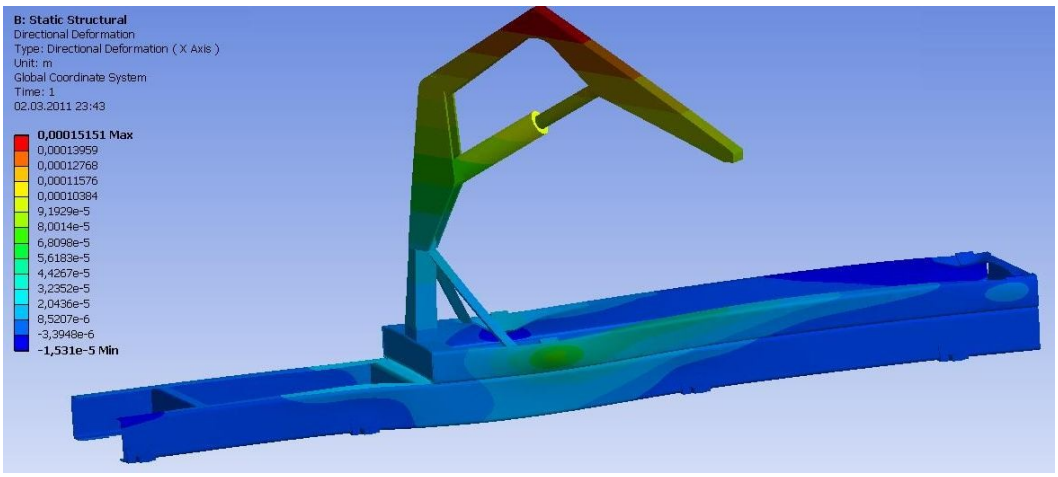


Fig. 3 - Stress state of the frame with a load of 65 kN on the body and 15 kN with full coverage of the boom hydromanipulator

Simulation allowed the frame material to be divided into zones in accordance with the level of internal stresses (Fig. 4): 1 - zones with a stress of 0.5-0.8 safety factor, which occupy about 21% of the volume of the frame material; 2 - zones with loads close to the limiting ones, and occupy about 12%, in which the probability of occurrence of cracks is high. The remaining volume 3 of the frame material is lightly loaded and practically unchanged.

The location and size of the zones depend on the operating conditions, circuitry and intensity of loads on them.

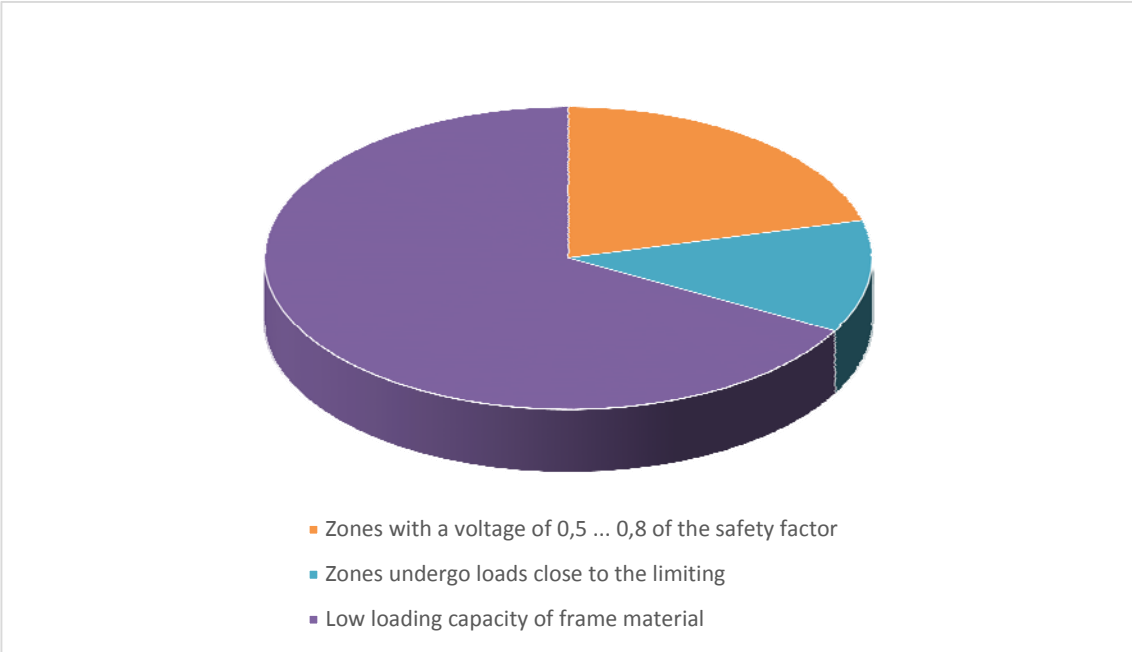


Fig. 4 - Volumes of car frame material with different stress levels

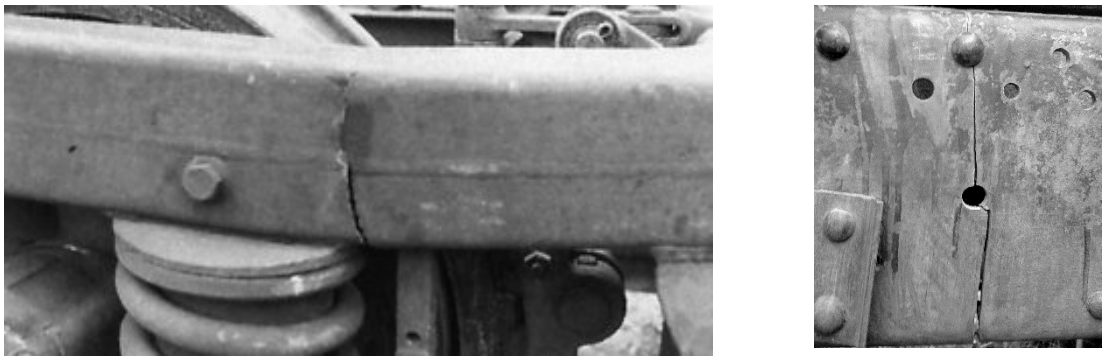
Zones 1 and 2 are subject to more thorough elimination using additional equipment. In zones 3 the frame material is practically not damaged, since it does not

withstand critical loads, so, in our opinion, does not require deep elimination of defects.

It is assumed that defects of certain areas of frames are performed by known methods using optical, fluorescent, ultrasonic and other equipment.

The main defects of the frames are the curvature of the rays and transverse rods, fatigue cracks, cracks around rivet holes, rupture strength rupture, corrosion and others. The greatest danger is represented by cracks passing almost along the entire section of the beam (frame) of the frame (Fig. 5).

Investigation of the appearance and development of cracks showed that they arose from within the beam and developed in a transverse direction with the appearance on the visible side.



a) b)

Fig. 5 - Transverse cracks of bearing structures: a - trolleys, b - truck frames

As a consequence, it is very difficult to detect such cracks at the initial stages of their development without performing examinations with the use of special diagnostic equipment, and in some cases it is almost impossible.

Unlike longitudinal cracks, which can be eliminated by welding, lateral cracks require the development of an individual technological process, taking into account many factors and the stress-strain state of the entire structure, which will prevent re-cracking.

The development of a high-quality technical repair process, the determination of modes, the need to install amplification elements is impossible without establishing the causes and conditions of destruction.

Conclusion

Computer simulation is a reliable way to timely detect frame defects and eliminate them. Since the three-dimensional model of the frame allows for visusal examination of the areas that are prone to defects.

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МОДЕЛИРОВАНИЕ С ЦЕЛЬЮ ОБНАРУЖЕНИЯ ПОВРЕЖДЕННЫХ УЧАСТКОВ РАМЫ

Гарцуев А.В., Дорошин Д.В.
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: gartsyev95@yandex.ru

Аннотация

Очень важно своевременно определить появление и развитие повреждения рамы. В данном случае на помощь нам приходит компьютерное моделирование, где используется трехмерная модель рамы и данные о эксплуатационных нагрузках машины. Оценка напряженно-деформационного состояния рамы позволяет определить зоны с нагрузками близкими к предельным. Далее производится дефектирование опасных зон с помощью аппаратуры. Обнаружение дефектов (трещин) на начальных стадиях их развития очень важно, это позволяет качественный процесс ремонта.

Ключевые слова: 3-D модель, дефектирование, прочность, рама, трещины.

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ББК 34.651

METHODS AND TECHNOLOGIES OF IIMPROVING THE QUALITY OF PRODUCTS

A. A. Dezha
Tambov State Technical University, Tambov, Russia
e-mail:dezha.anton@yandex.ru

Abstract
Methods and technologies for improving the quality of products are considered. Such concepts as product quality, quality, annealing, hardening, and steel tempering are analyzed.
Key words: temper drawing, quality, annealing, full annealing, partial annealing, low-temperature annealing, hardening, internal stresses in hardened steel.

An essential requirement for the successful development of the enterprise today is the production of competitive products. The basis of competitiveness is the quality of products.

Quality of products is the most important indicator of the company's activity. What is the product quality? This concept is regulated by GOST 15 467-79 *Quality management of products. Basic concepts. Terms and Definitions*. Quality is a set of properties of products that determine its suitability to meet certain needs in accordance with its purpose. [1]

Methods for ensuring the quality of products can be divided into two parts: provision for technological preparation of production and provision for production.

Methods for ensuring the quality of products in the process of technological production include:

1. Technological heredity.
2. Surface layer (Surface layer quality indicators, occurrence of roughness in machining, Hardening of the surface layer of metal, Residual stresses).
3. Ensuring reliability when choosing the methods of shaping.
4. Ensuring reliability in the design of technological processes for processing products (general methodology and design sequence; selection of technological bases and preparation of the workpiece processing path; technical control during processing of blanks; determination of allowances for processing and construction of machining operations; documentation that fixes technological developments).

The parts of the products, as a rule, have structural concentrators for stresses. The concentration of tensile stresses leads to a strong decrease in the resistance of parts to fatigue failure. In these cases, for example, thermal and chemical-thermal hardening treatments allow a sharp change in the quality of the surface of parts and provide the required operational properties (wear resistance, fatigue resistance, heat resistance, etc.), so their application is not only effective, but in a number of cases, the only possible means for improving the reliability of the work of the parts.

Expansion of the field of thermal and chemical-thermal hardening surface treatments became possible after the technology of surface hardening, carburizing, nitriding, cyanidation was improved, as well as in the result of the development of new processes of diffusion saturation of the material surface (aluminizing, diffusion chrome plating, boriding, etc.). Wear resistance and corrosion resistance can significantly increase when applied to work surfaces of metal and non-metallic coatings with high performance properties.

One of the methods for ensuring the quality of products is heat treatment. The main types of heat treatment changing the structure and properties of steel include annealing, normalization, quenching, tempering and aging [2].

Let me describe some of the types of heat treatment.

Annealing is used to produce structures close to the equilibrium state. The technology involves heating of steel to a predetermined temperature, holding it, and then slow cooling. Annealing improves machinability and hardness of steel. Annealing is used to remove internal stresses and reduce structural heterogeneity, and increases ductility and viscosity as compared to the products obtained by casting, forging and rolling. The following types of annealing are used: full, incomplete, low, isothermal, etc.

Full annealing is used for reducing hardness, removing stresses and improving the structure of products after forging in case of improper heating. As a result, the structure becomes fine-grained, providing high viscosity and ductility. *Incomplete annealing* differs in that the steel is heated to a lower temperature. It is used for steels that have been properly forged, in order to improve the machinability of cutting as a result of the reduction in hardness and the ability for cold plastic deformation.

Low-temperature annealing is used to reduce hardness and remove internal stresses. The product is heated to the appropriate temperature, kept to full heat, and then cooled together with the furnace or air.

Hardening involves heating the steel to the appropriate temperatures, holding for the completion of phase transformations and subsequent cooling at a speed higher than the critical one. For carbon steels, cooling is carried out more often in water, and for alloy steels it occurs in oil or in other media. Hardening is not the final operation of heat treatment. To reduce the brittleness and stresses caused by quenching, and to obtain the required mechanical properties, the steel is necessarily tempered after hardening.

Tool steel is mainly hardened to increase hardness, wear resistance and strength. As for the structural steel, it is tempered for increasing the strength and hardness, obtaining a sufficiently high ductility and viscosity and getting a high wear resistance for a number of parts.

The methods of hardening are as follows: full, incomplete, isothermal, etc. The methods of hardening are distinguished by the conditions of heating and cooling of steel. The choice of method depends on the composition of the steel, the required properties and the complexity of the products.

Internal stresses in hardened steel arise due to uneven cooling of the surface and core of the product these stresses are called thermal an increasing in the volume and inhomogeneity of martensitic transformation in the volume of the product. The stresses caused by these transformations are called structural (or phase).

Hardened steel tempering. The release of the product consists in heating the hardened steel to a temperature below the critical degree, holding at a given temperature and then cooling at a certain rate. Tempering is the final operation of heat treatment, as a result of which steel acquires the required mechanical properties. In addition, tempering completely or partially eliminates the internal stresses arising during quenching. These stresses are eliminated completely at a high tempering temperature. The cooling rate after tempering also has a large effect on the residual stresses. The slower the cooling, the lower the residual stresses are. Cooling after tempering in the air gives stresses on the surface 7 times lower and cooling in oil is 2.5 times lower compared to the stresses when cooling in water. For this reason, products of complex shape should be cooled slowly to avoid their war page after tempering at high temperatures. The main influence on the properties of steel is the temperature of hardening.

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МЕТОДЫ И СПОСОБЫ ПОВЫШЕНИЯ КАЧЕСТВА ИЗДЕЛИЙ

А.А. Дежа
Тамбовский государственный технический университет, Тамбов, Россия
e-mail:dezha.anton@yandex.ru

Аннотация

Рассмотрены способы и методы повышения качества изделий. Проанализированы такие понятия, как качество продукции, качество, отжиг, закалка, отпуск закаленной стали.

Ключевые слова: отпуск закаленной стали, качество, отжиг, полный отжиг, неполный отжиг, низкотемпературный отжиг, закалка, внутренние напряжения в закалённой стали.

УДК 621-05
ББК 34.5

IMPROVING THE PROPERTIES OF CONTROL PROGRAMS FOR MANUFACTURE OF PARTS AND PREFORMS ON CNC MACHINES

S. V. Dolotov
Tambov State Technical University, Tambov, Russia
e-mail: dolotov068@gmail.com

Abstract
The article considers the probability of increasing the properties of control programs by making corrections to them in the technological stage of processing programming. A specific feature of such an adaptive control system is the correction of the actuators of the executive working parts of the machine according to the current information on the controlled processes and the values of processing parameters.
Key words: automatic process control, adaptive control, productivity increase, CNC machine.

The technological stage of programming of parts machining on a CNC machine often consists of several operations. Any operation of the program code is part of the technological process, including one or more installations. The machine in turn consists of transitions of parts of operations that have a constant surface to be machined, a cutting tool and the operating mode of the machine. The trajectory of the tool is referred to as the stage traversed by the center of the tool with its relative displacement. [1] Selection of cutting modes is very important to increase the properties of control programs and, therefore, the efficiency of production in general. Up to 50 percent of all errors during machining are errors due to incorrect distribution of cutting modes. Optimization of cutting modes by calculation is a difficult task due to the low accuracy of the experimental dependences, unintended deviations in the cutting ability, the difficulty of adjusting during the operation of the machine with numerical program control.

Taking into account the factors affecting the increase in the productivity of machining of parts on CNC machines, cutting modes in the production of program code should be arranged on the basis of the selection of the maximum possible cutting depth, the maximum possible feed rate, cutting speed, and optimum tool stability. Here the limitation in the selection of the cutting depth is the value of the machining allowance set in the program, and when the feed rate is selected, the roughness of the treated surface and the amount of cutting force [2]. The cutting force in turn affects the accuracy of machining, the strength of the tool moving system, and the vibration resistance of the tool.

When selecting the cutting modes for CNC machines, it is important to consider the following features of the numerical control software: a noticeable lengthening of the machining cycles due to the concentration of operations, the presence of automatic tool change, the probability of adjusting the dimensional wear of the tool, the inevitability of averaging the cutting regime, the probability of reducing the optimum tool life.

The production of more accurate control programs using additional parameters allows using precise methods of calculation of cutting modes, covering the complex interconnectedness of technological requirements and constraints.

In order to avoid errors and programming shortcomings, it is sometimes worth using the correction devices that the machine is equipped with [3]. However, a significant improvement and increase in processing efficiency will be the acquisition of greater accuracy by making appropriate changes to the program code of the control program. The program needs to be corrected for the trajectory, which compensates for wear and guarantees the required accuracy.

The CNC machine has all the features for increasing processing modes even at the technological stage of programming. Of course, to increase the quality of the control programs, the high power of the main drive, high rigidity of construction, high vibration resistance will suffice. The machine time on CNC machines can be reduced by 20-30 percent, while the lowest cost price or the highest processing capacity is taken as the criterion of optimality, the measure of optimality is described as an evaluation function of the parameters of cutting conditions.

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ПОВЫШЕНИЕ СВОЙСТВ УПРАВЛЯЮЩИХ ПРОГРАММ ДЛЯ ПРОИЗВОДСТВА ЗАГОТОВОК И ДЕТАЛЕЙ НА СТАНКАХ С ЧПУ

С.В. Долотов

Тамбовский государственный технический университет, Тамбов, Россия

e-mail: dolotov068@gmail.com

Аннотация

В статье рассматривается вероятность увеличения свойств управляющих программ с помощью внесения в них исправлений на технологическом этапе программирования обработки. Специфическим свойством такой адаптивной системы управления служит корректирование приводов исполнительных рабочих частей станка по нынешней информации о подконтрольных процессах и значениях параметров обработки.

Ключевые слова: автоматическое управление процессами, адаптивное управления, повышение производительности, станок с ЧПУ.

УДК 629.3
ББК 39.3

WAYS TO IMPROVE THE SAFE OPERATION OF TECHNOLOGICAL EQUIPMENT IN PIGMENT PRODUCTION AT PJSC "PIGMENT"

D.P. Kuroedov
Tambov State Technical University, Tambov, Russia
e-mail: dmitriikuroedov@gmail.com

Abstract
This article deals with dangerous and harmful production factors arising from the operation of the technological system for the production of red 2C pigment and their effect on the health of workers. Methods for improving the safety and reliability of operation of technological equipment are proposed, and measures are described to prevent personnel from receiving occupational injuries, poisoning and diseases associated with the action of chemicals.
Key words: chemical industry, harmful and dangerous production factors, technological process, labor protection.

Great attention is given the issues of labor protection in various branches of human activity. Ensuring human security in the performance of job duties is a priority and is particularly acute in the chemical industry. The complexity of the process, the use of toxic and hazardous substances in production lead to the fact that the price of the error will be too great, and in addition to material damage of the organization, the harm will also be inflicted on the environment, and in the worst case scenario, people's lives and health will be endangered .

In accordance with the legislation of the Russian Federation and international standards, it is necessary to regularly identify hazards, assess risks and to take measures to reduce the level of risks, and develop, based on the results of monitoring working conditions, measures to prevent or reduce the impact of hazardous and harmful production factors on personnel.

In this regard, relevant studies are aimed at studying the causes of various emergencies in the production and development of measures to prevent them, as well as ensuring the safety of people in the performance of their duties.

We are faced with the goal of identifying hazardous production factors, proposing measures to protect personnel from their impact and developing recommendations for improving the safety of operation of process equipment.

At PJSC Pigment, production of red 2C pigment involves many hazardous and harmful production factors, such as [3]:

1. chemical burns caused by hydrochloric acid splashed on open parts of the body, as well as its vapors into the body; exposure to corrosive chemicals such as sodium hydroxide, a solution of a diazo compound, a solution of sodium salts without personal protective equipment;

2. acute poisoning with hydrogen chloride, nitrogen oxides due to exceeding their allowable concentration in the air of the working area due to violations during operation of the technological system or equipment malfunction;

3. thermal burns caused by contact between heated surfaces and damaged thermal insulation, steam, hot water in case of depressurization of equipment and pipelines and improper personal protective equipment;

4. electric shock during the operation of faulty electrical equipment, earthing devices, violation of insulation of electrical wiring;

5. Mechanical injuries cuased by violation of the equipment operation rules, lack of protective covers on the rotating parts, defective guards, and injuries due to falling from a height.

To avoid getting the described injuries by the personnel, it is recommended to follow the following rules of technological process:

- to use personal protective equipment consisting of tightly buttoned clothing, safety shoes, gloves, goggles, and a gas mask with a LFB box, which must be used in conditions of gas contamination of the room;
- to know and comply with the requirements of the process;
- to monitor the condition of the process equipment and do not use it if you know about its malfunctions;
- to monitor the integrity of the ground loop and do not start work if it is known of its damage;
- to conduct the technological process using a good ventilation system (both local and general) and use it constantly;
- to use effective protective guards for moving and rotating parts of process equipment;
- to have all the aisles fre of clutter, to have high-altitude platforms equipped with fences, handrails, if necessary to use safety ropes.

As additional measures, one can offer:

- to have the production process automated, allowing for remote control of technological process;
- to recruit qualified personnel and periodically carry out its retraining;
- to monitor the MPC of harmful substances in the air of the working area and monitor the health of ventilation devices;
- to conduct timely equipment modernization;
- to use thermal insulation coatings on pipelines, boilers, dryers.

In the production under consideration, emergency situations related to the depressurization of process equipment and pipelines at the joints of welded seams can occur. To reduce these risks, it is necessary to check and ensure the integrity and tightness of equipment and pipelines.

When operating the technological process of production of red 2C pigment, the release of hydrochloric acid vapors from the diazotization apparatus during the draining-filling operations can occur. Hydrogen chloride vapor presents a serious danger to humans, as they lead to severe chemical burns and cause poisoning.

Contact with the skin leads to tissue necrosis at the place of contact, getting inside through the respiratory tract causes burns of the mouth, bloody cough and suffocation. The reason for the occurrence of such a scenario is insufficient tightness of technological equipment. Leakage of a toxic substance is most likely to occur through the gap between the agitator shaft and the body of the apparatus due to the insufficient efficiency of the active seal. To exclude this scenario, it is recommended to use a seal of the original design, which ensures greater tightness.

According to the results of the analysis, the double mechanical seal manufactured under RU 2305810 provides the necessary tightness and its use is economically viable, and therefore recommended for installation.

In this model, the rotation of the shaft through the cage and the leash is transferred to the movable friction rings. Springs movable friction rings are held in place and pressed each to their stationary friction ring, preventing leakage through the mechanical seal. Leaks along the surface of the shaft are prevented by secondary elastic seals, which are pressed against the shaft and movable friction rings by springs through the pressure washers [1].

Such a design makes it possible to obtain greater reliability with simplicity of manufacture in comparison with currently used models. This seal is fixed to the shaft with a pin connection, which facilitates installation and allows for its replacement, and also allows the installation of a seal of similar design on the shaft.

Thus, to prevent the leakage of hydrogen chloride vapor from the diazotization unit, it is recommended to install a double mechanical seal of the described construction.

The implementation of the described measures will reduce the risk of emergencies and protect personnel from chemical and thermal burns.

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СПОСОБЫ ПОВЫШЕНИЯ БЕЗОПАСНОЙ ЭКСПЛУАТАЦИИ ТЕХНОЛОГИЧЕСКОГО ОБОРУДОВАНИЯ В ПРОИЗВОДСТВЕ ПИГМЕНТА НА ПАО «ПИГМЕНТ»

Д.П. Куроедов
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: dmitriikuroedov@gmail.com

Аннотация

В статье рассмотрены опасные и вредные производственные факторы, возникающие при эксплуатации технологической схемы производства пигмента алого 2С и их влияния на здоровье работников. Предложены способы повышения безопасности и надежности эксплуатации технологического оборудования, описаны мероприятия по предотвращению получения персоналом профессиональных травм, отравлений и заболеваний, связанных с действием химических веществ.

Ключевые слова: вредные и опасные производственные факторы, охрана труда, технологический процесс, химическая промышленность.

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ББК 39.3

DETERMINATION OF DESIGN PARAMETERS OF AUTOMOTIVE DRUM BRAKES

V.A. Sarychev
Tambov State Technical University, Tambov, Russia
e-mail: *svqwerty0@mail.ru*

Abstract
One of the main qualities of the car along with rapid acceleration is the effective braking. This possibility depends largely on the quality of the brake pads.
Key words: defective, strength, brake, abrasion, brake pads.

Introduction

Intense increase in the density and speed of vehicles, increasing need for security of its members, and the consequent tightening of national and international technical norms, standards and recommendations for braking systems cause the need for continuous improvement and optimization of vehicle braking. Significant progress has been made recently to improve the ergonomic parameters of the brake system while enhancing the quality of the braking process.

Brake pads – it is just those elements which exert the braking action (Fig. 1). Depending on the type of brake mechanism, they are of two types: disc and drum. Any pad regardless of the form has similar structure. They consist of a metal frame and attached to it an inhibiting layer made of the friction of the metal.

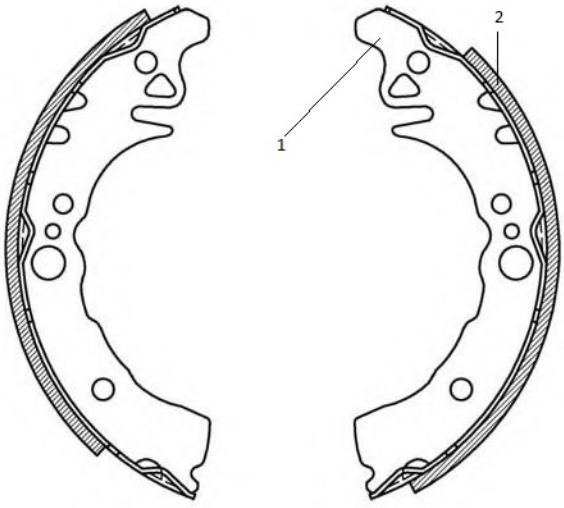

Fig. 1 - brake pads: 1 - metal base, 2 - pad

In challenging the composition of the inhibiting layer can include more than several dozen components. Because of this layer depends on the braking efficiency, many companies are kept classified as "top secret" ingredients of the composition

n. In most cases, the friction layer is made of organic and mineral fibers, synthetic rubber, various resins and various chemical additives.

Friction mix for brake pads can be divided into asbestos and without asbestos. Asbestos, used as a reinforcing material is inexpensive and quite traditional version, which is used for the manufacture of conventional brake pads. No asbestos brake pads – this is the next stage of technology development. There in as a reinforcing material use steel wool, copper or brass shavings or plastic materials.

From the beginning of development of mechanical vehicles started the race, continuing for two centuries – the race for high speeds. Along with this the race the designers were faced with equally important task – to force the car to stop when it wants the driver.

It is clear that for realization of this task, and was created by brake system. Although the first devices designed to stop vehicles, the system could be called a stretch. The first attempt to create a brake system can be considered a wedge, which is inserted between rim wheel carts and case carts (Fig. 2). It was very effective, because they present the effect of the self — rotating wheel, as it were pulled in by the wedge, thereby increasing a friction force between the wedge and the wheel. However, it is clear that the scope of such brakes was limited to horse-drawn carts and apply it in zambelich carts is impossible. To exit from a situation the designers had decided to use the car belt brakes. This system can be considered as the prototype of the modern brake systems: stationary leather strap, which played the role of brake friction tape, applied so far in special vehicles and tractors, when activating the brake system, tightened around the rotating pulley or drum (depending on design), thus stopping wheel rotation. At speeds of movement of the time, the effectiveness of the system was enough, but was too small a resource.

Fig. 2 - The first brake system

Gradually the braking system was improved (Fig. 3). But some radical changes were until then not yet invented the drum brake which has become "trendsetters" for many years. Undeniable advantages, such as high efficiency and long lifetime, literally forced designers around the world to apply the same system in cars. This situation lasted until the Second World War provoked a sharp pace of development and technological progress, mainly related to the military industry. Heavy-duty

equipment demanded higher margin of safety and power for all vehicle systems, including braking. And thanks to Spartan conditions, were identified the most significant drawback of the drum brake overheating when the load increases, and as a consequence loss in efficiency.

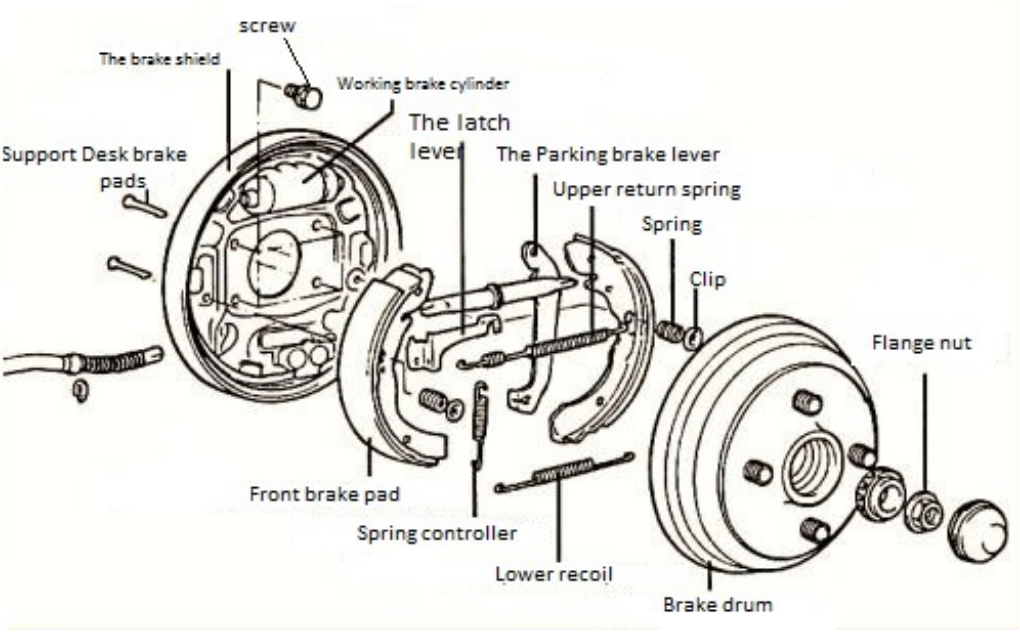

Fig. 3 - Modern brake drum

Drum brakes have several advantages and disadvantages.

1. The braking distance is 20% more than disc brakes.

2. As the system is closed, the products of wear (friction dust) remains in and affects the grip, getting on the friction surface.

3. Due to the large contact area between the pads and the drum, it is not stable, as well as deceleration.

4. The pads in drum brakes work "outside", so too much pressure in the cylinders can simply "break" the drum.

5. Temperature during emergency braking can reach 500 degrees, and since the system is closed, and not cooling down properly.

With so many disadvantages, have their advantages, thanks to which drum brakes are still in demand.

1. Design is protected against ingress of dust and dirt.

2. A closed system allows you to make the friction area even more by increasing the diameter and width of drum.

3. Because of the worst clutch pads wear out less.

4. Also the disadvantages include the complex structure of the brake unit. Not everyone will be able to disassemble the unit to replace.

There is an opinion that drum brakes are cheaper, and they need to be changed less frequently. But as shown by car manufacturers on selected models drum brakes cost more than vice versa. Although when you consider their lifespan, the investment is justified.

Basically drum brakes are put on trucks and buses. And also put on a "subcompact", where expensive equipment is not advisable to use. Most often on cars at the front axle are disc brakes and rear drum.

But progress does not stand still. With the development of engineering and increased speed of movement, therefore, there is a need in effective braking system. So there were disc brakes.

Conclusion

Combined brake system does not allow to force organically inherent shortcomings in effectively using the rear brake mechanisms for the transformation and dissipation of the kinetic energy of decelerating the vehicle when the service brake applications and challenges effective use of regulators of brake forces. This leads to the fact that up to 90% of the kinetic energy of the car when service braking is dissipated exclusively front disc brakes, what is the cause of their high loading.

Rear brakes, even when driving in difficult conditions, remain virtually "cold".

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ОПРЕДЕЛЕНИЕ КОНСТРУКТИВНЫХ ПАРАМЕТРОВ АВТОМОБИЛЬНЫХ БАРАБАННЫХ ТОРМОЗОВ

В.А. Сарычев
Тамбовский Государственный Технический Университет, Тамбов, Россия
e-mail: svqwerty0@mail.ru

Аннотация

Одним из главных качеств автомобиля, наравне с быстрым разгоном, является эффективное торможение. Эта возможность зависит во многом от качества тормозных колодок.

Ключевые слова: дефект, прочность, тормоза, износ, тормозные колодки.

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ББК: 39.353

TECHNICAL DIAGNOSTICS TOOLS

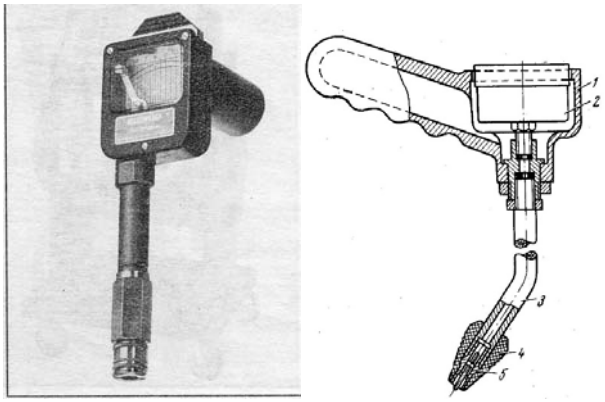
K.A. Sergienko
Tambov State Technical University, Tambov, Russia
e-mail: kir7073@yandex.ru

Abstract
This article refers to the systems of diagnostics, their structure and functions, and principle of operation.

Key words: compressor, motortester, uniflow gas compression, KI-4887-1 flowmeter, TO 69 device.

The system of technical diagnostics is a set of tools prepared for diagnostics and implementation of regulations established by appropriate documentation.

The most frequently used tools in the practice of diagnostics of uniflow gas compression in the engine include the means to assess the integrity of over-piston space: compression gauge, compressor, a device that measures the leakage of compressed air from the cylinders and motortester. Diagnostics according to the maximum pressure of the compression stroke (compression) is carried out using compresor or compression gauge (Fig.1.1). Compressor allows recording the measurement results by a graphical display of compression values using special plug-in cards. The compression gauge is a pressure gauge with a check valve. It allows measuring the end pressure and to some extent the dynamics of pressure rise for several revolutions of the crankshaft. The numerical values of each cylinder pressure are compared agaisnt each other. The discrepancy in measurements should not exceed 10 %.



a b

Fig. 1.1 - Devices to measure compression in the cylinder: compressor (a); the compression gauge model 179 (b); 1 – housing; 2 – pressure gauge; 3 – tube; 4 – rubber tip; 5 – spool

Factors affecting the value of the measured pressure are engine temperature and the crankshaft revolutions. When the temperature in the engine parts are

expanding, improving, thus, the seal in the joints. When the engine is hot the oil has less resistance to rotation. The speed of the crankshaft greatly influence on the magnitude of compression. Because, in the process of diagnosing engine crankshaft scroll using the starter, then during the consecutive measurements it is difficult to provide the engine with the same number of revolutions. Instant speed depends on the friction losses, the state of the battery, the starter. Flames O. indicates that the factors temperature and engine speed must be considered, and ideally to correctly interpolate. The method of measuring the pressure in the cylinder with compression gauge and compressor is widely used for maintenance and repair of engines. The advantage of this method is its simplicity, speed of work and low cost measuring instruments. A significant disadvantage of this method of diagnosis using the compression gauge or compresor is the measurement uncertainty and ambiguity in diagnosis. Primarily this is because compression depends on the state of CPG, and on the tightness of the valves, so the results obtained need to differentiate. The main disadvantage of this method is low sensitivity to structural changes CPG. Even with significant wear the compression varies by only 10-15 %, while depreciation, which is accompanied by ingress of oil into the cylinder, compression increases. Dankovtsev V. T. in his work indicates that the most accurately you can determine the state of CPG on the changes of compression. However, the existing devices are practically not suitable for determining the change in compression depending on the state of CPG. This is because they are by design sensitive to pulsations of pressure and allow you to measure it with accuracy 0,5 - 1,5 *105 PA, while the pressure end of compression stroke depending on the wear of cylinder-piston group is changing slightly to 1 - 1,5 *105 PA. Most quickly and effectively test the values of compression allow modern motortester. In this case, the measurement of the amplitude of the pulsations of the current is consumed by the starter when scrolling the crankshaft. The most expensive and modern motortester capable of measuring the absolute value of the peak current on each cylinder, and compare them with the actual pressure (Fig.1.2).

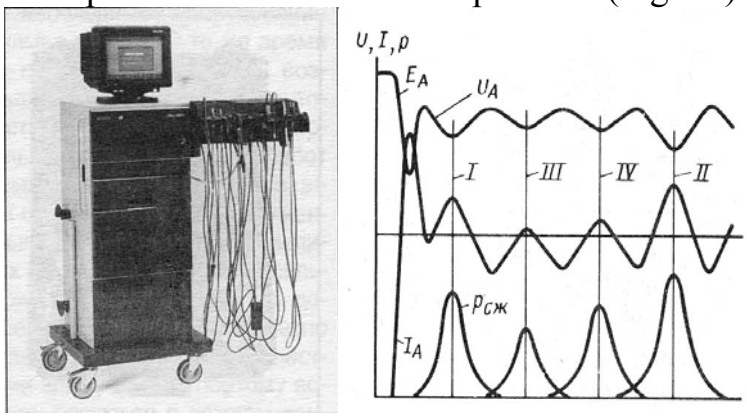


Fig. 1.2 - Motortester and measurements: I-IV – numbers of cylinders; IA and UA, respectively the current and the voltage in the starter circuit; EGS – cylinder pressures; EA – electromotive force of the battery

The advantage of this means of testing is quick and simultaneous pressure measurement in all cylinders within 10-15 seconds, no need of twisting the candle,

which is especially useful in the diagnosis of multi-cylinder engines. Motortester as a compression gauge to determine the reason causing the pressure drops in the cylinder. The reason could be either in the tightness of the valves, or malfunction of CPG. The above-mentioned disadvantages of measuring compression are more manifest in the diagnosis of petrol engines. For assessing the technical state of cylinder-piston group and valve mechanism common method, based on the relative air leakage through the gaps, the value of which depends on the degree of deterioration of mates. The relative air leakage through the gaps is measured by the device model K-69 designed for car engines with a bore of 50-130 mm (Fig. 1.3).

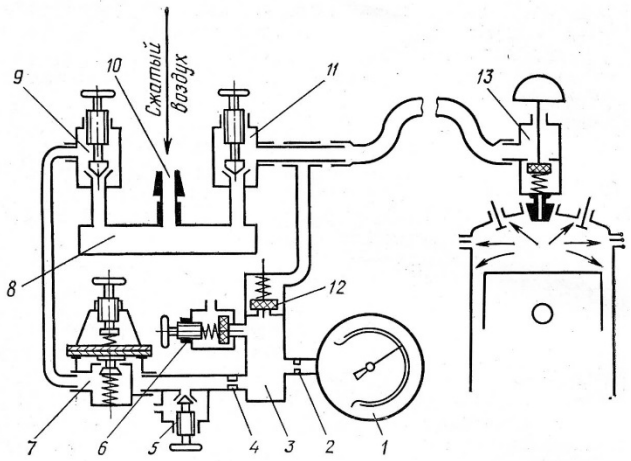


Fig. 1.3 - Diagram of the device TO 69: 1 – pressure gauge; 2 and 4 gauge holes; 3 – air chamber; 5 – adjusting needle; 6 – safety valve; 7 – pressure reducer; 8 – collector; 9 – the valve of measurement of leaks; 10 – inlet fitting; 11 – the valve listening for leaks; 12 – non-return valve; 13 – tip

The relative amount of air leakage is determined on a scale of a manometer, graded in percent. The maximum pressure corresponding to the full containment of the cylinder is taken as zero and the total leakage from the cylinder 100%. The more gaps in the coupling of the piston-ring-cylinder, the greater the percentage of relative air leak will show the needle. Measurements are made on a pre-warmed engine when the piston is at TDC, and then when the piston is at bottom dead center (BDC). If there is a difference between the values of the relative air leakage when the piston is at TDC and BDC longer valid values, the CPG needs to be repaired. Air leakage through leakage is determined by the meter or by ear. The ability to separate the definition of a technical condition of details of CPG distinguishes this method from others. Full engine control device is necessary to spend 20 min., and, as shows experience of many researchers, the results are not always reliable enough and does not exceed 50 %. Thus, the definition of the wear of piston rings this way is difficult. The compressed air presses the ring to the lower edge of the piston groove, and the mirror cylinder, which makes it impossible to establish a reliable dependence between the wear and the rate of air leakage. In addition, this method requires additional equipment and skills for measuring quantities and determining the location of an air leak. Also, a significant disadvantage of conducting such measurements is that the engine is in a static state, the details of which CPG is a random position

relative to each other. The probability of error of the measurements due to the lack of dynamic development processes is appropriate to the working condition of the engine. The following informative is the method of diagnosis according to the breakthrough gases in the crankcase. The amount of breakthrough gases into the crankcase depends on the wear CPG of an engine and corresponds to the mileage of the car. In case of faulty CPG, the gas pressure in the crankcase is increased to 80-160 mm Hg.St. To measure the pressure in the crankcase the pressure gauge should be used. When measuring the pressure or amount of gas burst through the engine crankcase needs to be sealed. The volume of intruding gases is measured by gas meter or flow meter. Gas meters have significant accuracy, for example, GKF to 10-20%. A more accurate device for measuring breakthrough gases in the crankcase is a flowmeter KI–4887-1 (Fig. 1.4).

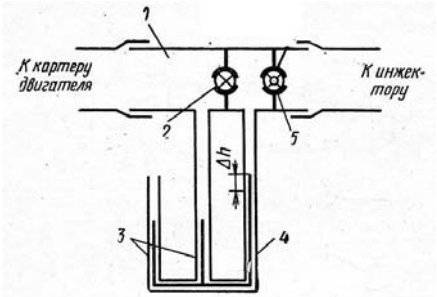


Fig. 1.4 - Diagram of the flowmeter KI-4887-1: 1 – channel suction gas from the crankcase; 2 – input the throttle for adjusting the pressure in the crankcase; 3 – the liquid pressure gauge, fixing the lack in the crankcase of excess pressure; 4 – tube piezoscanner to measure breakthrough gases on the opening value of the output inductor; 5 – closed throttle

Conclusion

The disadvantage of this type of means of CPG diagnosing is the inability to locate the fault in the cylinders. Thus, as practice shows maintenance and repair of automobile engines, the existing means of diagnosing, assessing the tightness of the combustion chamber, do not allow quickly, precisely and unambiguously determine the nature of the problem CPG, to locate the fault and establish why. The nature of diagnostic decision is largely determined by the experience of the operator and is subjective.

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СРЕДСТВА ТЕХНИЧЕСКОГО ДИАГНОСТИРОВАНИЯ

К. А. Сергиенко
Тамбовский Государственный Технический Университет, Тамбов, Россия
e-mail: kir7073@yandex.ru

Аннотация

В статье рассматриваются системы диагностики его структуры и функций, а также принцип работы

Ключевые слова: компрессор, мотостер, КПГ, расходомер ки-4887-1, прибор до 69.

УДК 656.1
ББК 39.33

THE INFLUENCE OF ABS SYSTEM ON ROAD SAFETY OF THE VEHICLE

A.A. Galdobin, A. A. Lavrenchenko
Tambov State Technical University, Tambov, Russia
e-mail: galdobin.aleksey@mail.ru

Abstract
The article presents the possibilities of improving road safety by analyzing the ABS system and identifying the positive factors and disadvantages. Giving the conclusion of the feasibility of using this system, the ABS provides optimum braking (shortest stopping distance) of the vehicle with preventing the wheels from locking. In modern cars the ABS is a complex system, which typically includes: a system, controlling the stability and a traction system. The ABS, in any case prevents the wheels from locking, and ensures control over the course of the movement, but in some cases it cannot guarantee shorter braking distances. This applies particularly to the normal road surface – to the dry road covering when the braking distance can be longer than the cars without this system.
Key words: road safety, traffic accidents, the ABS system, the braking distance.

Introduction

The situation of traffic safety on the roads of the Russian Federation for the traffic police was improved but not much. In the Russian Federation a decline was marked in the main indicators of accidents during all 12 months in 2016. The number of road traffic accidents (RTAs) decreased by 10306, the number of fatalities and injuries – by 2806 – 10057. However, the level of accidents in the country remains high – one in nine accidents was fatal. The severity of the accident, despite the decline compared to the same period last year (SPLY), made up of 8 dead against 100 injured. The number of traffic deaths increased in 15 regions. The largest growth occurred in Sevastopol city (+55.1 per cent), Kamchatka Region (+23,2%) and Tyumen region (+15.8 per cent). The main causes of accidents are the growth of the car fleet and its simultaneous aging as well as a decline in the culture of drivers, thus it is necessary to introduce more new technologies to ensure the safest driving.

Modern vehicles have high tractive and dynamic characteristics, which places high demands on the qualification of the drivers.

Among the devices that automate the management, the most widely anti-lock braking system (the ABS) to brake the actuator. The ABS controls the brakes during emergency braking, preventing the wheels from locking and, consequently, uncontrolled slipping of the vehicle. Numerous studies and experience of operating vehicles showed a significant increase in the level of active safety when the ABS is installed on the car. Currently, the ABS is standard inthe most long-haul tractors, buses, cars, middle and small classes.

Methods

The device of the ABS system is relatively simple. The basis for the work is taken with two measures of speed: the wheel speed and vehicle speed.

It is noticed that the maximum traction wheels with the road surface (in case of dry or wet asphalt, wet pavement or packed snow) is achieved by some, but rather 15-30 percent relative slippage. Only this slippage is acceptable and desirable, which is provided with the configuration elements of the system. What kind of elements? First, note that the ABS works by creating pressure pulses in the brake fluid that is transferred to the wheels. In the guidance of the instructor executes instead of a man for electronics and actuators, making it in the best possible way. In all the existing cars the ABS includes three main components: sensors on wheels and registered the speed of their rotation, the electronic data processing unit and a modulator or even the power modulators, which change cyclically the pressure in the brake lines.

Triggered on/off of the ABS system is automatically up to 30 times per second. Therefore, during the operation of the ABS system, the driver feels a slight runout on the brake pedal. Thus, the ABS System maintains a proper and efficient grip of car wheels and the road surface. And it already provides the ability to control the behavior of the machine in certain situations. The advantages of emergency braking with the use of anti-lock braking system are as follows: due to the use of the ABS the braking efficiencyincreases, the stopping distance is reduced by 15%, providing a better maneuverability on a slippery road surface and handling in case of emergency braking. An additional advantage is uniform and less tyre wear, which is 6% less.

Certainly, any electronic ABS system is not without drawbacks: the main drawback of the ABS is its behavior in a loose soil, namely sand, snow, or gravel. On such surfaces the braking distance increases and the minimum stopping distance is achieved by locking the wheels. This process occurs due to the accumulation in front of the wheel wedge, which shortens the braking distance. For modern cars this drawback is eliminated, this is achieved by defining the surface on which the inhibition, and the selection of the best algorithm for braking.

Conclusion

We studied design vehicles with the ABS and without it, from the point of view of road safety. The existence of such a systemadditionally insures the driver from force majeure on the roads. It independently assesses the strength of the sliding blocks by itself and releases the wheel in the desired time. These transitions will be eveninvisible to the driver since everything is done automatically and it takes only some shares of a second. In my opinion, the ABS system will be useful for beginners who find it difficult to comprehend the moment of failure of the wheels in the lock. It allows them to press on the brake pedal, not thinking about the drifts, and keep the possibility of making a smooth maneuver. Let’s note that the main components of security continue to remain the driver’s experience and skills, his ability to make decisions quickly, assess the situation on the road, and readiness for unforeseen situations.

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ВЛИЯНИЕ СИСТЕМЫ АБС НА БЕЗОПАСНОСТЬ ДОРОЖНОГО ДВИЖЕНИЯ АВТОМОБИЛЯ

А. А. Галдобин, А. А. Лавренченко
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: galdobin.aleksey@mail.ru

Аннотация

Статья посвящена исследованию возможностей улучшения безопасности дорожного движения за счет анализа системы АБС, выявления положительных факторов и недостатков. Приводится вывод о целесообразности использования данной системы. Система АБС обеспечивает оптимальное торможение (наименьший тормозной путь) автомобиля при помощи предотвращения блокировки колес. На современных авто АБС представляет собой сложную систему, в состав которой, как правило, включены: система, контролирующая устойчивость, противобуксовочная система. АБС в любом случае предотвращает блокирование колес, а также обеспечивает контроль над курсом движения, но в некоторых случаях она не может гарантировать уменьшение тормозного пути. Особенно это относится к нормальному дорожному покрытию - именно на сухом покрытии тормозной путь может быть большим, нежели у авто без данной системы.

Ключевые слова: безопасности дорожного движения, ДТП, система АБС, тормозной путь.

УДК 656.1
ББК 39.33

THE ANALYSIS OF THE PROBLEM OF CARGO TRANSPORTATION

I. R. Laukhin
Tambov State Technical University, Tambov, Russia
e-mail: layxin96@gmail.com

Abstract
In this paper, the problem of packing cargo in a vehicle is analyzed. The main types of vehicles are described. The limitations that arise during loading are considered. Optimization methods that are used to solve similar problems are analyzed.
Key words: cargo packages, optimization methods, vehicles, restrictions.

Introduction

Optimization is an important stage in improving production processes, for example, loading goods into a vehicle. The main problem is to fit the cargo. The cargo should take up as little space as possible. We are faced with the problem of optimal packaging. It is called the 3-dimensional problem of the backpack. The optimal solution reduces the cost of transportation in the vehicle, because the cargo is distributed more compactly.

Subject area analysis

The choice of transport is important for transportation. Transport is divided into six types. Each type of transport has its own features, advantages and disadvantages. Let's consider each of them in detail.

A popular way to deliver goods is by road. This is due to many factors. Road transport ensures the efficiency and dynamism of transportation. The market is provided by a large number of automobile carriers. This provides competition between them. This method of transportation has disadvantages. If the path increases, then the cost of transportation increases. Road conditions are the second disadvantage. Road transport has not a large carrying capacity.

Railway transport provides transportation practically in any weather conditions. It has a low freight price. But rail transport has a big drawback. Limitation is superimposed on two aspects. The number of carrier companies is limited. A small number of stations require additional transportation.

Air transport ensures fast delivery. Delivery is provided anywhere in the world. Air transport has a high cost. The restriction is imposed on the number of airports and additional transportation from the airport.

Sea transport is considered the cheapest. It provides high load capacity. Sea transport is designed for the transport of goods over long distances. Long delivery time is its main drawback. It depends on geographical conditions and the degree of infrastructure development.

River transport has the same advantages and disadvantages. It is used sometimes as sea transport.

Constraints arise when considering the layout problem. Limitations are the orientation of the boxes, stability, density, weight distribution, the maximum weight of the container.

Stability of packaging is an important condition of the task. It manifests itself in practice. Unstable packaging can damage the cargo. Stability of loads during loading is important. The cargo is fixed with straps for stability. The empty space is filled with cushioning material. This increases the stability and cost of transportation. The best stability is to fill the container. The box is located entirely on a flat surface.

Boxes will lie on top of each other. This laying constraint implies their bearing capacity. Each box should have the maximum weight that it can withstand. This will depend on the orientation of the box. Sometimes the bearing capacity of the box is provided by its side walls. Therefore identical boxes are packed on top. Heavy boxes have height restrictions.

Weight of goods and distribution on the container are restrictions when loading into a container. Weight should be distributed along the container. The centre of gravity of the container must coincide with its geometric centre. Additional restrictions apply when loading land vehicles. Weight loads are taken into account on the vehicle axis.

All restrictions affect the packaging of the container. They must be combined in a method. The method will solve the set assembly problem.

The choice of the algorithm is an important stage for the solution. The layout task will be implemented on its basis. Tasks use optimization methods. They are divided into exact and approximate. Algorithms for brute force, branches and boundaries, dynamic programming are exact methods. Greedy and genetic algorithms refer to approximate methods. We will consider some of these methods.

The method of simple search is the most trivial. It takes a long time to solve the problem. The method goes through all possible solutions. A simple search works with a small number of objects.

The branch-and-bound method is an improved method of enumeration. It cuts off the wrong layout options. Clipping occurs when the container is reloaded. The branch will not be considered.

The genetic algorithm is the most extraordinary. The essence of the algorithm refers to natural selection. The cargo is supposed to be an individual. The essence of the algorithm is as follows. We create the initial population. Next, calculate the utility coefficient for each individual. Two individuals are selected for crossing. The operation is repeated five times. Individuals appear from each crossing. All the children are sorted. Mutations occur in random individuals. Individuals receive a utility coefficient. The basis for the new population will be the first ten individuals.

Conclusion

The article considers the main aspects of loading: the description of types of vehicles,consideration of loading restrictions, analysis of optimization methods.

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АНАЛИЗ ЗАДАЧИ УПАКОВКИ ГРУЗОВ

И. Р. Лаухин
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: layxin96@gmail.com

Аннотация
В данной статье рассматривается анализ задачи упаковки грузов в транспортное средство. Описаны основные типы транспортных средств. Рассмотрены ограничения, которые возникают во время погрузки. Проанализированы оптимизационные методы, которые используются для решения подобных задач.

Ключевые слова: ограничения, оптимизационные методы, типы транспорта, упаковка грузов.

УДК 656.11
ББК 39.12

DRIVER'S RELIABILITY AND SAFETY OF THE TRANSPORTATION PROCESS

E. V. Vasilyeva, A. L. Usnyan, A. Y. Chetyrin
Tambov State Technical University, Tambov, Russia
e-mail: ketvas.ru@rambler.ru

Abstract
Reasons and conditions causing road accidents are considered and measures aimed at the reduction of accidents and their consequences are suggested.
Key words: driver's reliability, motor transport enterprise, road accident, road safety, transportation process, transport safety, vehicle.

Introduction

Providing professional reliability of drivers is one of the most important activities of enterprises, organizations and individual entrepreneurs involved in the transportation of passengers and cargo. According to the traffic police of the state inspection of road safety of Russia errors related to the human factor cause approximately 80% of road accidents. This long-term statistical regularity indicates the predominant role of the driver in ensuring the safety of the transportation process and traffic as well as the system "Driver-Vehicle-Road-Environment" (DVRE).

The influence of the driver on the transportation process

Road transport is superior to other means of transport concerning the quantitative indicator of transportation of goods and passengers. The great popularity of vehicles is explained by such a criterion as mobility. The vehicle is a source of danger. Therefore, transportation safety is one of the main problems at the moment.

Safe transportation is a major component of the transportation process. The safety of the transportation process includes:

- road safety;
- environmental safety;
- the safety of transported goods and means of transport;
- personal safety of drivers and passengers.

As shown by the analysis of numerous studies, traffic safety depends on road safety.

The influence of the driver on road safety is crucial. The task of the driver controlling the vehicle is to ensure road safety.

The driver's reliability is affected by many different factors:

1. External factors: characteristics of the road surface, weather conditions;
2. Internal factors: conditions of the driver's workplace;
3. Factors related to the medical, physiological, professional and social-psychological state of the driver: experience, age, qualification, mental and physical conditions.

These circumstances testify that there is a dynamic system on roads that includes a person (driver, pedestrian), a vehicle, a road and environment (DVRE).

By the end of 2016 there had been a decline in the main indicators of accidents in the Russian Federation. However, the level of accidents in the country is high. In general 173694 road accidents have occurred on all streets and roads of the country. Among them 150860 accidents have occurred due to the fault of the drivers of vehicles. Among the total number of road accidents caused by drivers of all ages, the number of accidents and the number of the injured have increased significantly due to traffic violations made by drivers who are 60 years old or more. The more the driver is adapted to danger, the more attentive the driver must be to react properly. This psychological behavior must not be forgotten by experienced drivers. However, the main reason of road accidents is drivers with the experience which is less than 2 years, their share in the total number of road accidents is almost 40% annually.

For the management of the motor transport enterprise, heads of departments, the issues of ensuring road traffic safety are the most important ones.

The reduction of accidents on the road can be achieved through a focused and coordinated approach to the issues of training and retraining of drivers. If the driver got wrong skills and wrong knowledge at the stage of learning the increase of driving experience may not lead to increased reliability of the driver. So systematic errors combined with the high self-esteem of their skills can lead to negative consequences. Therefore, for trucking companies, it is important to hire drivers with a long driving experience and abilities to solve difficult problems. They must have periodical check – ups as well as professional development courses to make transportation safe. The motor transport enterprise staff develops a clear timetable and a route so that drivers will not be exhausted.

Conclusion

Thus, it is important to outline factors which have the greatest influence on the safety of transportation:

- drivers-beginners can be allowed to drive public transport after additional training with periodic re-examination;
- certain restrictions on driving for drivers-beginners (prohibition of driving in difficult weather conditions);
- the mandatory presence of the psychologist in the motor company for the daily inspection of the psycho-physiological state of the driver;
- the necessity to choose drivers aged 26 – 60 years old;
- permanent monitoring of drivers' knowledge and skills in traffic safety;
- the driver's working day must not be more than 4,5 hours;
- reduction of cargo transportation at night since the probability of an accident increases by 1.5-3.5 times.

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НАДЕЖНОСТЬ ВОДИТЕЛЯ И БЕЗОПАСНОСТЬ ПЕРЕВОЗОЧНОГО ПРОЦЕССА

Е.В. Васильева, А.Л. Уснян, А.Ю. Четырин
Тамбовский Государственный Технический Университет, Тамбов, Россия
e-mail: ketvas.ru@rambler.ru

Аннотация

Рассматриваются причины и условия, способствующие совершению дорожно-транспортных происшествий, предлагаются конкретные меры, направленные на снижение аварийности и ее общественно опасных последствий.

Ключевые слова: автотранспортное предприятие, безопасность дорожного движения, безопасность перевозок, дорожно-транспортное происшествие (ДТП), надежность водителя, перевозочный процесс, транспортное средство.

УДК 623
ББК 0332

THE CONCEPT OF SEMI-PASSIVE HOMING METHOD OF THE OBJECT

K.A. Mamontov
Tambov State Technical University, Tambov, Russia
e-mail: kirillmamontow@bk.ru

Abstract
A new sequence of actions for the use of destruction means with passive radar homing system is developed. The essence, the scope and the main features of a semi-passive method of homing weapons are considered.
Key words: a semi-passive homing; stealth object; range of application; electronic warfare.

Introduction

In recent years, many countries adopt models of aircraft and marine equipment of the fifth generation. Their distinctive features are radiology instability and risk obscurity, high tactical and technical characteristics of the means used for expression, enhanced maneuverability and functionality, integration of information and measuring devices in General spatially distributed field of information, the ability to conduct electronic warfare. Reducing the visibility of important military facilities locating means is achieved by using Stealth and carries a big threat to the opposing party, as it is more secretive. This technology is achieved by reducing the effective reflective area of the object in the direction of the combined transmitting-receiving radar station. In this regard, decreases the range of the means of destruction with active and semi-active methods of guidance

The conception of semi-passive homing method

The main elements of the concept at the development stage include: a method of forming and some of the requirements to the probing signal; the type of guidance system – a missile seeker and algorithms of spatial-temporal information processing; a method of homing missiles.

In this concept, the probe signal should simulate mode, which can be homing missiles. Further, such a probe signal will be referred to a provocative probing signal (PPS). Each of the high frequency instrument missile seekers in the method of homing in a certain way must be consistent with the parameters used in the current time of the PPS. Currently, the wavelength range of the radar seeker is 2-4 cm and the size (diameter) missiles, power of the radiated signals, the effective area of reflection purposes can significantly increase the range of information contact with the target in the implementation of active and semi-active homing methods. In this regard, taking into account the available technical means for conducting network-centric operations the concept of SPH provides the ability to integrate locating means

decimeter and centimeter ranges. In this radar of the decimeter range can serve as a mean of detecting targets, including made by technology "Stealth" and target designation radar centimeter range source PPS. General requirements for the PPS can be formulated in the form: 1. PPS has to simulate one of the possible modes of target tracking radar and have the ability to radiation of different PPS; 2. PPS source can be not only a radar carrier rockets; 3. PPS may be the mode of tracking a carrier or only to imitate; 4. PPS source must have appropriate means of telecommunication for the conduct of network-centric military operations; 5. The radiation direction of the PPScan be consistent with the radar detection of longer wavelengths in the centimeter or decimeter range; 6. PPS is based on the technical characteristics of the missile seeker and algorithms of spatial-temporal information processing. It is obvious that these requirements are not contradictory.

In accordance with the inventive method the staff of the rocket measured by analogy with passive location available only the azimuth and elevation aerial target (AT). Structurally, the semi-passive seeker will be whiter simplicity in comparison with the equipment necessary for the implementation of active or semi-active homing methods. Also due to the considerably large amount of a priori information about the interfering signals emitted by the jamming stations purpose in accordance with the laws and regulations of the electronic warfare (EW) in response to the PPS, the semi-passive seeker will be structurally simpler "pure" passive counterpart. At the same time when SPH is significantly more complicated algorithms of secondary processing thay are implemented in the onboard computer of the missile. To active jamming signal was suitable to solve the problem of homing, it is necessary to identify and to estimate parameters. Due to the fact that the range of interference is very diverse, you may experience different interference situations. Each interference situation must correspond to a defined structure of the identification algorithm and evaluation. Algorithms of processing of the received signals and semi-passive missile seeker are better to develop a class of systems with randomly varying structure.

As a method of homing missiles, when implementing a SPH can be taken as a basis for the method of proportional guidance (navigation), the main parameter of which is the angular velocity vector, the relative range missile – is VTS. In accordance with the method of proportional guidance perfect communication is superimposed on the velocity vector of the missile so that the angular speed of the velocity vector of the rocket was proportional to the angular velocity of rotation of the vector relative range. Best results for optimization of the rocket trajectory are achieved for variants of correction of the proportionality factor depending on the values of the target range, the speed of convergence with the target and, in some cases, acceleration of the target. When implementing the PPS the measurement data of the phase coordinates of VTS in the missile seeker is fundamentally impossible. However, there are no some special needs for these measurements. So, it is shown that the coefficient of proportionality, called the navigation constant, which is in the range of 4-6, the kinematic trajectory of a missile when you hover over maneuvering

target are almost coincident with the trajectories of the method of parallel convergence.

An important characteristic of any mean of destruction (MD) is precision targeting. It is shown, that for exact hit in maneuvering target when you hover on a method of proportional navigation lateral overload of the rocket is not more than 20% should exceed the current overload of the target. This confirms the principle possibility of using SPH for missile guidance on a method of proportional navigation only on the basics of goniometric measurements. It is also relevant to note the following positive effect on the pointing accuracy, namely, the absence of wandering reflection center on the contour of the goal in the method of SPH is due to the fact that the source of radiation is the transmitting station antenna interference objective, unlike active and semi-active methods, when sources of radiations/reflections are brilliant points located across the surface of the target.

Specific values of the navigation can be entered in the missile seeker at start-up depending on the tactical situation, to be programmed in accordance with the forecast for the development of the tactical situation, or be adjusted in the presence of a communication channel "carrier-rocket". Use of estimates of the range and speed of convergence will reduce lateral overload and to improve the accuracy of missile guidance for maneuvering target. In particular, the development of specific laws targeting the missiles with the missile seeker implementing SPH, and media of these missiles – are the springs of PPS, it is advisable to use methods of the theory of multiple electronic control systems.

Conclusion

This article discusses some of the most important aspects of the concept of the method of SPH MD. Based on the analysis of the characteristics of modern samples of military equipment, composition and techniques, application equipment, and laws of radar and EW can be approved to wait that way of SPH MD will have better characteristics in comparison with other ways of homing in its implementation on the basis of multiple systems in the conduct of network-centric military operations. The theoretical development of the elements of the SPH that are related to methods of forming a PPS, the algorithms of spatio-temporal Ob-processing signals in a passive seeker of the joint venture, and the subsequent practical implementation of the concept available technical settentrionali funds will contribute to the reduction of the claimed combat capabilities of the stealth features. The developed method of SPH is universal as the range of MD and the types of goals.

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КОНЦЕПЦИЯ ПОЛУПАССВНОГО СПОСОБА САМОНАВЕДЕНИЯ ОБЪЕКТА

К.А. Мамонтов
Тамбовский Государственный Технический Университет, Тамбов, Россия
e-mail: kirillmamontow@bk.ru

Аннотация

Разработана новая последовательность действий по использованию средств разрушения с пассивной радиолокационной системой самонаведения. Рассмотрена сущность, сфера применения и основные особенности полупассивного метода самонаводящегося оружия.

Ключевые слова: полупассивное самонаведение; стелс-объект; область применения; радиоэлектронная борьба.

УДК 621.362.1
ББК 54.101

THE DEVELOPMENT AND RESEARCH INTO THE METHOD OF INCREASING THE ACCURACY OF OSCILLOGRAPHIC MEASURING ARTERIAL BLOOD PRESSURE

A.A. Meshcheryakov
Tambov State Technical University, Tambov, Russia
e-mail: St.Grand@bk.ru

Abstract
The article is dedicated to the development and research into the ways of improving the accuracy of the oscillographic method of measuring blood pressure of a person.
Key words: blood pressure, oscillogram, systole, diastole, tonometer.

Measurement of arterial blood pressure (ABP) is an integral part of prevention, epidemiology, diagnosis and treatment of arterial hypertension (AH) and scientific research in the field of cardiology.

The most accurate method of measuring blood pressure is a direct infra-arterial method, and the standard of ABP is the blood pressure in the aorta. Since this method is rather laborious and can cause complications for patients, non-invasive methods of measuring ABPare are used in everyday clinical practice.

In modern medical devices intended for non-invasive measurement of blood pressure, two methods of registration are mainly used: auscultatory and oscillometric.

Currently, most methods for measuring blood pressure are focused on processing a volumetric compression oscillogram. The aim of this work is to develop a new method that increases the accuracy of arterialblood pressure measurement.

The oscillographic method of measuring ABP involves recording and data analysis the oscillograms of arterial vessels during the process of increasing pressure in the blood pressure cuff with the following electrical transformation. Registration and analysis of the volumetric oscillogram of arterial vessels is performed in the frequency range from 0-0.1 Hz to 40-60 Hz, the compression of the blood pressure cuff continues until the appearance of oscillogram waves. In order to determine the magnitude of diastolic and systolic pressure by the amount of pressure in the blood pressure cuff, it is necessary to identify the limiting value of the amplitude and time constant.

The informative parameters of the diastolic part are determined with respect to two values of the amplitude and time instants.

To define the diastolic pressure on the diastolic part of the oscillograms, the amplitude Uis recorded in two time t. By the value of the amplitudes and the instant of time it is possible to find out a successive approximation to the regulated error of the iterative calculation, the limiting value of the amplitude and the time constant over which the diastolic pressure is determined. (Fig.1)

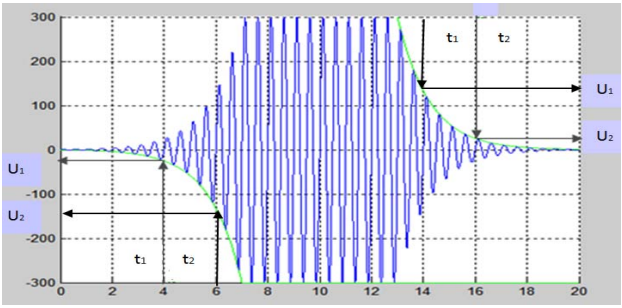

Fig. 1 - Approximation of the diastolic and systolic parts of the oscillogram.

It is expedient to approximate the diastolic part by an exponential dependence. By the value of the amplitude U_D and T_D the time point, a limiting value of the amplitude and a time constant over which the diastolic pressure is determined are found by successive approximation to the regulated error of the iterative calculation, similarly the systolic pressure is found, T_D and U_D are a measure of reference for measuring diastolic pressure.

The diastolic pressure is measured as follows:

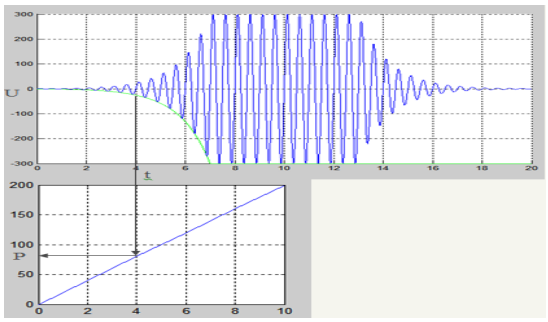

Fig. 2 - Determination of diastolic pressure from experimental data.

Approximating the oscillogram from the dependence, enter a measure of the reference, which is equal to the time constant T_D.

For the diastolic part of the model $t = T_D$, therefore for the measured pressure $P = vt$ according to a linear law: $P_D = vt$,

where v is the speed of the linear pressure set in the he blood pressure cuff

Similarly, systolic pressure is found.

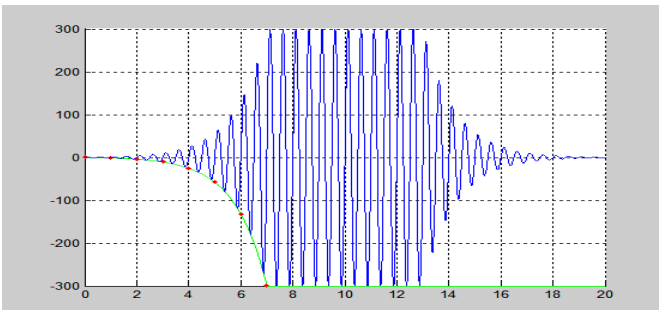

Fig. 3 - Comparison of the approximations of the diastolic part.

When comparing the approximations of the diastolic part (Fig. 3) by the oscillographic method of measuring blood pressure, characterized by the fact that to determine the systolic pressure on the systolic part of the oscillograms, the amplitude is recorded at two points in time, according to the amplitude and time values, by successive approximation to the regressed error of the iterative calculations, the limiting value of the amplitude and the time constant over which the systolic pressure is determined, the error does not exceed $4 \cdot 10^{-9}$ (fig.4).

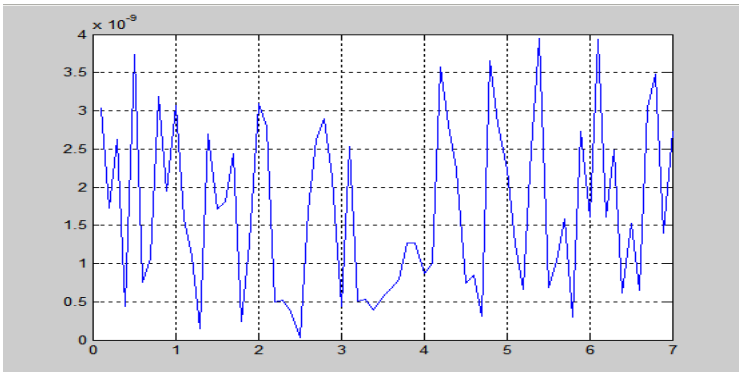

Fig. 4 - Error in approximating the diastolic part.

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РАЗРАБОТКА И ИССЛЕДОВАНИЕ МЕТОДА ПОВЫШЕНИЯ ТОЧНОСТИ ОСЦИЛЛОГРАФИЧЕСКОГО СПОСОБА ИЗМЕРЕНИЯ АРТЕРИАЛЬНОГО ДАВЛЕНИЯ ЧЕЛОВЕКА

Мещеряков А.А.
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: St.Grand@bk.ru

Аннотация

Работа посвящена разработке и исследованию метода повышения точности осциллографического способа измерения артериального давления человека.

Ключевые слова: Артериальное давление, осциллограмма, систола, диастола, тонометр.

УДК 616.12
ББК 54.101

METHOD OF DETERMINATION OF STROKE VOLUME OF HEART

V.V. Nedosekin, T.S. Sjuksina, Yu.E. Shikhkaibova
Tambov State Technical University, Tambov, Russia
e-mail: vladislavnedosekin@yandex.ru

Abstract
This article proposes a method for determining the stroke volume of the heart, which has high accuracy and based on the measurement of hemoglobin and resistance of the human skin.
Key words: electrodes, heart, hemoglobin, resistance, rheogram, stroke volume.

Stroke volume (SV) is the volume of blood pumped from the left ventricle per beat. Stroke volume is calculated using measurements of ventricle volumes from an echocardiogram and subtracting the volume of the blood in the ventricle at the end of a beat (called end-systolic volume) from the volume of blood just prior to the beat (called end-diastolic volume). The term stroke volume can apply to each of the two ventricles of the heart, although it usually refers to the left ventricle.

Stroke volume is an important determinant of cardiac output, which is the product of stroke volume and heart rate, and is also used to calculate ejection fraction, which is stroke volume divided by end-diastolic volume. Because stroke volume decreases in certain conditions and disease states, stroke volume itself correlates with cardiac function.

Very often cardiovascular diseases develop slowly and therefore can remain undetected for a long time. Often, a person gets to know that he has heart problems suddenly, when it is too late to prevent pathology.

The importance of this problem and the large amount of research conducted stimulated the development of various types of instruments and methods for determining the stroke volume of the heart. But their accuracy is not enough, so a new method has been developed.

The aim and objective of the research is to increase the effectiveness of metrology method for determining stroke volume of heart by eliminating methodological error.

1. To conduct the information analysis methods for determining stroke volume of heart;
2. To create the innovation from prototype;
3. Metrological effectiveness improvement.

The existing methods for determining the stroke volume of the heart were analyzed. After that, a new method was developed.

Technical task is increase in accuracy of definition of a stroke volume of heart on adaptive range, a priori regulated by the normalized values of resistance and a hemoglobin of two patients with the known values of a stroke volume of heart.

The technical task is reached by the fact that:

1. In the way of definition of a stroke volume of heart including imposing of two current and two potential electrodes on particular parts of the body, filing of resistance of R between electrodes at removal of a rheogram (RG), blood hemoglobin measurement unlike a prototype, the stroke volume of heart is determined by the gage characteristic by Q attitudes of resistance of R towards the limiting value of R_0 between RG electrodes with the Q_{0i} function of the normalized volume from a blood hemoglobin Hb

$$Q = Q_{0i} \cdot e^{\frac{R}{R_0}}. \quad (1)$$

2. Unlike a prototypes, the limiting value of resistance of R_0 is adapted to range to the values of resistance R_i of patients, the normalized volumes of heart of Q_{0i} and values of stroke volumes of heart of patients of Q_i registered on top and bottom borders, with various calibration for men and women

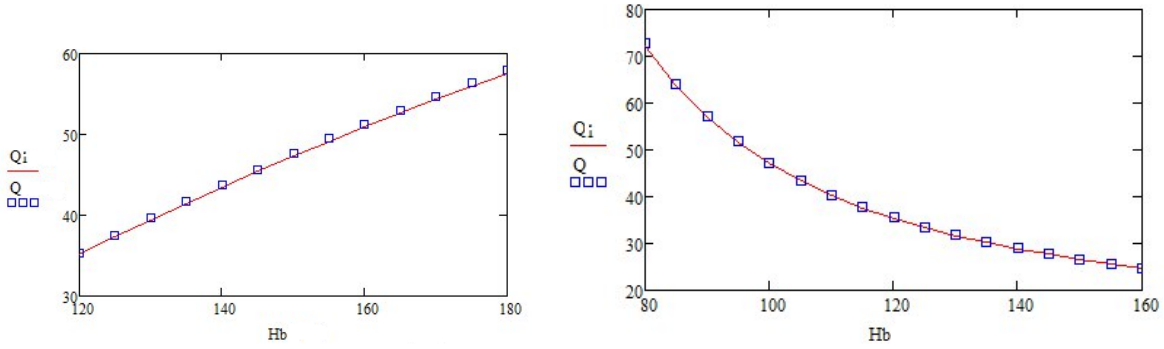
$$R_0 = \frac{R_2 - R_1}{\ln(\frac{Q_{01} \cdot Q_2}{Q_{02} \cdot Q_1})}. \quad (2)$$

3. Unlike a prototypes, function of the normalized volume Q_{0i} is calibrated a priori on the measured value of Hb hemoglobin of one patient with the known value of a stroke volume of heart of Q on which count a successive approximation parameters: values of the extreme volume of heart Q_0 and the limiting hemoglobin of blood Hb_0, for men and women

$$Q_{0i} = Q_0 \cdot e^{\frac{Hb_0}{Hb}}. \quad (3)$$

Fick's method is accepted to a standard.

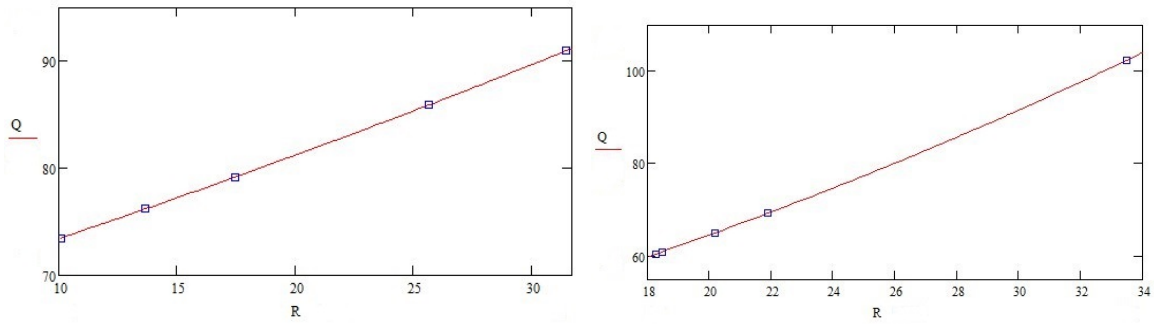
According to the obtained data schedules of dependence of volume of the offered way (fig.1a,b - full curves) concerning Fick's method (fig.1a,b, squares), which shows identity of the offered way to a natural experiment with a margin error no more than 0,1% are constructed. Need of division of patients by gender is explained by a different slope angle and curvature. (Fig. 1)



a) For men *b) For women*

Figure 1 – Identity of the normalized volume of heart from hemoglobin

Adequacy of function of a stroke volume of Q from resistance of $R$is estimated in Fig. 2a,b.



a) For men *b) For women*

Fig. 2 – Stroke volume of heart from skin

Thus, determination of the real volume of heart according to the gage characteristic of the attitude of resistance towards the limiting value between rheogram electrodes with function of the normalized volume, identical to a natural experiment for any single measure of a hemoglobin, unlike the known decisions, increases accuracy on two orders and surpasses them in a methodical error for 10-20%.

The main scientific and practical results of this work include:

1. Information analysis methods was done

Methods for determining the stroke volume of the heart were analyzed and a prototype was chosen on the basis of which a new method was proposed.

2. Innovation was created based on the prototype

A new method was created, optimization of the limiting value of resistance over the range was made and calibration was carried out for the limiting values of hemoglobin and the limiting values of the stroke volume of the heart.

3. Assessment of methodological error was carried out to improve the efficiency

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СПОСОБ ОПРЕДЕЛЕНИЯ УДАРНОГО ОБЪЕМА СЕРДЦА

В.В. Недосекин, Т.С. Сюксина, Ю.Э. Шихкаибова
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: vladislavnedosekin@yandex.ru

Аннотация

В данной статье предложен метод определения ударного объема сердца, обладающий высокой точностью и основанный на измерении гемоглобина и сопротивления кожи человека

Ключевые слова: гемоглобин, реограмма, сердце, сопротивление, ударный объем, электроды.

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ББК 32.844-02

FEATURES OF GALVANIC CELLS APPLYING IN MOBILE MEDICAL DEVICES

A. V. Neprokin, R. A. Kulikov, K. S. Savinova
Tambov State Technical University, Tambov, Russia
e-mail: alexhome16@mail.ru

Abstract

The paper explores the existing medical devices powered by galvanic cells and methods for estimating the residual capacity of batteries. The algorithm for the functioning of the device for estimating the residual capacity of galvanic cells and calculating their service life in a specific medical device is proposed. Electrical circuit of the device and a program for its functioning applied to elements with voltage up to 5 volts are developed. The algorithm can be used in developing mobile medical devices.

Key words: chemical current sources, galvanic cells, residual capacity, mobile medical devices, portable medical devices.

Introduction

Nowadays galvanic cells are widely used as power sources in mobile medical devices [1-7]. Premature failure of a galvanic cell can lead to other consequences such as halt in the process of patient diagnosis and loss of data in Holter monitor. Also, premature failure of a galvanic cell can be dangerous for patient's life if it is used in medicine ventilator or hemodialysis machine. Thus, it is necessary to obtain prompt and reliable information about the current state of the batteries.

There are two types of the galvanic cells: primary and secondary. A primary cell is a cell that cannot be recharged after a full discharging. Primary cells are called dry cells because they have a solid or molten electrolyte. A secondary cell is a cell that can be recharged once when it has been fully discharged. Structural and technological differences influent on the characteristics of the batteries, especially on their capacitance. Only some parameters of the cells can be measured with sufficient accuracy: voltage and current flow [1]. The process of measuring of the capacitance and lifetime of the elements has certain difficulties. The accuracy of this measuring depends on type of the battery and some few factors [6].

The problem of capacitance measurement is also relevant, because of the pollution of the environment by toxins in the manufacture and utilization of the batteries [2].

The aim of the research is to create a device for measuring the capacitance and lifetime of galvanic cells. It makes possible to determine their suitability for use, reduce the frequency of replacement of batteries, and reduce the costs for these measures.

There are a lot of medical devices that has no indication of battery status. Some of the devices can show it, but usually this indicates only voltage of the battery [5]. According to practical experience, it is not reliable method of controlling batteries.

Methods and materials

There are some devices and techniques for measuring of the capacitance [1, 3]. However, they have many limitations such as:

they are not suitable for primary cells (because of fully discharging);

they unable to apply in portable devices (because of size and weight);

they are used only for certain type of the batteries (Lead–acid battery for cars);

Thus, none of these methods can be used in portable medical devices. Except one, that was chosen for the device. For the development of the device such method as a method from patent RU №2172044 was used by which the capacitance of the elements is calculated. This method is used during the charging time of the capacitor to calculate the capacitance of the chemical cells. The method for measuring the electrical capacitance of chemical current sources is:

1. To discharge the current source to a capacitor load
2. To measure the charge time of the capacitor
3. To calculate the electrical capacitance and lifetime by the formulas:

$$Q = \frac{C \cdot U}{2 \cdot t \cdot k}$$

Q – is a capacitance of the galvanic cell (A·h);

C – is a capacitance of the capacitor (F);

U - is a voltage of the galvanic cell (V);

t – is charging time of the capacitor (sec);

k – is a coefficient of the structural and technological characteristics of the cell (sec^{-1});

$$T = \frac{Q}{I}$$

T – is a lifetime of the cell (h);

I – is maximum current consumption from the device passport (A)

The method was improved. In addition, this method uses the original algorithm. Measuring of voltage level on the galvanic cell was excluded from algorithm to reduce time of the calculation.

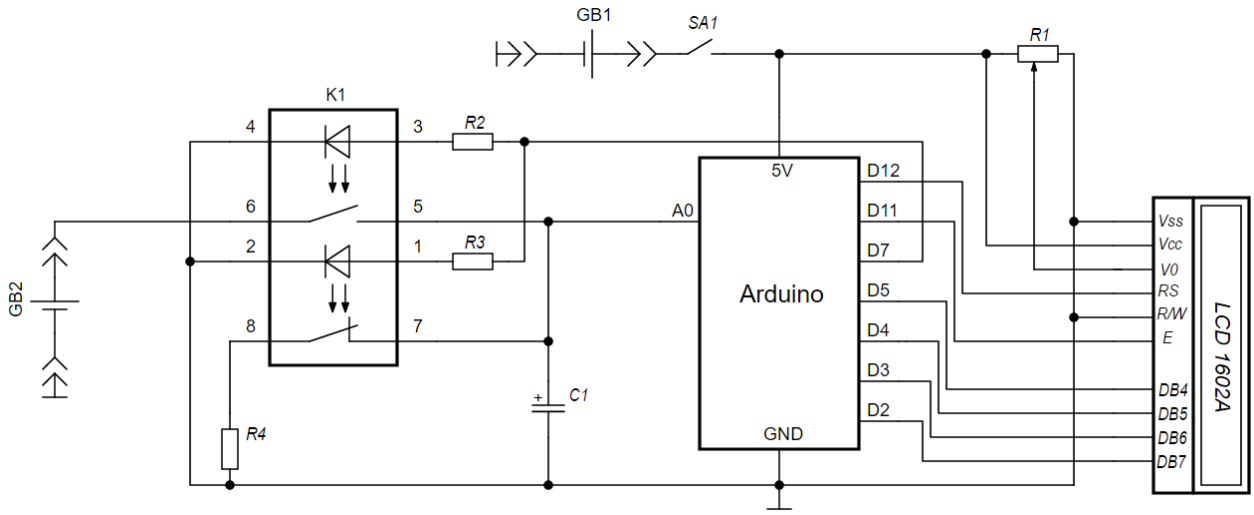

Fig. 1 - Circuit diagram of the device

The device is based on Arduino platform (Fig. 1). To reduce triggering time and improve reliability the solid-state relay was applied [5].

All calculations makes by Arduino UNO microcontroller. The LCD can indicate value of the capacitance and lifetime of the measuring cells. It takes about 0.03% energy of the battery to charge the capacitor and make all the calculations.

Conclusion

To achieve the aim of the following tasks the following was done:

1. current methods and techniques of capacitance measurement were analyzed;
2. the best method of the measurement was chosen;
3. circuit diagram of the device and program for the microcontroller were developed.

The algorithm can be used in new developing mobile medical devices.

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ОСОБЕННОСТИ ПРИМЕНЕНИЯ ГАЛЬВАНИЧЕСКИХ ЭЛЕМЕНТОВ В МОБИЛЬНЫХ МЕДИЦИНСКИХ УСТРОЙСТВАХ

А. В. Непрокин, Р. А. Куликов, К. С. Савинова
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: alexhome16@mail.ru

Аннотация

Рассмотрены существующие медицинские изделия с питанием от гальванических элементов и методы оценки остаточной емкости элементов питания. Предложен алгоритм функционирования устройства оценки остаточной емкости гальванических элементов и расчета их срока службы в конкретном медицинском приборе. Разработана принципиальная электрическая схема устройства и программа для его функционирования применительно к элементам с напряжением до 5 вольт, что может быть использовано для создания промышленного образца.

Ключевые слова: химические источники тока, гальванические элементы, остаточная емкость, мобильные медицинские устройства, портативные медицинские приборы.

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IDENTIFICATION OF MATHEMATICAL MODEL OF HUMAN RESPIRATION SIMULATION

N.A. Nesterov, E.S. Yakushin
Tambov State Technical University, Tambov, Russia
e-mail: nesterov@zavkomepc.com

Abstract
The article describes a mathematical model of the process of imitation of human's respiration simulation. It is presented by the device called "Artificial lungs" and it takes into account changes in volumes of respiratory gases in phases "inhale-exhale". There is the algorithm of a parametric identification of this model. It is based on spectral operators which allow using it in a real-time mode.

Key words: artificial lungs, parametric identification, spectral method, model of human's respiration.

Introduction

The model of the process of imitation of human's respiration which is implemented in the device called "Artificial lungs" (AL) considers as an object of identification. The AL device is designed for testing and certification of respiratory protection equipment against various factors of anthropogenic nature.

All processes in the AL device are controlled by a control system, which includes relevant measuring and actuating devices, a control unit which implements the operating modes with the help of the special mathematical software.

A fairly accurate mathematical model is required to manage all the subsystems and the system as a whole.

Methods based on the decomposition of signals and temporal dynamic characteristics of the systems on the orthogonal bases in connection with the orthogonal Walsh's functions [1-6], Laguerre's [4-5], Chebyshev's [4-5,7], Fourier's [7], Legendre's [4-5], Hermite's [4] block pulse functions (BPFs) [6,7], hybrid functions [6], etc. are used to identify linear non-stationary systems.

This article suggests expanding possibilities of usage of the customizable model [4] to identify the time-varying parameters of a linear system.

Theoretical foundations

The task of parameter identification is that using information about signals at the input and output of the object and model ($u(t)$, $y(t)$, $y^M(t)$) it's necessary to get the function value $k(t)$ and time constant T_d which provide the greatest approximation of the output signal of the model $y^M(t)$ to the actual output signal of the object $y(t)$ in accordance with the selected optimization criterion $F(\varepsilon(t))$, determined by the error signal $\varepsilon(t) = y(t) - y^M(t)$, and thus to set the model.

In order to identify the model's parameters $k(t)$ иT_d model it is necessary to create a quality indicator.

The parameters' identifier is based on the usage of the apparatus of projection-matrix operators describing the processes in the customizable model.

The algorithm of identification

There is a block diagram of the algorithm for identifying the parameters of a standard subsystem of AL at the illustration 1. Since the subsystems of AL perform the supply of gases to the breath simulator and reset the calculated volume of GDS in the inspiratory phase, the identification algorithm operates cyclically. Information about $u(t)$, $y(t)$, $y^M(t)$, accumulated in the phase of the previous inhalation, is transferred to the parameter identifier (illustration 1). In the exhalation phase, an identification algorithm comes into operation, as a result of which the identified parameters enter the model and are used by the AL control system at the next inhalation.

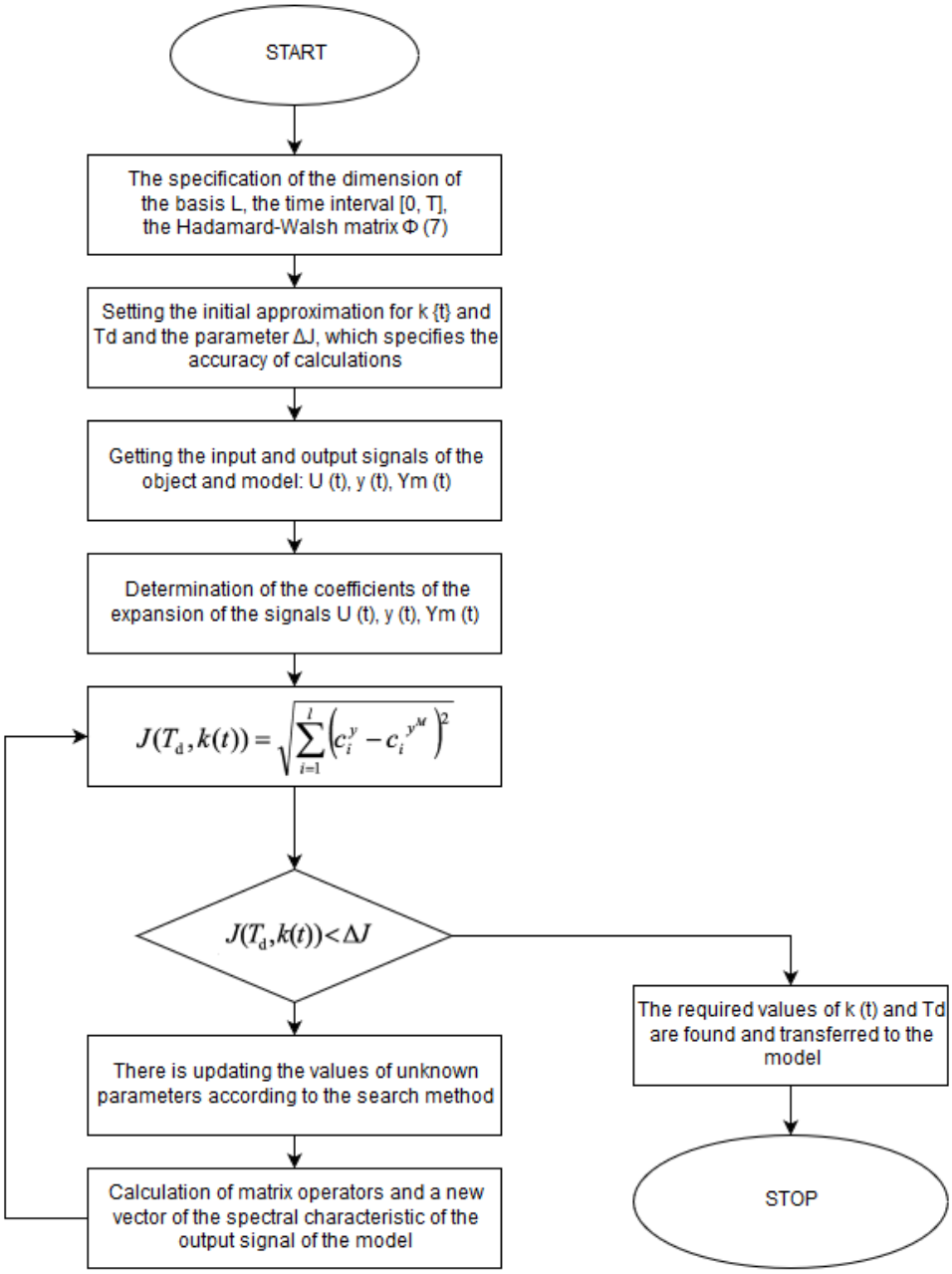

Fig. 1 - Block diagram of the identification algorithm

Experimental research

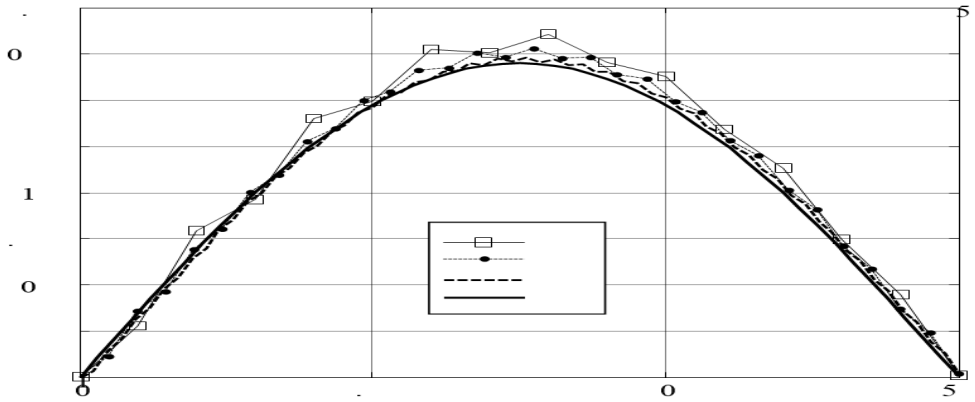

Fig. 2 -Results of the identification of the gain for various dimensions of the basis

The time of execution of the algorithm for various dimensions of the basis for various probing signals and various pneumotahograms of respiration was obtained experimentally (Fig. 2).

On the basis of obtained data we came to the conclusion that the best conformity of the output signal model to the object's output signal achieves by using a sinusoidal probe signal with linearly increasing amplitude.

Conclusion

A mathematical model of the process of imitation of human's respiration simulation realized through the "Artificial lungs" device which takes into account changes in the respiratory volumes of gases in the inhalation-exhalation phases, was considered in this article.

Possibility of usage of the developed identification algorithm with the help of a model with adjustable parameters in the contour of the artificial lung control system was presented as a result of the theoretical and experimental researches.

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ИДЕНТИФИКАЦИЯ МАТЕМАТИЧЕСКОЙ МОДЕЛИ ПРОЦЕССА ИМИТАЦИИ ДЫХАНИЯ ЧЕЛОВЕКА

Н.А. Нестеров, Е.С. Якушин
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: nesterov@zavkomepc.com

Аннотация

В статье рассмотрена математическая модель процесса имитации внешнего дыхания человека, реализуемого установкой «Искусственные легкие», учитывающая изменения дыхательных объемов газов в фазах вдоха-выдоха. Приведен алгоритм параметрической идентификации модели на основе спектральных операторов, позволяющий использовать его в режиме реального времени.

Ключевые слова: искусственные легкие, параметрическая идентификация, спектральный метод, модель внешнего дыхания человека.

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NON-CONTACT AERODYNAMIC MEASUREMENT OF SURFACE TENSION

A. P. Savenkov, M. E. Safonova
Tambov State Technical University, Tambov, Russia
e-mail: selena250893@rambler.ru

Abstract
This article describes the results of the analysis for the surface tension measurement method. The method based on deformation of a tested liquid by a gas jet. The determination of deformation degree is realised using the property of a deformed surface to converge the optical radiation. The method excels in relatively slight aerodynamic impact on the tested liquid and a low sensitivity to the change in it's density and viscosity.
Key words: jet, gas, liquid, cavity, optical, focusing, laser.

Currently, non-contact methods for measuring surface tension based on physical effects of different nature are being developed [1-4]. Such methods make it possible to prevent the mutual destructive effect of the means and the object of measurement, to reduce the influence of the measuring instrument on its result, and to reduce the time and reagent costs for cleaning the measuring vessels and sensing elements.

In this paper we propose a non-contact aerodynamic method for measuring the surface tension. The method is characterized by a weak influence of the density and viscosity of the controlled liquid on the measurement result. Also we present the description of the device for implementing the method and the results of experimental studies

Fig. 1 shows a schematic diagram of the device for implementing a non-contact aerodynamic method for measuring the surface tension of liquids.

On the base 15, the inkjet tube 8, a translucent screen 10, a laser diode 14 of the TXL04 type and a hydrostatic level indicator 17 are rigidly fixed. At the end of the tube 8, a diaphragm 9 with an aperture of a jet of diameter d is installed. The shield 10 is located parallel to the surface of the monitored liquid 12. The laser diode 14 is powered by a current generator 16. The plane of polarization of the laser diode is located perpendicular to the plane of the base 15.

Prior to the measurements, the axis of the jet tube 8 is aligned vertically, the diaphragm 9 is placed at a predetermined distance *H* from the undeformed surface of the liquid 12. Alignment in the plane of the circuit is carried out using a level indicator 17. A setting for a specified distance *H* and vertical alignment in a plane perpendicular to the plane of the circuit is performed by the marks 11 applied on the screen 10. With the correct installation of the device, an image 4 is formed on the screen 10, in which the laser radiation strip is centered between the end marks. After setting the device to the predetermined position, the distance from the surface of the liquid 12 to the screen 10 is *H*s.

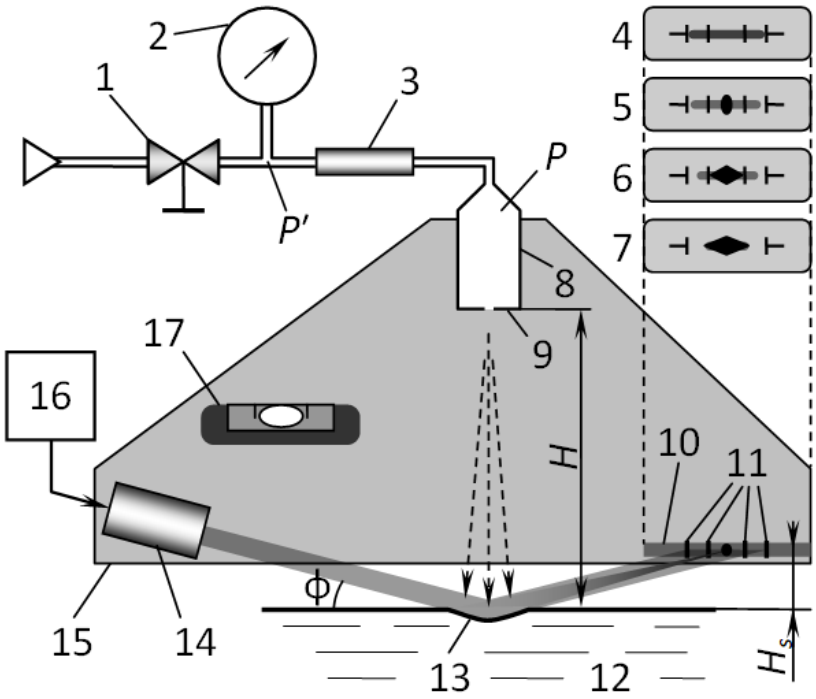

Fig.1. Scheme of the device for realization of a contactless aerodynamic method for measuring the surface tension of liquids

The air supply from the power source to the tube 8 is carried out through laminar pneumatic resistance: alternating 1 and constant 3. The intensity of the action of the gas jet on the surface of the liquid 12 is regulated by the variable resistance 1 and monitored by the liquid micromanometer 2.

The gas stream flowing out of the opening in the diaphragm 9 forms on the surface of the liquid 12 an indentation 13 with axial symmetry. The concave surface of the recess 13 focuses the laser radiation reflected from it on the screen 10 to form the image 5. The device design allows the laser beam to pass strictly along the axis of the recess. The control of this condition is carried out with high accuracy on the radiation spot on the screen 10. At the slightest deviation of the laser beam from the axis of the depression, the spot loses symmetry.

Surface tension σ is judged by the excess pressure *P* before the diaphragm 9, corresponding to a given degree of deformation of the surface of the controlled liquid. Greater surface tension corresponds to a greater pressure. The physical basis for the dependence of the pressure *P* on the surface tension σ is presented in [5-].

In this paper we used three criteria for determining a given degree of deformation of the surface of a liquid. The first criterion is the coincidence of the focal length of the surface of the recess 13 with the distance to the screen 10 (the radiation is focused on the screen). The achievement of this criterion is determined by the minimum area of the radiation spot on the screen 10 (position 5 in Figure 1). In connection with the fact that the width of the laser beam in the plane of the undeformed surface of the liquid is greater than the diameter of the depression, in addition to the spot of the focused part of the radiation, the original strip is also preserved on the screen with

lower intensity.

As the pressure P increases, the intensity of the aerodynamic action and the curvature of the recess 13 increase. The focal length of its surface becomes less than the distance to the screen 10 and the area of the radiation spot increases. The second criterion for achieving a given degree of deformation is determined by the equality of the dimensions of the spot of focused radiation to the distance between the internal marks 11 of the screen 10 (position 6 in Figure 1). In experimental studies we used a screen with a distance between internal marks equal to half the distance between the outer ones.

With a further increase in the degree of deformation, the dimensions of the spot of the focused radiation increase, and the length of the original band decreases. The equality of these sizes is chosen as the third criterion for achieving a given degree of deformation of the surface of the liquid (position 7 in Figure 1).

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БЕСКОНТАКТНОЕ АЭРОДИНАМИЧЕСКОЕ ИЗМЕРЕНИЕ ПОВЕРХНОСТНОГО НАТЯЖЕНИЯ

А. П. Савенков, М. Э. Сафонова
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: selena250893@rambler.ru

Аннотация

Представлено описание и результаты исследований бесконтактного метода измерения поверхностного натяжения, основанного на деформации поверхности контролируемой жидкости газовой струёй. Определение степени деформации производится с использованием свойства деформированной поверхности собирать оптическое излучение. Метод отличается сравнительно слабым аэродинамическим воздействием на контролируемую жидкость и низкой чувствительностью к изменению её плотности и вязкости

Ключевые слова: струя, газ, жидкость, углубление, оптический, фокусировка, лазер.

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NUMERICAL STUDIES OF BLOOD FLOW IN THE INTERNAL CAROTID ARTERY

S.V. Sindeev
Tambov State Technical University, Tambov, Russia
e-mail: ssindeev@yandex.ru

Abstract
A method for multiscale mathematical modeling of the cardiovascular system is proposed, allowing to couple models of hemodynamics with a different spatial scale to assess the preoperative hemodynamics of patients with cerebral aneurysm. The results of simulations based on the model could be used by physician to develop strategies and tactics for treating cerebral aneurysms depending on the individual characteristics of the patient's cardiovascular system.
Key words: hemodynamics, cerebral circulation, computational fluid dynamics, patient-specific model.

Introduction

Studies of genesis and treatment of cerebral aneurysms is very important, since rupture of cerebral aneurysms is a cause of about 50% of hemorrhagic strokes. In assessing the preoperative hemodynamics of patient with cerebral aneurysm the problem of hemodynamic parameters estimation in the cerebral artery arises. Although at the moment there are significant advances in the modeling of hemodynamics of cerebral aneurysms, some areas are still not well studied. In numerous studies the researchers have not considered non-Newtonian properties of blood, which in some cases lead to significant influence on results. Moreover the relationship between the global hemodynamic disorders, heart disease and hemodynamics of cerebral aneurysms is not considered in detail. Therefore a development of methods, models and algorithms for modeling of the cardiovascular system for preoperative assessment of hemodynamics of patients with cerebral aneurysms is a topical scientific and practical task. The aim of this study is to improve methods of mathematical modeling of cardiovascular system taking into account individual characteristics of the cardiovascular system and influence of factors of global hemodynamics.

Methods

To assess the preoperative hemodynamics of patients with cerebral aneurysms a multiscale mathematical model of the cardiovascular system was used [1]. The multiscale model of the cardiovascular system is a set of mathematical models of hemodynamics with different spatial scales, which are coupled together using corresponding boundary conditions.

0D model of hemodynamics was used to describe the hemodynamics of the whole cardiovascular system, i.e. the entire cardiovascular system was considered as a set of interconnected elements. Each element was described as a lumped parameter model.

The developed 0D model describes the main compartments of the cardiovascular system, and includes a physiological description of heart. In the developed model of the arterial tree hemodynamics (1D model) an arterial tree was described as the set of one dimentional arteries. It was assumed that blood velocity and pressure in the artery changing only along the vessel axis. The arterial tree model consisted of 48 arteries and represented the upper body arteries, as well as cerebral circulation. For the proper description of the 1D model the corresponding boundary conditions at the inlet and outlet elements of arterial tree were imposed. A 3D model of local hemodynamics was developed using the Navier-Stokes equations and non-Newtonian properties of blood were represented by power-law approximation. High performance computing techniques were used to solve the 3D model of local hemodynamics of cerebral artery. The boundary conditions for the 3D model (an inlet velocity and outlet pressure) were obtained from the model of arterial tree hemodynamics.

Thus, for correct numerical studies of hemodynamics of the cerebral artery with aneurysm a set of coupled mathematical models of hemodynamics (0D, 1D and 3D) was developed, which represents a multiscale mathematical model of the cardiovascular system. The multiscale model of the cardiovascular system allows to utilize the advantages of each type of models e.g. for assessment of cerebral artery hemodynamics it is possible to study the influence of global hemodynamic disorders (0D model) on the local hemodynamics of the cerebral artery with aneurysm (3D model).

Results and disscussion

The left internal carotid artery with aneurysm was selected to assess the preoperative hemodynamics of the patient. The cerebral artery segment length was 8 cm and width was 40 mm, whereas the aneurysm size was 12 x 10 x 7 mm. The input segment diameter was 8 mm. Diameter of output segments - 4 and 6 mm, respectively. For a preliminary assessment of preoperative hemodynamics of the selected cerebral artery a series of experiments using CT angiography was conducted at the department of Neuroradiology of Klinikumrechts der Isar of Technical University of Munich (Munich, Germany). The experimental studies were conducted using a modified experimental setup located in the laboratory of interdisciplinary research [2]. A patient-specific cardiac cycle was simulated using an experimental setup. Physician uniformly injected a radiopaque substance in the model of cerebral artery. Fig. 1 shows an angiogram obtained during the experiments. Such images are used in clinical practice for a preliminary assessment of hemodynamics in cerebral arteries, but they do not allow assessing blood velocity for the cerebral artery with acceptable precision.

To assess the preoperative hemodynamics of the cerebral artery the developed multiscale mathematical model of the cardiovascular system was used. The advantage of this approach is that velocity and pressure in the aneurysm model can be determined with high precision in a reasonable time (about 6 hours). It was prepared a computational mesh consisting of 2 million hexahedral elements. The simulated

time was 5 seconds. As a result of simulation the velocity and blood pressure fields as well as particle tracks and streamlines were computed (Fig. 2).

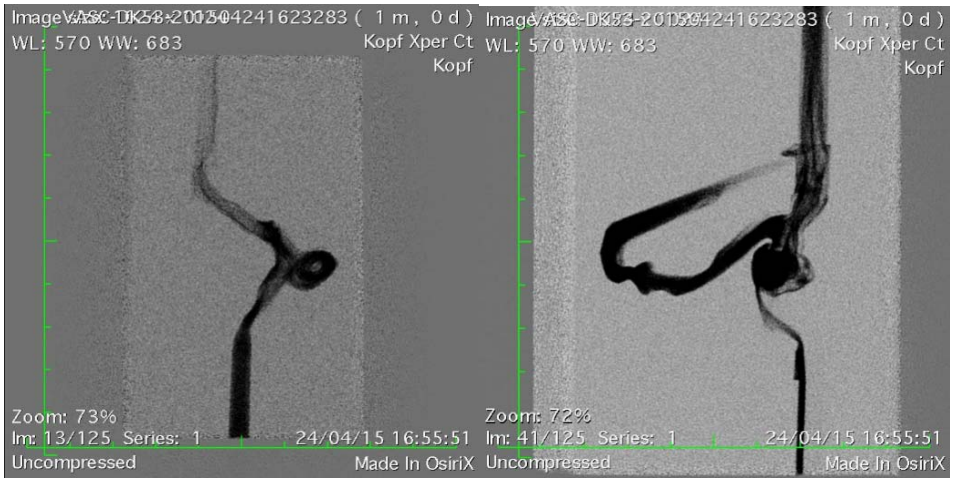

Fig. 1- Angiography of the cerebral aneurysm: AP and LAT projections.

Conclusion

According to the numerical results, the presence of unstable vortex could lead to thrombus formation during the clinical follow-up. In the inlet segment blood flows with a maximum velocity of 1.27 m / s, whereas in the output segment a blood velocity does not exceed 0.75 m / s. A blood velocity magnitude inside the aneurysm changes in range of $\left[4 \cdot 10^{-4}; 0.5\right]$ m/s. The smallest value of wall shear stress was found in the dome of the aneurysm, which might cause a further growth and rupture. Numerical results show a good agreement with experimental studies. The relative error doesn't exceed 10%, therefore the proposed multiscale mathematical model of the cardiovascular system could be used for preoperative assessment of hemodynamics of patients with a cerebral aneurysm.

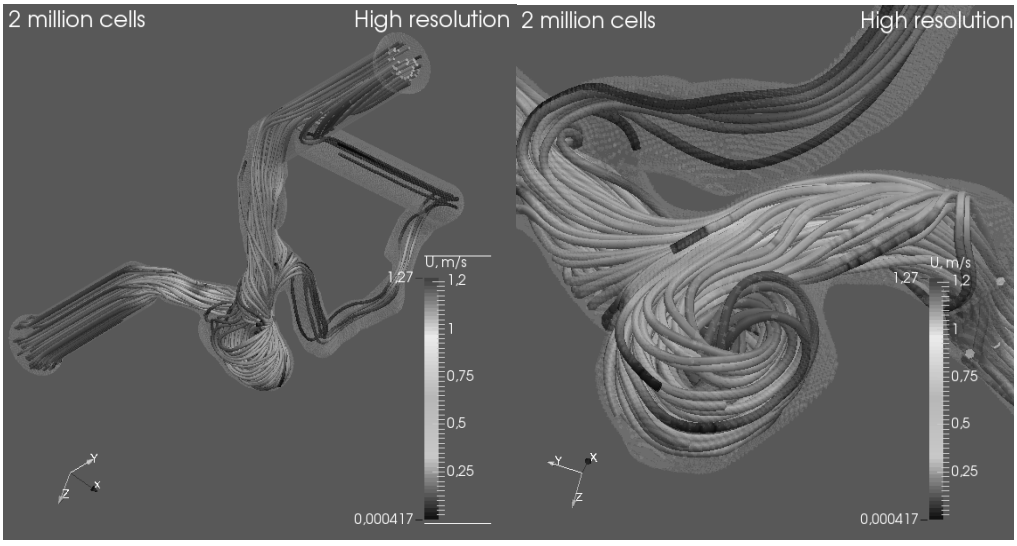

Fig. 2 - Computed streamlines in the cerebral aneurysm model during the systolic peak

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ЧИСЛЕННЫЕ ИССЛЕДОВАНИЯ КРОВОТОКА ВО ВНУТРЕННЕЙ СОННОЙ АРТЕРИИ

С. В. Синдеев
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: ssindeev@yandex.ru

Аннотация
Предложен метод многомасштабного математического моделирования сердечно-сосудистой системы, позволяющий объединить модели гемодинамики разной размерности для оценки предоперационного состояния больных с церебральной аневризмой. Результаты расчета на основе модели могут быть использованы врачом для разработки стратегии и тактики лечения церебральных аневризм в зависимости от индивидуальных особенностей сердечно-сосудистой системы пациента.

Ключевые слова: гемодинамика, мозговое кровообращение, вычислительная гидродинамика, индивидуализированная модель.

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ББК 38.79

STUDIES OF BUILDINGS AND STRUCTURES DESIGN IN THE COLD CLIMATE

I.Y. Baturov, O.V. Umnova
Tambov State Technical University, Tambov, Russia
e-mail: igor.baturov2017@yandex.ru

Abstract
The problems of buildings and structures design in cold climate conditions are considered.
Key words: cold climate, construction in special conditions, frozen ground.

Introduction

Permafrost prevails in the regions of the northern hemisphere. In other words there is a permanent negative temperature a significant amount of ground ice. The thickness of the permafrost reaches hundreds of meters, most of the ground moisture as a result of freezing turns into various forms of underground ice - from single crystals that are not visible to the eye to huge clusters in the form of layers and veins. In this regard, the design and construction of buildings in these conditions requires special attention.

It should be paid to the choice of the place of the construction, i.e. ground conditions. White designing foundations, it is necessary to account for the influence of sediments on the work of buildings, which are connected with theactivity of permafrost soil.

Studies of buildings and structuresdesignin the cold climate

Choosing the place for the construction of buildings on permafrost soils, it is necessary to take into account the physical and mechanical characteristics of the soils and the formation of ice sheets and landslides. The choice of the volumetric - planning and structural concepts as well as the methods of erecting buildings on permafrost soils is a technical and economic task. The result of this task will be the optimization of costs for the design, manufacture, transportation, installation and operation of the building in difficult climatic conditions.

The choice of the arrangement of foundations in permafrost conditions depends on the condition of the soil. Based on geological and climatic conditions, one of the following methods is chosen:

1. The construction of foundations by conventional methods.
2. Preservation of base soils in the permafrost state.
3. Defrostingof the under the ground base.
4. Preliminary defrosting of soil and its compaction under the base.

The first method is used for the erection of foundations on rocky or semi-local bases, where it is unimportant whether permafrost is present or not.

The second method is used for soils that have a stable negative temperature (ice-saturated soils). They have a small resistance to subsidence. In this case it is important to know whetherthebuildingwill be heated or not. If the building is heated, then it is necessary to take measures to protect the soil from the effects of positive temperatures in order to avoid defrosting of the ice-saturated ground and subsequently prevent deformation of the soil and overstress of the load-bearing structures of the building. For this purpose, the base is reliably protected from defrostingwith the help of ventilated underground with the height of 0.5 m to 1.0 m or more depending on the area of the building and the use of the sealed ceiling above the underground, which has a reliable thermal resistance.In the basement of the building, there are purges that allow to regulate the air supply depending on the time of the year.

The third method is used for the construction on soils that do not have abrasive deposits, i.e. do not have large precipitation during defrosting. To ensure the uniform and slow defrosting of soils, the depth of the foundations is designed to be minimum, but not less constructive. It is possible to replace the heaving ground or to achieve the general rigidity of the building by the arrangement of continuous reinforced concrete zones with the grouting of joints, etc.

The fourth method is used for the construction of heated buildings on soils that do not require the restoration of the frozen state [1].

The erection of foundations for soil-smearing low-temperature characteristics - solid-frozen, plastic-frozen according to the 1 principle (preservation of the initial characteristics by the method of "conservation"), requires ventilated underground under the building.

This principle is the main one for construction in the Far North.

Rocky or other low compressible soils that, defrost thawed without exceeding the maximum permissible values of deformations in heated buildingsrequire the construction of foundations according to the 2 principle: the ground must be defrosted before the construction, or all necessary calculations are madeto ensure that the base will defrost during the operation of the building.

This principle is rarely used, provided that the soil on the construction site is not rampant or subsident. This principle is also used when it is impossible to provide the required level of the construction reliability for the technical and structural features of the structure and the engineering conditions of the building site, even if the soil is preserved in the natural "frozen" state [2].

General demands for the design of industrial buildings on permafrost soils

When choosing a space-planning solution, preference should be given to blocking the buildings in one. For large-span buildings, decisions should be made on the location of working equipment on the stackers that are not connected with the frame of the building. Enclosing structures should be made of lightweight effective materials, to ensure airtightness of the building. Special attention should be given to the areas of connection of elements and panels.

Designing in the North, should also take into account the length of the winter period (185-305 days), when low temperatures, permafrost conditions, strong winds and snow storms prevail.

When providing protection against snow and snowdrifts, the building is protected from natural influences, using natural obstacles (relief or vegetation) or methods of mutual disposition of buildings and structures on the ground.

With the use of different methods of mutual arrangement of buildings, one can achieve wind control by aerodynamic groups of buildings if the snow protection front is constructed of buildings that are located on the windward side, and on the contrary, organize through ventilation with the aerodynamic devices snowremoval out of the production zone, building a streamlined form, or arrange in buildings or the ventilated underground.

Special features of space-planning concepts for building in difficult climatic conditions

All buildings are designed rectangular in plan, without the use of niches and zones that contribute to the retention of precipitation. Incase the event that the building has a height difference due to technological and technical and economic reasons, it should be located along the direction of the prevailing winds.

It is necessary to pay special attention to the coverings of buildings (flat, single-slope and multi-slope ones). The most commonly used covers are flat and single-slope roofs.

For single slope roofs it is advisable to design the slope on the windward side, and multi-slope roofs should be placed along the direction of the dominant winds thereby unloading the building from a the strong wind load.

Particular attention should be paid to the design of multi-apartment residential buildings. During the operation of the building, the soil can change its characteristics, resulting in uneven sedimentation of the soil, which adversely affects the structure of buildings.

Only a building with the increased rigidity of the above-ground part can perceive uneven sediments of defrosting grounds. It is advisable in this case to use metal zones along the perimeter of the building in at level of covering.

Buildings should be designed rectangular in plan, beingto arranged next to each other to reduce the heat loss.

When selecting a heater, attention must be paid to the floor slab do-building wall, connection to reduce air permeability and formation of cold bridges.

Conclusion

In this paper, the features of the construction of industrial and residential buildings in permafrost conditions are have been considered.

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ИЗУЧЕНИЯ ВОПРОСОВ ПРОЕКТИРОВАНИЯ ЗДАНИЙ И СООРУЖЕНИЙ В УСЛОВИЯХ ХОЛОДНОГО КЛИМАТА

И.Ю. Батуров, О.В. Умнова
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: igor.baturov2017@yandex.ru

Аннотация
Рассмотрены вопросы проектирования зданий и сооружений в условиях холодного климата.

Ключевые слова: холодный климат, строительство в особых условиях, мерзлый грунт.

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FEATURES OF VENTILATED FACADE DESIGNING

S. A. Bachin
Tambov State Technical University, Tambov, Russia
e-mail: bachin.stas@yandex.ru

Abstract
The exterior decoration of buildings is an important part of construction and installation works and architectural design. The purpose of it is to create a presentable appearance of structures and solve practical problems. The latter includes the strengthening of the structure, protection from aggressive environmental influences and prolongation of the service life. In modern conditions, the hinged facade is considered to be the optimal technology.
Key words: ventilated facade, frame subsystem, insulation layer.

A hinged ventilated facade is an innovative system for finishing external walls of buildings, consisting of finishing materials mounted on the frame. The peculiarity of the technology is that the method of installation of the structure provides for a layer between the elements of the finish and the wall of the structure, thanks to which the air circulates freely, reliably protecting the building from excess moisture and reducing the heat transfer of the house.

Hinged ventilated facades are sometimes called ventilating facades. This phrase is not correct, because it does not accurately reflect the meaning and scope of the technology.

Modern facades are a rather complex and versatile system. It is the latter factor and the presence of several types of fastening that make it possible to apply the technology everywhere in public as well as in private construction. The ventilated facade, as it is sometimes called, becomes not only a functional element, but also a part of the decorative finishing of the house. Today, the ventilated facade of a monolithic house is becoming more and more popular. This is because the monolith as a foundation provides high strength and reliability of the structure, which does not require additional reinforcement measures. Here you can use the simplest light brackets, increase the profile pitch. This reduces the cost of materials and speeds up the installation process, which is a good way to save money.

Having installed ventilated facades, it is possible to solve several tasks at once: to provide reliable protection of the building against the destructive effect of moisture, wind and temperature drop, to reduce energy costs due to thermal interlayer, to improve noise insulation of the interior, to prolong the service life of the structure, to create an interesting decor with a wide range of colors and design finishes.

Ventilated facade systems are a multi-layered structure, the elements of which are:

1. Frame subsystem, which is attached to the wall of the building and serves as a support for the entire structure. Most often it is made of galvanized or stainless steel or aluminum.

2. Insulation layer. It is a multifunctional component that provides protection from moisture, steam, wind, cold, and also reduces the heat transfer of the building.

3. Clearance for air circulation. It is he who promotes constant ventilation in the system.

4. External decorative shell. Protects the lower layers of the facade and gives the building a presentable appearance.

Hinged ventilated systems are used for exterior decoration of buildings and structures using a wide range of finishing materials. Due to the versatility and variety of installation options, the technology is in demand both in the construction of new facilities, and in repair work and reconstruction of old buildings. Ventilated facades are suitable for private and multi-apartment residential buildings, are actively used in industrial and public buildings, commercial buildings, technical rooms of bus stations, gas stations, etc.

The advantages of such facades include the following indicators:

• wide range of applications;

• Ease of installation;

• Ability to install at any time of year;

• no need for special preliminary preparation of the external surface of the building;

• the ability to hide defects in enclosing structures and even to a certain extent compensate for violations of the geometry of the building;

• improvement of the thermal insulation properties of the finish;

• elimination of excess moisture and prevention of its accumulation;

• resistance to aggressive atmospheric and mechanical influences;

• durability;

• absorption of thermal deformations caused by diurnal or seasonal temperature fluctuations;

• prevention of occurrence of any damage to the load-bearing structure and cladding;

• aesthetic appeal;

• possibility of using interchangeable elements and universal technologies;

• the widest choice of materials, shapes, colors and textures;

• simplicity of restoration;

• An additional opportunity to save on air conditioning in the summer and on heating in the winter.

The disadvantages of hinged ventilated facades are only the high cost of quality materials and the need to turn to professionals for proper design.

When all necessary conditions, such as correct design, quality materials and installation, are fulfilled, the ventilated facades will perform their functions for the entire service life. And yet, it should be understood that such a technologically

complex and responsible system of facades cannot be cheap. To minimize the costs that arise in the design, installation and operation of ventilated facades, it is necessary to search for new and further development of existing methods for calculating ventilated facades systems for the period of long-term operation, development and improvement of the regulatory and budget bases. Also, to optimize the design solutions and the main components of the facade systems, it is necessary to work together with the designers of the building and the facade designers.

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ОСОБЕННОСТИ ПРОЕКТИРОВАНИЯ ВЕНТИЛИРУЕМОГО ФАСАДА

С.А. Бачин
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: bachin.stas@yandex.ru

Аннотация

Внешняя отделка зданий является важной частью строительно-монтажных работ и архитектурного дизайна, цель которого – создание презентабельного облика сооружений и решение практичных задач. К числу последних принадлежит укрепление конструкции, защита от агрессивного воздействия окружающей среды, продление срока эксплуатации. В современных условиях оптимальной технологией считается навесной вентилируемый фасад.

Ключевые слова: вентилируемый фасад, каркасная подсистема, изоляционная прослойка.

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ББК 85.118

ZONING AND NAVIGATION: WAYS OF CREATING COMFORTABLE RECREATION ENVIRONMENT

P.I. Gunina
School of Design, Higher School of Economics, Moscow, Russia
e-mail: guninap@gmail.com

Abstract
The paper describes an approach to improving the layout of the recreation area, using the example of a medical rehabilitation center in the Moscow region. The proposed solution is based on the functional approach to zoning of the territory of the medical center with reference to the patients' needs and modern requirements to space planning.
Key words: zoning, design, navigation, recreational center.

Introduction

The majority of medical institutions in the Moscow region are located in environmentally friendly locations remoted from industrial areas. Despite their favorable geographical and climatic conditions, most of them were built during the Soviet era and have a high level of depreciation of facilities. Although the buildings and equipment are more or less regularly updated and refurbished, the area remains insufficiently developed.

The research into LRNC "Russkoe pole" (Chekhov, the Moscow region) showed that the reconstruction works on this site were not fully completed and only led to renewal of medical facilities, purchase of new expensive equipment and refurbishment of medical and residential buildings. A new building of Research Center was constructed. At the same time, the problem of creating comfortable recreational environment remains unsolved.

The area has two main problems:

1) irregular zoning;
2) poor navigation.

Thus, the main emphasis was be put on these two problems. A couple of successful projects based on the innovative approach to space planning and creating the intelligent environment were selected - Zaryadie Park [1] and the Aksakovskie Zori rehabilitation centre in Mytischi, Moscow Region [2].

Zoning

The area of the land, where the complex is located is 1,259,962 hectares. The vast part of the territory is covered with forest and vegetation. There are also two ponds with a wide alley in-between connecting two main zones:

1) the main building, comprising a swimming pool and a dining hall;
2) the area between the perinatal campus and the research center, covering 21,268 square meters in total.

The field research illustrates that the visitors of the rehabilitation center do not want to spend time outdoors, despite lovely landscape and clean air. This problem is especially typical of the area between the perinatal campus and the research center. The main reason for this is the zoning problem.

Currently, space organization is quite random: thematic zones are not allocated, there are no pedestrian paths, no places for recreation and sport activities. There is no parking lot, which makes communication within the area very complicated. The process of zoning requires dividing the area into the key zones. Here there are four of them:

- Parking lot
- Playground
- Sports ground
- Recreation area and place for outdoor activities

Each of them meets the different needs of visitors (Fig. 1).

Playground is the largest zone, which is walled from the parking lot with a special equipment for handicapped kids and a large surface on which children can draw. The next zone is a sports ground with simulators made for children with disabilities. The recreation area is located within the walking distance of the school. Thus, when the weather permits, classes can be organized outdoors on a special modular upholstered furniture made of high-density polyethylene.

It is very important that, during the spatial transformations, the natural landscape of the area is not damaged and the requirements of sustainable development are met. The planning structure of the territory will be improved, a network of pedestrian zones will be developed as well and overall comfort of the environment will be improved with the minimal effect on the landscape.

Fig. 1. Zoning of *LRNC "Russkoe pole" (Chekhov, the Moscow region)*

Navigation

The environment of the medical and rehabilitation research center is a special system of social, professional and public communications, the purpose of which is an integrated approach to the rehabilitation of children and adolescents suffering from severe oncological and cardiovascular diseases. In addition to effective medical treatment, it is important to give patients an opportunity to enjoy the external environment. In other words, make them feel as they are at home. Clear and stylish navigation network will help to achieve that goal.

Without any doubt, one of the main navigation tools is a map because it provides information about the services and helps not to get lost [3]. However, using a map is not enough. Visitors will not have an idea about the area of the center without information signs. That is why it is crucial to add information signs showing routes or providing interesting facts about the place. That will also draw children' attention and keep them interested. All navigation elements should be as visible as possible, have the same style and color in each zone. In this case, the colors from the logo of the " Russkoe pole " are used. Bright pointers (Fig. 2) are essential elements of navigation. They will help people to navigate in the nearby zones.

To create a single and understandable system, all navigation elements must meet the basic requirements described in the guidelines for the implementation of projects to improve the quality of monocities [3], In other words, they must be simple and have color-coding. In this particular example, navigation is developed according to all the recommendations.

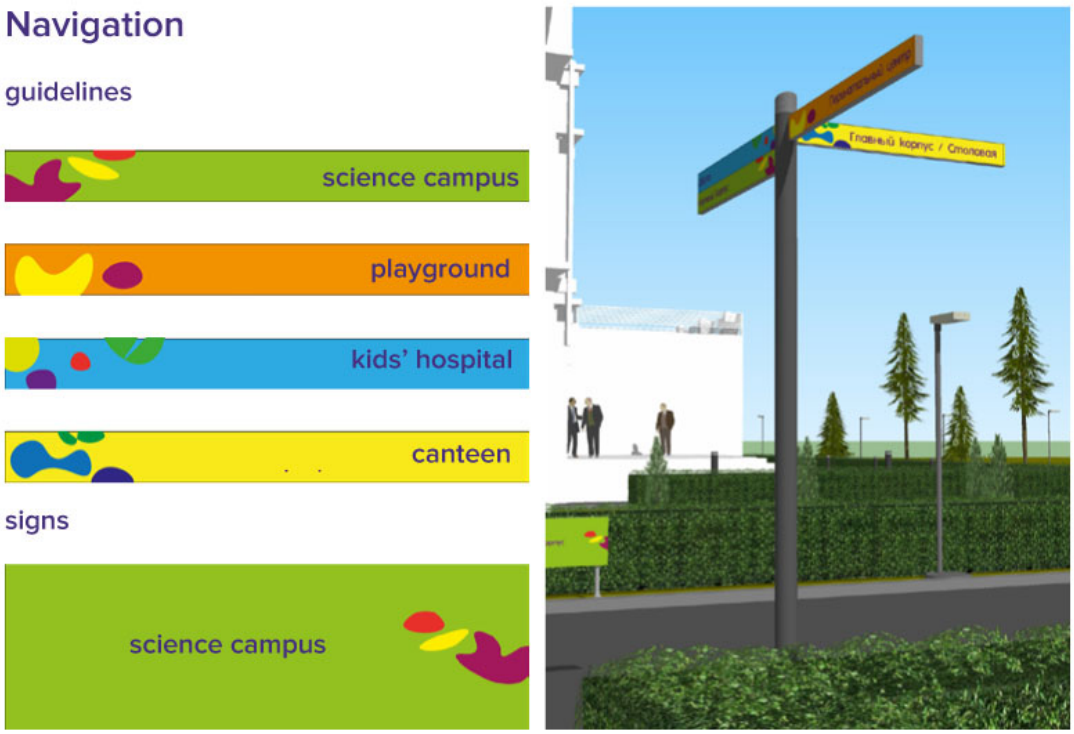

Fig. 2. Navigation system in LRNC "Russkoe pole" (Chekhov, the Moscow region)

Conclusion

One of the trends is improving the quality and efficiency of recreation. Therefore, it is necessary to provide a wider range of recreational services ensuring a choice of places and forms of recreation, as well as a variety of services for different groups of visitors. At the same time, special attention is given to the organization of such types of recreational services that promote an active lifestyle. One of the objectives is to facilitate the communication between visitors and environment and help people with disabilities to go through the process of rehabilitation as comfortably as possible from the psychological point of view. Successful organization of space and competent navigation will help to reach these goals. The example of this study shows how they can be achieved without using a very expensive technology. All successful design projects are guided by the principles of sustainable development and well detailed.

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ЗОНИРОВАНИЕ ТЕРРИТОРИИ РЕАБИЛИТАЦИОННОГО ЦЕНТРА С ЦЕЛЬЮ СОЗДАНИЕ КОМФОРТНОЙ РЕКРЕАЦИОННОЙ СРЕДЫ

П.И. Гунина
Школа дизайна, Высшая школа экономики, Москва, Россия
e-mail: guninap@gmail.com

Аннотация

На примере медицинского реабилитационного центра в Московской области описаны возможности создания комфортной рекреационной среды за счет рационального функционального зонирования территории. Предложенный подход учитывает потребности пациентов медицинского центра и современные нормативные требования проектирования лечебно-профилактических учреждений.

Ключевые слова: зонирование, проектирование, навигация, рекреационный комплекс.

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PREREQUISITES FOR CREATING THE CONSOLIDATION OF NORMS AND RULES FOR TRAINING BASE DESIGNING.

I.Yu. Karasova, T.V. Blokhina
Tambov State Technical University, Tambov, Russia
e-mail: tanuff_ka@mail.ru

Abstract
In this paper the material and technical state of training bases in Tambov are described, architectural and planning decisions of buildings and territories of training bases are shown. Today analysis of the complexity of designing of such structures leads to the proposal to create set of rules(SR) for this category of facilities.
Key words: building, design, training base.

Introduction

Today, our country faces the most important task - to return Russia to the list of leading sports powers. High sports achievements contribute to the growth of the country's prestige at the world arena. Especially it is shown at sports competitions of a world scale, such as the Olympics, World and European Championships, cups of various Federations. But in order to take prizes in such competitions, a great and serious work is needed to develop the sport, not only at the level of the national teams, but also at the regional level. Education of professional athletes begins, as a rule, in amateur sports at the regional level. To achieve significant success, athletes need training and training facilities should be equipped with modern sports and medical and recovery equipment. The equipment of bases should correspond to regulations of that league in which this or that club plays.

On the official website of the Russian Football Union (RFU) «Strategy for the development of football in the Russian Federation until 2020 («Football 2020»)» was published. The most important goals for the development of football at present are correcting the unsatisfactory condition of the material and technical base of professional football, as well as developing standards, technical recommendations for the construction and reconstruction of modern sports facilities for football and its varieties. Obviously, to achieve serious success in the development of sports, it is necessary to create conditions for the qualitative preparation of football clubs and national teams.

Athletes spend about a third of their professional career at training bases. Here they train, rest, sleep, from here they leave for matches, they recover after injuries. That is why the bases need not only sports and recreation facilities, but also facilities that provide personal comfort to athletes, taking into account their personal needs - recreation rooms, comfortable rooms for long-term residence.

Now the sports bases in the regions of the country are under the unsatisfactory conditions. Many clubs have them in principle and conduct training in different

places on a rental basis. The majority of sports bases, which still exist in the hotel regions, were created back in Soviet times. They were built according to the norms of construction of that time, and at the present moment they do not correspond to modern requirements. Therefore, it is necessary to reconstruct the old ones and design new training and training bases in accordance with the current norms and rules.

And Tambov is no the exception. Currently, no professional club has its own specialized base in Tambov. Earlier in Tambov there was the football club “Spartak”, which had a base in a suburban forest. But even at that time it did not meet modern requirements. Later FC «Spartak» was disbanded, the buildings of the base received a new owner and are used as a hotel complex, which has no relation to professional sports. The newly created football club “Tambov” temporarily uses the Tambov regional state autonomous institution of additional education “Specialized children’s and youth sports school of the Olympic reserve “Academy of Football”, created for the development of children's and youth sports.

Tambov's volleyball and basketball clubs do not have any training facilities at all. This creates certain difficulties in terms of training, recovery, as well as financial difficulties. Money that can and should be used for the development of sports has to be used to pay for the rent.

Training bases are quite a complex mechanism. Therefore, when designing the training base for any sport, a clear functional zoning is done. These zones should interact as much as possible, but not overlap. For this purpose it is necessary to create not only a rational multifunctional space, but also a comfortable environment that meets all modern requirements, which can be used not only by local regional teams and clubs, but also provided for temporary use to non-resident and foreign teams when holding championships of European and world championships at the levels of Russia.

The territory of any base is functionally divided into administrative, sports, economic and residential zones.

The administrative zone includes the following buildings and facilities: checkpoint, administrative building, parking for buses and cars, a platform for the collection of athletes. The sports area includes: sports buildings, a medical-restorative complex, football fields and grounds. The economic zone is represented by a complex of engineering and technical buildings, structures and networks.

At present, in order to design a training base, it is necessary to use different building regulations and rulesor (BRR)or set of rules(SR)for each functional zone. For the design of sports facilities is used “SR31-112-2004 Physical culture and sports halls. Part 1, 2, 3”. For the design of administrative and business premises – “SR 118.13330.2012 Public buildings and facilities”. For the design of the restaurant – “Benefit to BRR 2.08.02-89. Design of public catering establishments”. For the design of residential buildings – “SR 118.13330.2012 Public buildings and facilities”. The selection of individual items from these documents that contain regulatory requirements for sports bases leads to significant time costs due to the large amount

of unnecessary information. Also, the specified regulatory documents do not take into account individual specialized requirements of federations and leagues.

To streamline the design, it is necessary to create a specialized set of rules for the design of training bases, which is absent at the moment, which will include all the necessary aspects.

A modern sports facility is a complex technical "organism", saturated with various engineering and technical systems. These complex engineering systems help athletes achieve victories both in regional competitions and olympiads, and at the world level.

Conclusion

Physical culture and sports are the integral part of the population`s life of the country, which is aimed at improving the nation and achieving high sporting successes at the international level. That is why the mass construction of sports facilities today is one of the most priority areas of activity of various state and private structures, as well as construction organizations.

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ПРЕДПОСЫЛКИ СОЗДАНИЯ СВОДА НОРМ И ПРАВИЛ ДЛЯ ПРОЕКТИРОВАНИЯ УЧЕБНО-ТРЕНИРОВОЧНЫХ БАЗ.

И.Ю. Карасова, Т.В. Блохина
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: tanuff_ka@mail.ru

Аннотация

Вданной статье описывается материально-техническое состояние учебно-тренировочных баз в городе Тамбове, архитектурно-планировочные решения зданий и территорий учебно-тренировочных баз. Анализ сложности проектирования в данный момент таких сооружений приводит к предложению создания СП для данной категории сооружений.

Ключевые слова: здание, проектирование, учебно-тренировочная база.

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MODULAR ARCHITECTURE OF SCHOOL BUILDINGS

D. O. Kotov, A.A. Shukan
Tambov State Technical University, Tambov, Russia
e-mail: dimakotoff@bk.ru

Abstract
School building is the most important city-forming and social element. Modern society needs affordable, highly industrial, aesthetically and competently planned school buildings. Such projects are often expensive and their construction is a long process. Developers often design entire areas of multi-storey housing, while ignoring socially important facilities. In small settlements, general educational institutions are either absent or closed. To solve this problem should be approached in a comprehensive manner, using modular architecture's advantages.
Key words: architecture, block-module, design, urbanism, project, school building, space-planning solution.

Architecture is a powerful social tool. Buildings can have a positive impact on society. It's not just about the cleanliness of the territories and the beautiful facades. This is an integrated design approach of educational institutions and the planning of territories with different urbanization levels.

The extensive growth of modern cities generates new residential areas in need of high-tech school buildings. Do not forget about the countryside. In most cases, the construction of a school building from small-sized elements is too time-consuming and expensive. The current growth rate of cities necessitates an increasing level of construction industrialization.

The architecture of school buildings requires constant development. Prefabricated schools can gain great popularity; this will contribute to the low cost and short terms of modular construction. The design, manufacture and assembly of prefabricated schools will be carried out according to established technologies. As a result, we will receive children's institutions that meet all the requirements for safety, construction, sanitation, environment and other regulations.

There is no secret that the block-modular buildings can get wide social attractiveness and popularity in the construction areas, when not just prefabricated buildings are required, but such structures that can be dismantled and quickly mounted in a new place. But what if we look at the problem more broadly? Why don't we turn such efficient and mobile technology into a standard solution for different types of buildings?

Block-containeris a standard box-module intended for assembling prefabricated buildings by means of bolted or welded joints. The block-container can be manufactured in the factory conditions taking into account all transport and operational loads. Multiple transportation, installation and dismantling of modular buildings absolutely don't affect its design and exploitation characteristics. This opens up a wide range of planning and aesthetic solutions for architects and

developers.

Having analyzed the regulatory documentation, we can develop a catalog of structures and modules. Unification of some technical aspects will make it possible to create the most diverse in terms of the volume-planning structure of the building, with the help of such a "kit". Visual integrity and the uniqueness of each object will be achieved by a combination of materials, constructions and colors.The tempo of constructing is one of basic advantages ofblock-modular projects. The building having an area of 1000 square meters can be put into use in 4-5 months after the signing of the contract for its supply, because of parallel production processes. It's important that different modules can be stored in production warehouses and give out, if it's necessary, a very impressive volume of ready-to-install products.

Modular school projects will allow not only reducing the cost and speeding up the process of building new micro districts. Thiskind of architecture can solve a number of social problems.

Flexible planning system will provide schools to those areas that are built up in rules violation for the educational institutions placement. A number of combinations of complete solutions can meet the needs of any type of terrain with different population density and housing structure. Municipalities of different levels can afford to order such a project.

There is a tendency to build large boarding schools in regional centers. Children from nearby villages have to travel to such institutions on special buses, often live in school hostels. It would be much more logical to provide small settlements with functional and comfortable school buildings, large school complexes in the villages should be reformed into technical schools and colleges. Of course, such a process should be preceded by the development of manufacture in the villages; it can quite stop the rapid process ofpopulation urbanizing. People will have no reason to leave places where they have all necessary infrastructures for comfortable life of several generations, and also work, of course.

Another feature of modular buildings is the low cost of heating. Thanks to the cladding and energy-saving glazing, these objects can be operated at a temperature of -50 ° C and lower. It is an actual project solution for schools located in the northern parts of Russia.

Developing a database of modular elements and school projects for different numbers of students, for different settlements and all kinds of climatic conditions - all this can help to revise the architecture of educational buildings, systematize the volume planning decisions and approach to design in general. The implementation of such a large-scale project will make the construction of schools more accessible; positively affect the formation of the urban and rural environment in Russia.

It should be noted that the development of modular architecture will not lead to monotonous projects. The only norm will be the dimensions of the blocks transported from the factory to the construction site. The volume, silhouette and coloristic solution of the buildings designed in this way will vary depending on the specific town-planning situation. This is not a step to boring typical construction. It is a way

out of the framework of "brick, beam and concrete".

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ТЕНДЕНЦИИ В АРХИТЕКУРЕ ШКОЛЬНЫХ ЗДАНИЙ

Д. О. Котов, А. А. Шукан
Тамбовский Государственный Технический Университет, Тамбов, Россия
e-mail: dimakotoff@bk.ru

Аннотация
Школьное здание – важнейший градообразующий и социальный элемент.Современное общество нуждается в доступных, высокоиндустриальных, эстетичных и грамотно спланированных зданиях школ. Проекты такого рода нередко дорогостоящие, их возведение это длительный процесс. Застройщики зачастую проектируют целые районы многоэтажного жилья, при этом игнорируя социально-значимые объекты. Общеобразовательные учреждения отсутствуют или закрываются в небольших населённых пунктах. К решению данной проблемы следует подходить комплексно, используя преимущества модульной архитектуры.

Ключевые слова: архитектура, блок-модуль, градостроительство, проект, проектирование, здание школы, объёмно-планировочное решение.

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ARCHITECTURE AS A WAY TO ACHIEVE THE NOOSPHERE

V.M. Levin
Tambov State Technical University, Tambov, Russia
e-mail: LVMT94@yandex.ru

Abstract
This article presents the interrelation between the doctrine of the noosphere and architecture. The noosphere is represented by a shell created with the help of the human mind. At this stage, its development leads to a decline in the biosphere. The influence of noospheric teaching on the development of architectural styles is examined. The principles of the noosphere, applied in practical architectural activities are revealed. On the basis of the studied data one can regard architecture as the main human activity reflecting the achievements of the noosphere by mankind as a whole.
Key words: noosphere, nature, biosphere, humanity, architecture, shell, science.

The demand for Vernadsky's teachings in the last 10-15 years has increased dramatically. This is due to the fact that at the end of the 20th century, the modern world was confronted with serious environmental, raw material and social problems. And they are not connected with the natural processes taking place in the biosphere, but with the conscious actions of aman and his reluctance to solve complex contradictions between man and nature, which was and remains the environment of his dwelling. Such a situation sooner or later will lead to the death of civilization or force humanity to hiccup a solution to the situation. Appeals for sustainable development of territories, conservation of resources and environment have recently become more frequent.

Solve all the problems that have appeared in the modern world in a short time is not possible, but a gradual and correct movement according to the teachings of V.I. Vernadsky [1] can correct the current situation in a favorable direction.

The noosphere is a shell formed on the planet Earth according to the ideas of the mind, which includes people, natural objects and objects created by man with the help of his mind and labor. The noosphere began to form with the advent of a man on Earth and is being formed at the present time.

According to V.I. Vernadsky, when the era of the noosphere sets in, the primacy of reason will come, based on rational use of the resources of nature and the democratic development of society in all spheres such as economics, politics and science. In the course of its development, mankind becomes a powerful geological force capable of changing the planet by its activities. The transition of the biosphere to the noosphere requires universal unity from humanity.

The doctrine of the noosphere reflected the interrelationship of knowledge received by man about the surrounding world and the self-knowledge of mankind. The scientist asserts that the noosphere is the highest step of the biosphere and is directly connected with the transformation of both nature and society as a whole. To

date, the noosphere is a kind of sphere of relationship between aman and nature, where the determining factor of development is the human mind and human activity. The structural units that form the noosphere are: mankind, social interrelations, scientific knowledge, and products of technological development, embedded in the biosphere. The main basis for the existence and development of the noosphere is the coordinated work of all its constituent parts.

Architecture is the main force that transforms the human environment. Its products accompany a person throughout his lifetime and evolve with him. With the help of architecture, a person shapes the world around him for his own needs with the maximum benefit for himself, forgetting and ignoring the nature with its already established processes. By this, he approximates himself not to the achievement of the noosphere, which characterizes the harmony between man and nature, but to the technosphere, which in turn leads to the destruction of the biosphere and humanity as a whole.

The connection between aman and nature is inseparable; it can be traced from the birth of aman on Earth. The first rudiments of architecture are represented in the form of a person's transformation of nature into his utilitarian functions. The development of architecture and architectural styles constantly based and formed according to the principles taking place in nature.

As mentioned above, the history of architecture gives us many examples of imitation of wildlife forms, for example, with the example of organic architecture, whose bright representative is Frank Lloyd Wright, whose work was greatly influenced by Goethe's philosophy. In his outline of plants, the German philosopher was able to distinguish two principles of their structure: the principle of internal nature, according to the laws of which the development of the organism and the principle of external factors affecting further changes took place. Evolutionary theories served to further the development of organic architecture. In these theories, the idea of "evolving" a style arose, like living organisms that exist in the natural world.

Le Corbusier the representative of modernism, considered biology "the greatest new word in architecture and planning" did not neglect the thoughts of the German biologist Raul Franz. In his book he wrote that "necessity predetermines certain forms for certain properties. Therefore, it is always possible ... to draw a conclusion about activity and purpose on the basis of their form. "

At present, architectural bionics has received a new round of development thanks to modern technologies, allowing exploring the geometry of natural forms: the patterns of shape formation, features, development and connection with nature. On the basis of these studies, programming and modeling of bioforms is carried out.

The history of the development of architecture and its styles testifies that human society strives to achieve an interrelation with nature; this is a reflection of one of the main principles of achieving the noosphere according to the teachings of V. I.Vernadsky. At this stage of development, architecture only copies the principles that flow in living nature and shifts them to buildings and structures, but a harmonious,

equitable union is not achieved, because mankind does not have a favorable effect on the world around by its actions. People create their own alien environment to the technosphere, which alienates mankind from the noosphere. To achieve a harmonious symbiosis, architecture should serve not only as a reflection of the idea of the mind, but also as a link to the world of aman and the world of nature.

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АРХИТЕКТУРА КАК СПОСОБ ДОСТИЖЕНИЯ НООСФЕРЫ

В. М. Лёвин
Тамбовский Государственный Технический Университет, Тамбов, Россия
e-mail: LVMT94@yandex.ru

Аннотация

В данной статье представлена взаимосвязь учения о ноосфере и архитектуры. Ноосфера представлена оболочкой, созданной при помощи человеческого разума. На сегодняшнем этапе её развитие приводит к упадку биосферы. Рассмотрено влияние ноосферного учения на развитие стилей архитектуры. Выявлены принципы ноосферы, применяемые в практической архитектурной деятельности. На основе изученных данных можно считать архитектуру основной человеческой деятельность, отражающей достижения ноосферы человечеством в целом.

Ключевые слова: ноосфера, природа, биосфера, человечество, архитектура, оболочка, наука.

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PROBLEMS OF IMPROVING ACOUSTICS OF MUSIC CLASSROOMS

I. V. Matveeva, J. I. Seregina
Tambov State Technical University, Tambov, Russia
e-mail: seregina-juliv@rambler.ru

Abstract
This paper considers problems of acoustic design of music classrooms. Special attention is given to music schools, which are located in converted buildings. The main requirements for acoustic improvement are given. The analysis of the received information showed that the provision of acoustic comfort can be achieved only with the painstaking development of the space-planning decision and structural concept.
Key words: acoustics of musical premises, acoustic defects, sound energy.

In accordance with the Federal Targeted Program for the Development of Education for 2016-2020, there is a lot of work to develop and implement an effective system of additional education for children in Russia. That's why, the creation of a network of children's music institutions has been significantly developed.

Today there are many requirements for such objects not only to the space-planning decision and structural concept, but also to developing solutions for providing acoustic comfort in training and rehearsal rooms.

The concept of acoustic improvement is an integral parameter, which affects the quality of music halls. And it means a set of measures, constructive decisions and parameters in project decisions, which lead to the necessary comfort characteristics of the concert action. It is impossible to achieve acoustic improvement without careful joint work of the acoustician and architector at all stages of the project. Only joint engineering will help to avoid many mistakes, resulting in acoustic defects, the correction of which will require large additional costs or will be completely impossible.

The problems, associated with the acoustics of music rooms, were the subject of many experimental studies. Its results were used in the creation of new and reconstruction of existing classes and rehearsal rooms for various purposes.

The acoustic design is associated with an accurate choice of the volume, the shape and the proportion of the room, with the quantity, the quality and the spatial arrangement of the several (sound-reflecting and sound-absorbing) materials.

There are a lot of children's music schools today in Russia. Most of them are located in adapted buildings (such as residential houses, former kindergartens, general education schools etc.). Many of them are objects of cultural heritage. This fact can cause a lot of problems in providing acoustic comfort due to the discrepancy between the actual parameters of the classrooms and the recommended parameters.

In buildings, originally designed as music schools, there are less acoustic problems, because at the design development phase all nuances of acoustic improvement were taken into account. In the process of changing the functional process in the building many factors, affecting the provision of a comfortable acoustic mode during operation, should be taken into consideration.

Constructive and planning parameters in each building, especially pre-revolutionary buildings, are individual. The first problem, which can be encountered in the process of changing of a building function, is small rooms with a significant height of the room. A typical acute problem in this case will be acoustic low-frequency resonances.

Their occurrence is only due to the parameters of the room, when the distance between parallel reflecting surfaces is a multiple to half of the length of the sound wave. In other words, to create an acoustic resonance, it is necessary that the sound wave, "started" at one wall, pass through the entire room in a straight line to the opposite parallel wall and, reflected from it, again returned to the beginning of the path at the moment, when the second wave begins to appear. And so on in a closed loop.

As a result of mutual amplification of direct and reflected sound waves, there is an unnatural increase in the amplitude of the aggregated audio signal. This is expressed in accentuating it with respect to the remaining frequencies and causes the sound of boominess at a given frequency. In practice, this is perceived as a "dirty" "buzzing" bass.

In the design practice, the optimal parameters of the music room are: the air volume of premises shouldn`t be less than 200-230 cubic meters at a room height of at least 4,0-4,1 meter. When the volume of music rooms is understated, there is a danger of excessive loudness of performances [2].

If the room has low ceilings, the first reflections will suppress all others, leading to a loss of volume and degree of spatial impression of musical sounds.

One more important parameter is the ratio of the linear dimensions of the room, i.e. the ratio of its length, width and height. With an unfavorable ratio of linear dimensions, there is a tendency to fuse (mutually reinforce) several resonances. The most problematic in terms of the formation of resonances are rooms with the same or multiple linear dimensions. The worst variants are cubic rooms. The observance of basic proportions (the ratio of length to width and width to height) is a prerequisite for music rooms and should be selected within 1,4 – 1,6 [2].

The next prevalent acoustic problem is «flutter». This definition in acoustics means the process of multiple cyclic reflection of sound between two parallel surfaces with high reflectivity. Its presence negatively affects the quality of sound reproduction, because it worsens the intelligibility of speech, "smears" the sound of music programs and gives him a sharp unpleasant color. That`s why the longitudinal walls of rooms should have bevels from an ideal parallelism and have angles not less than 10-12°[2].

The decoration of rooms also affects the provision of comfortable acoustic mode. As a rule, all the acoustic problems of the music room are due to reflections of sound from its walls, floor and ceiling, so that smooth, hard and massive reflective surfaces are worse, because they easily reflect the sound back into the room [1].

To avoid acoustic problems, the ceilings of rooms must completely reflect the sound, floors must be wooden. In the decoration of rooms it is recommended to use traditional building materials. Structures with the open use of reinforced concrete should be completely excluded in the decoration of the envelopes [1].

Insufficiently considered application of special acoustic linings can affect and distort the frequency response of the room, resulting in a loss of room reverberation.

Generally, well-thought-out space-planning decision and structural concept of buildings of music schools, located in specially designed or adapted buildings, will avoid problems in creating acoustic comfort in rehearsal and concert rooms.

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ПРОБЛЕМЫ АКУСТИЧЕСКОГО БЛАГОУСТРОЙСТВА ПОМЕЩЕНИЙ МУЗЫКАЛЬНЫХ УЧЕБНЫХ ЗАВДЕНИЙ

Ю.И. Серегина
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: seregina-juliv@rambler.ru

Аннотация

Рассмотрена проблематика акустического проектирования помещений музыкальных учебных заведений. Особое внимание уделяется зданиям приспособленным под музыкальные школы. Приведены основные требования к акустическому благоустройству.

Анализ приведенной информации показал, что обеспечение акустического комфорта может быть достигнуто только при тщательной разработке объемно-планировочных и конструктивных решений.

Ключевые слова:акустика музыкальных помещений, звуковая энергия, акустические дефекты.

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HISTORICAL DEVELOPMENT OF THE NATURAL STONE FROM A STRUCTURAL ELEMENT TO AN ELEMENT OF DECORATION

V. V. Popov, A. V. Erofeev, V. A. Mikhailov
Tambov State Technical University, Tambov, Russia
e-mail: sir.vladimir-popoff@yandex.ru

Abstract

In this paper an attempt to trace the historical path of development of the natural stone use in construction is made. It is shown that originally the natural stone was used as a structural material. This was due to the lack of an alternative and the lack of the need to create large internal volumes of the room. Since the era of ancient Greece and ancient Rome, the field of application of the natural stone has changed. It has a double purpose. It can be used as the structural and finishing material. At the present time it is used only as a finishing material.

Key words: constructive material, decoration material, monumentality, natural stone.

Introduction

The natural stone along with the wood is the first building material. Its strength characteristics, resistance to the effects of unfavorable factors, which cause high performance indicators, initially determined the scope of the natural stone as the main bearing structural element of buildings. However, at different historical periods, the purpose of the stone was different: at the dawn of the centuries the natural stone was used only as a structural material, then during periods of the history it was used both as a structural and finishing material. You can also distinguish periods during which it was used only as a finishing material [2]. Thus, the way of development of the natural stone from a constructive element to a decorative element is very interesting.

History of natural stone in buildings

One of the first structures made of stone, which have survived to this day, are religious buildings: menhirs, dolmens and cromlechs. The purpose of the first structures made of the natural stone is still not fully established, and causes a large number of disputes among specialists.

At the next historical stage of the development, the end of which can be limited to the beginning of the era of Ancient Rome, all the buildings and facilities were divided according to residential and religious purpose; the first buildings were constructed of wood and clay (they played the role of the temporary residence in this world). The latter were built of the stone. The purpose of cult stone structures was the suppression of the man and the exaltation of the deity and his power on earth. The interior space of such buildings is insignificant in contrast to exterior. This is due to the fact that it was not possible to block large spans with stone structures but it was possible to create monumental perpetual buildings. A vivid example of such buildings is the Egyptian pyramids. At this period of time, the stone still played the role of a structural element.

The purpose of religious buildings (temples) in Ancient Greece was somewhat different than in countries with the despotic form of government. In this country, religious structures played the role of the unity element for both spiritual and physical development of the man, the education of a heroic man. That is why the tendency to escape from the domination of the mass (the mass of the stone) over the space is clearly traced through the improvement of the pillar-and-beam system, which led to a clear division into the supporting and enclosing elements. Tectonic pillar -and-beam system made of stone developed in ancient Greece and has become a universal part of architecture. It is at this historical period that the stone fulfills the function of not only a cladding element but also a finishing element.

In the era of ancient Rome, the construction of public buildings (amphitheatres, basilicas, baths) begins which leads to the need to create large internal volumes. At the same time, the stone-based pillar-and-beam system developed in Ancient Greece does not allow to create the required volumes and the stone application is gradually abandoned. The stone is replaced with concrete. The natural stone at this period of time plays the role of decoration material [1].

In the middle ages, with the loss of antiquity construction technology they begin to use the stone as a structural material again. The required internal space is created by erecting spatial structures. At this period of time, systems of vaulted ceilings are used. Both the stone and the brick are applied for the construction.

By the 19th century, with the appearance of a large number of new building materials, the natural stone had begun to play the role of a finishing material. The use of the natural stone as a structural material because of its high cost becomes an unaffordable luxury. However, its use in the lining provides the building with an expensive fashionable appearance [1].

In the Soviet era, since the 30s of the last century, the natural stone began to be widely used as a facing material for the construction and reconstruction of buildings and structures in Moscow. We can say that at this period of time Moscow had mainly stone buildings. The central roads of the city are radically rebuilt.

In the 90-s of the 20th century due to the objective circumstances, the use of the natural stone, even as a facing finishing material, decreased greatly. But in the modern conditions, there has been a recent increase of interest in using the natural stone such as marble and granite. However, it should be noted that there is no discussion about the use of the stone as a structural component. The requirements of the economy must be met.

Conclusion

Thus, the historical path of the use of natural stone in construction has been traced.

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ИСТОРИЧЕСКИЙ ПУТЬ ПРИРОДНОГО КАМНЯ ОТ КОНСТРУКТИВНЫХ ЭЛЕМЕНТОВ ДО ДЕКОРАТИВНЫХ ЭЛЕМЕНТОВ

В. В. Попов, А. В. Ерофеев, В. А. Михайлов
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: sir.vladimir-popoff@yandex.ru

Аннотация

В данной работе сделана попытка проследить исторический путь развития использования природного камня в строительстве. Показано, что изначально природный камень применялся в качестве конструктивного материала. Это было связано с отсутствием альтернативы и отсутствием необходимости создания больших внутренних объемов помещения. Начиная с эпохи Древней Греции и Древнего Рима, область применения природного камня начинает изменяться и его назначение становится двояким – конструкционный и отделочный материал. В настоящее время его используют только в качестве отделочного материала.

Ключевые слова: конструктивный материал, монументальность, отделочный декоративный материал, природный камень.

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THE PROSPECTS FOR THE DEVELOPMENT OF SHELL STRUCTURES

A.V. Popova
Tambov State Technical University, Tambov, Russia
e-mail: popova920@yandex.ru

Abstract
The article outlines the prospects for the development of aesthetically appealing and technically effective new forms of folded shell structures in different areas of architecture and construction. The functions of folded shells are shown when applied in architectural objects. Further research priorities and creative experiments in the field of structural morphology of folded shells have been identified. The creation of new types of folded systems allows clarifying perspective directions and their use in various areas of construction.

Key words: new architectural forms, folded shell, invention, artistic and aesthetic expressiveness, perspective directions

The invention of new types of folded shells, as well as the improvement of geometric and physical methods of their structural modeling, is traditionally one of the most topical and complex scientific and creative directions in the sphere of structural morphology. Traditionally the concept of "folded shell" is interprited narrowly by most architects and designers - only as a certain variety of bearing roof slabs and walls of buildings and structures.

At present the range of promising areas for the use of new forms of aesthetically appealing and technically effective folded systems has expanded significantly. In addition to the bearing roof slabs of flat, vaulted, domed and complex folded forms, such folded structures will be successfully applied as:

• tent tension structures of various configurations;

• transformable prefabricated quickly erectable residential and public buildings for hard-to-reach areas of gas and oil fields as well as relocatable shelters in natural disaster – prone areas;

• sound absorbing ceiling and wall screens in the halls;

• hyperbolic and umbrella pipe folded structures;

• glass façade cladding curtain wall structures of public buildings;

• small architectural forms (light lanterns, canopies, fountains, covered passages and galleries, sculptures, etc.);

• Vertical or raking bearing parts of structures, arches and beams.

Practically significant directions of further scientific researches and creative experiments in the field of structural morphology of folded shells:

1. Unlocking theartistic and aesthetic potential of plane folded shells, transformed from the plane;

2. Development of theoretical foundations for structural morphology and creating new types of folded shells with fractal structure, as well as identifying their composite potential;

3. Research on the aerodynamic aspect of the folds formation, and the creation of new promising types of pipe folded high-rise buildings;

4. Study of the acoustic aspect of the folds formation;

5. Development of theoretical frameworks for composite modeling of domed shells.

Fig. 1 – Sports Education Center Mülimatt, Switzerland, 2008-2010
Architects of Studio Vacchini Architetti

Nowadays the study of new types of folded shells without plain structure is becoming particularly relevant:

- composite shells consisting of compartments of hyperbolic paraboloid;
- composite shells consisting of the conoid and helicoid compartments;
- composite shells consisting of the cone and cylinder compartments;
- composite shells consisting of the compartments of surfaces with positive Gaussian curvature.

The above-mentioned types of shells are distinguished from plane folds by their increased strength characteristics and improved sound-scattering characteristics (in case hyperbolic folds are used).

One important point is worth noting: these types of composite folded shells are markedly different from well-studied plane folds. At the same time, the analysis revealed that their artistic and aesthetic potential has not been unlocked yet and therefore it should be the subject of an in-depth study.

The development of the theory of architectural shaping of folded shells is a scientific platform for creating promising innovative architectural and artistic

concepts of buildings and structures, and it is also an important prerequisite for their legal protection.

The most practical and productive one among the possible ways of modeling folded forms is the experimental approach.

The invention of new types of folded systems allows not only to improve known technical solutions of shells, but also to reveal previously unknown promising directions of their effective use in various construction sectors; whereas expanding the range of possible applications of folds is one of the most urgent priorities for modern architecture.

The most important aspect of architectural shaping of folded shells is unleashing their artistic potential: modeling of original forms with fractal or torsion composite structure; such forms possess a characteristic and dynamic silhouette, an expressive crystal pattern of texture, an active and changing black - and - white picture of the surface relief.

The topical technological highlights of shaping folded shells is the improvement of the methods of accurate forming of surfaces relief from large-sized sheet materials as well as the development of constructive design solutions for flexible and pin-connected joints of transformable structures.

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ПЕРСПЕКТИВЫ РАЗВИТИЯ АРХИТЕКТУРЫ СКЛАДЧАТЫХ ОБОЛОЧЕК

А.В. Попова
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: popova920@yandex.ru

Аннотация

В статье изложены перспективы развития эстетически выразительных и технически эффективных новых форм складчатых оболочек в различных сферах архитектуры и строительства. Показаны функции складчатых оболочек при их применении в архитектурных объектах. Определены значимые направления дальнейших научных исследований и творческих экспериментов в области формообразования складчатых оболочек. Создание новых типов складчатых систем позволяет выявить перспективные направления и их использование в различных сферах строительства.

Ключевые слова: новые архитектурные формы, складчатая оболочка, изобретение, художественно-эстетическая выразительность, перспективные направления

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ARCHITECTURE AS A SOURCE OF INFORMATION

E. S. Solovyova
Tambov State Technical University, Tambov, Russia
e-mail: evgesha_soloviova@mail.ru

Abstract
The levels of architectural shaping are discussed in the paper. Much attention is paid to the communicative-environmental level of architectural shaping. The interaction of man and architecture is considered from the point of view of human needs. The problem of environmental influence on the psyche and physical human health is highlighted.
Key words: architecture, emotions and architecture, factors of shaping, information in urban space, levels of architectural shaping, perception types of architectural object.

Introduction

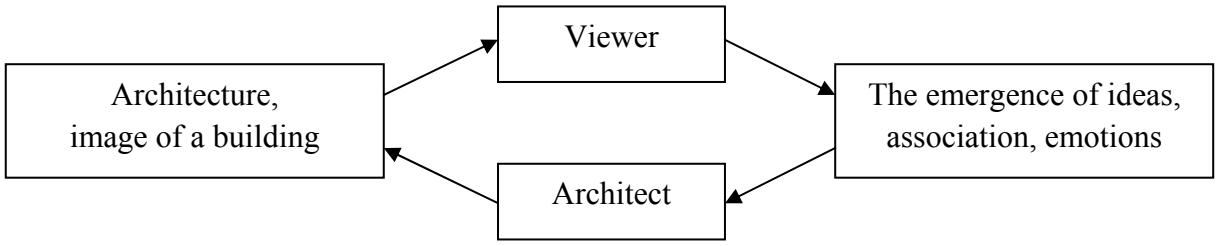
The building can be compared with a mechanism where each part has its own role. The architect's task is to regulate all components of the building and bring the utilitarian and artistic aspects into balance. Marcus Vitruvius Pollio named three qualities that architecture should have: "benefit", "strength", "beauty." Such an order of words tells us: the most important component of the architectural object is the utilitarian. However, this is far from true. As we know, A.V. Ikonnikov in his book "Function, form, image in architecture" says that it is impossible to compare the importance of the factors of shaping. In any case, "spatial values" will be in contradiction with the influence of fashion or style features [1]. The centre of architectural theory is problems of organizing the architectural object like a piece of art [3].

Architecture and information

G. Yu. Somov quotes A. Kuchmar's words: Architectural formation is subordinate, first of all, to the reproduction of life in its integral material and spiritual manifestation. G. Yu. Somov concludes that the most important thing for understanding the form-building process is such concepts as a "way of life" and "a complex of life processes". He also identifies three levels of architectural shaping: the level of material organization, the communicative-environmental level and artistic level. All three levels interact with each other and "communication processes and information associated with them, meaning, signs are inherent in all selected levels of form" [3]. Communicative-environmental and artistic levels of formation together form the emotional connection of humans and architecture.

The architect passes a specific architectural task through his own consciousness and understanding of piece, considers the objective and subjective factors of shaping. As a result, the architect gives his own impressions to a piece of art and creates the image and artistic form of buildings. It influences the image of the city. The artistic image of the building is called "a world of ideas, various associations, shades of

moods and feelings [3, p. 62]. You can pay attention to the mutual influence of man and architecture:



The emergence of various emotional states is a result of the interaction of architecture and man. The environment around us should create positive emotions with the help of clear spatial connections, systems of visual communications and artistic solutions.

The organization of the architectural environment is based on two groups of human needs: physiological and indicative. Indicative needs can be separated into cognitive needs, emotional contact needs and the need to search for the meaning of life [4]. Indicative needs are related to the stream of information that the environment gives. The quantity and quality of such information differently affects not only an emotional state of a person, but also a physical state. G. Yu. Somov gave an example of the organization of airport areas, where visual communication systems are very important. If the main and secondary information flows in one flow, there is a feeling of discomfort and confusion. If the information is ordered, navigation in space becomes easier and unpleasant emotions do not arise [4]. The physical state, as was said, can also be a consequence of the space organization. Monotony of surface coatings makes information about the object not sufficient. The abundance of repeating elements is excessive. Both situations are causes of stress, they worsens the state of health and influence the human's nervous system [5]. The last example refers to the creation of Japanese architect Kisho Kurokawa. It is a building in the style of Japanese metabolism.

The Nakagin Capsule Tower consists of 140 small-size identical elements (2.3x3.8x2.1 m). The Tower was built in 1972. In 2007, the inhabitant of the Nakagin said that they wanted to demolish a building, due to the poor state of the tower. However, the author of the paper about The Nakagin believes that a monotony atmosphere inside and outside could be the cause of sleeplessness, headaches and nervous disorders. Those things could become another reason for changing the place of living [5].

Fig. 1 – Kisho Kurokawa. Nakagin Capsule Tower

A person needs to change views and the semantic variety of information received in the urban environment. If the semantic diversity of the environment is determined by the processes of activity and features human's behavior, then visual diversity is the active differences of the environment elements [4]. If we compare a historical center of the city and areas of new buildings, we will see how easy it is to navigate in the historical part of the city. Changing of the views, necessary dominants and accents in the composition of streets, the integrity of architectural images, the rhythm of windows and cornices, a hint of the ensemble - all of them create cosines and positive emotions. The city's picture of new areas is another: the destruction of space, awkward altitude in combination with low-rise buildings, monotony of high-rise buildings, the difficulty of finding landmarks, etc. In the last case, the authors of projects forget about programming of the view pictures and the differences of the perception types of individual objects.

Types of perception affect the environment organization. It is the perception aimed of the selection of useful information or aesthetic perception. In the second case, the object goes outside utilitarian properties; an object endowed aesthetic value and becomes the symbol of the era [4].

As we know, several architectural schools appeared at the beginning of the 20th century. The most famous of them are the Bauhaus in Germany and Higher Art Technical Workshops in the Soviet Union. Each school in its own way changed the notion of architectural composition and touched upon the problem of creation and the experimental approach to architectural shaping [2]. If the Bauhaus seems like a creative laboratory, then Higher Art Technical Workshops looks a little different. The creation of members of the Soviet school was associated with the new ideology of the state and an emergence of new ideas about the relationship of people. This approach to the creation helped to express a new ideology and meanings. One example is the change of attitude towards the notion of "palace". As A.V. Ikonnikov says, the "palace" was a symbol of hostile forces for the mass consciousness of revolutionary years, but it turned into a symbol of the triumph of a new social order after the victory of the October Revolution [1].

Conclusion

Symbols and signs are the base of information systems. The difference of architecture is the composition of material elements, which, apart from the practical use, serve as signs for the expression of the figurative content of an object [1]. The architecture gives information not only to satisfy a person's need to navigate in space, but it also brings more complex philosophical and ideological meanings. Each element of the building has its own meaning, and together they can form a holistic picture of the life or world outlook of the people of their time.

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АРХИТЕКТУРА КАК ИСТОЧНИК ИНФОРМАЦИИ

Е.С. Соловьёва
Тамбовский Государственный ТехническийУниверситет, Тамбов, Россия
e-mail: evgesha_soloviova@mail.ru

Аннотация

В данной статье рассматриваются уровни архитектурного формообразования. Уделяется большое внимание коммуникативно-средовому уровню. Рассматривается взаимодействие человека и архитектуры с точки зрения ориентировочных потребностей человека. В статье освещается вопрос влияния информации об окружающей среде на психику и здоровье человека.

Ключевые слова: архитектура, архитектура и эмоции, информация в городском пространстве, типы восприятия архитектурных объектов, уровни архитектурного формообразования, факторы формообразования.

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NAVIGATION SYSTEM IN A SPORTING FACILITY FOR PEOPLE WITH THE POOR EYESIGHT

Yu.P. Spiridonova
Tambov State Technical University, Tambov, Russia
e-mail: Jullihp@mail.ru

Abstract

A unified navigation system for people with the poor eyesight in a sports facility is considered.

The author reveals the reasons why it is difficult for people with the poor eyesight to use sports buildings today. The tasks set for the architect are discussed and ways of solving problems arising in the design of a sports facility that can provide people with the poor eyesight with a comfortable existence in it are suggested.

The existing measures to ensure a comfortable existence in a sports facility for people with the poor eyesight are generalized, structured and supplemented, so that the author identifies and explains such a concept as "Effective navigation system" in a sports facility.

Key words: navigation system, poor eyesight, sports facilities.

Introduction

Today, sports facilities are not available for people with disabilities. This problem is relevant because of the lack of sports facilities equipped with a special navigation system. This system provides comfortable and understandable orientation within the facility for people with limited sensory capabilities

In this paper, we propose to consider a unified navigation system for people with the poor eyesight.

A navigation system in a sport facility for people with poor eyesight

This system is designed to provide all opportunities for the independent movement within the facility and on the adjacent territory. The navigation system can be considered more effective only if it gives independent free orientation in the facility for a person with the poor eyesight.

An effective building navigation system can be divided into three conventional directions: architectural and planning solutions of the object; specialized equipment of premises; accessible information system.

The optimal architectural and planning solution of the facility involves the arrangement of rooms where people with the poor eyesight can be, at the level of the entrance closest to the ground. The ramps, lifting platforms for disabled persons or elevators are provided if other rooms are arranged in a different way in the building, except for stairs.

In addition, if the building includes a room for sports games, then it must be perfectly smooth, and playgrounds must be indicated with sticking strips.

The modern specialized equipment includes: horizontal handrails installed at the 0.9 to 1.2m from the floor; tactile ground indicators; artificial irregularities; outdoor signposts.

Tactile landmarks and artificial irregularities form the basis of an effective building navigation system. They are unified and regulated by GOST R 52875-2007. These indicators can be divided into guiding and warning signs. [2] Guidance signposts should provide an opportunity to move in the right direction inside public buildings independently and without an accompanying person for the people with the poor eyesight.

The public buildings and structures have tactile floor signs in the corridors and on the staircases to indicate the direction of movement to the disabled people, as well as to warn them about possible dangers on the route. Outdoor signs can indicate a direction; warn about a possible obstacle, turn, staircase, etc. (fig. 1)

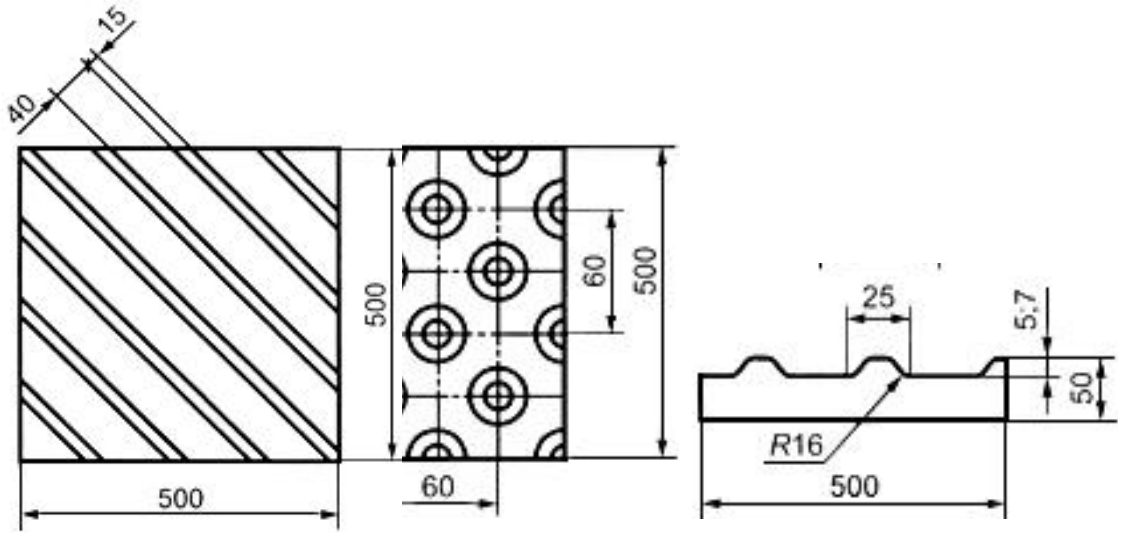

Fig. 1 - Forms of surface corrugation

Another important aspect of an effective navigation system for people with the poor eyesight is the easily assimilated information component. [1] It can include the installation of information mnemonic diagrams, information stands and sound informants.

The information component of the navigation system requires special attention. The task of its organization includes a lot of complex nuances. For example: a tactile traffic pattern for the people with the poor eyesight should be installed near the entrance to the building. It must display information about the premises in the building and not interfere with the main flow of visitors. It should be located on the right side in the direction of the route at the distance of 3 to 5 m. Tactile and light pointers, scoreboards and pictograms should be actively used as well as a contrasting color concept for the interior elements to draw the attention of people with the poor eyesight to the necessary information. The information desk in the field of specialized services for invalids should be clearly seen by people with the poor eyesight.

In addition, the installation of sound informants is provided in the vestibules. Visitors with the poor eyesight can use them. Similarly, all types of information room are equipped. [2]

Therefore, the effective orientation system is the system which allows people with the poor eyesight to accurately identify their own location and places being the target of the visit at any time of the day; the possibility to have continuous information support on all routes; the possibility to receive information in various formats (visual, sound, relief font and Braille font).

Conclusion

Therefore, only taking into account all three components of an effective navigation system, it is possible to create comfortable conditions for people with the poor eyesight in a sporting facility.

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СИСТЕМА НАВИГАЦИИ В ОБЪЕКТЕ СПОРТИВНОГО НАЗНАЧЕНИЯ ДЛЯ ЛЮДЕЙ С ОСЛАБЛЕННЫМ ЗРЕНИЕМ

Ю.П. Спиридонова
Тамбовский Государственный Технический Университет, Тамбов, Россия
e-mail: Jullihp@mail.ru

Аннотация

В данной статье предлагается к рассмотрению унифицированная система навигации для людей с ослабленным зрением в спортивном объекте.

В статье выявляются причины, по которым спортивные постройки сегодня остаются труднодоступными для людей с ослабленным зрением. Также рассматриваются задачи, поставленные перед архитектором, и предлагаются способы решения проблем, возникающих при проектировании спортивного объекта, способного обеспечить людям с ослабленным зрением комфортное в нём существование.

Существующие на сегодняшний день меры по обеспечению комфортного существования в спортивном объекте людям с ослабленным зрением обобщаются, структурируются и дополняются, благодаря чему в статье выявляется и получает объяснение такое понятие как «Эффективная система навигации» в спортивном объекте.

Ключевые слова: ослабленное зрение, система навигации в объекте, спортивные объекты**.**

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ББК 85.11

PUBLIC SPACES IN THE URBAN STRUCTURE

A. A. Shukan, D. O. Kotov
Tambov State Technical University, Tambov, Russia
e-mail: shukan_anastasia@mail.ru

Abstract
The extensive growth of Russian cities is a common phenomenon of recent decades. As a consequence there is a growing problem, because such a developed periphery requires a highly developed center. The quality of the central parts of the city is determined precisely by the availability of a right historical and modern buildings balance at the junction of which public spaces are formed. These architectural units are the most important aspect of the citizen's life.
Key words: architecture, urbanism, extensive growth, city center, periphery.

A modern city is a constantly developing, growing organism. He is subject to urban and urban laws in all aspects of his growth. There is a certain system of interaction between the elements and structures of the city, dictating the dynamics of the urban environment. All this is inextricably linked with society, and the development of the city occurs solely under the influence of social processes.

Thinking about public spaces as a concept, we must go beyond the "squares" and "parks". They represent a branched network, smoothly flowing from the embankments to the courtyards of schools and houses, dissolving and again appearing on the general plan. In modern conditions, a highly urbanized environment is saturated with various aspects of social life and projects them to society. A self-sufficient, continuously developing closed system "society-public space" is being formed.

In the post-Soviet space, many cities experienced a transition from a planned economy to a market economy. All of them underwent extensive growth due to new opportunities for commercialization. This process was accompanied by a complete lack of familiar urban planning systems, so characteristic of the architectural practices of the Soviet Union. In most cases provincial cities lack the capacity for autonomous development. This entails a lack of investment, especially foreign ones.

The attractiveness of the center is also lost because of the active development of the periphery. Extensive growth is due to the availability of free areas. This situation is easier for developers and officials. There are too many attractive factors involved - large volumes of construction from scratch, scale, transport accessibility, relative cheapness of the land, no problems in the process of project approval. All this generates supermarket boxes and faceless residential neighborhoods without the proper social infrastructure, often even without schools.

A consequence of these processes is the high development and saturation of the periphery. This hypertrophied ring around the city began to impose higher

demands on the central zone. The natural consequence will be an increase in the social and cultural potential of the center.

It is necessary to determine in advance some key expressions for correct work with the concept of public spaces. The historical center is the territory of city appearance, the focus of cultural and historical heritage. The central zone is a highly urbanized area, characterized by a wide range of human activities in various spheres, a variety of functions, increased use of citizens, as well as historical depth.

Public space is the territory that forms and integrates citizen's communities. The ideal public space covers three aspects of the life of citizens: social, cultural and political. The social aspect is expressed in the formation and reproduction of the public sphere, when people go beyond the usual circle of friends and acquaintances and face strangers.

Public space should provoke interaction among different sections of the population. People should not only be aware of the existence of each other, but also have the opportunity for real interaction and communication. This is the manifestation of the democratic potential of citizens. At the moment, there is a social dilemma in front of the general planners: how to "design" anew, to build urban social life so that it stimulates a sense of community and understanding of identity in the urban environment?

Cultural activities began to play a significant role in the viability of the city's economy. The city uses the appeal of culture to saturate its economic well-being.

Public space is not always inextricably linked with the historical center of the city. But historically it was formed in the center. In the process of people's activity, over time, it began to form in other, rapidly growing parts of the city. Our goal, as architects, is to gradually transform the divided public spaces into a network.

Looking at the prospects for the development of Russian cities, we must pay special attention to the center, saturated with public spaces. Analyzing the very concept of "centrality" in urbanism, we see that the merging of people into a single community is traditionally taking place in public spaces.

The urban potential of parks and recreation areas is high. But at this stage of development they do not provide all the necessary aspects of the ideal model of "public space". Objects of their cultural reach are difficult to call unique, in essence they are identical. The very fact of occurrence of places attracting citizens, their analysis and systematization is important. Studying an evolving network of public spaces will provide an opportunity to effectively manage the city. Further, the qualitative improvement of the environment in all aspects will follow logically.

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ОБЩЕСТВЕННЫЕ ПРОСТРАНСТВА В СТРУКТУРЕ ГОРОДА

А. А. Шукан, Д. О. Котов
Тамбовский Государственный Технический Университет, Тамбов, Россия
e-mail: shukan_anastasia@mail.ru

Аннотация

Экстенсивный рост русских городов – характерное явление последних десятилетий. В связи с этим нарастает проблема, ведь столь развитая периферия требует высокоразвитого центра. Качество центральных частей города определяется именно наличием грамотного баланса исторической и современной застройки, на стыке которых формируются общественные пространства. Эти архитектурные единицы – важнейший аспект жизни горожан.

Ключевые слова: архитектура, периферия, урбанизм, центр города, экстенсивный рост.

УДК 574
ББК О145

RECONSTRUCTION OF RESIDENTIAL BUILDINGS IN TAMBOV

K.E. Yakovleva
Tambov State Technical University, Tambov, Russia
e-mail: ki.o.m.@mail.ru

Abstract
The article presents the characteristics of houses construction of XX(60-70) in Tambov within Pionerskaya, Naberezhnaya, Uborevicha, Andreevskaya Streets. The solutions for the reconstruction of buildings, improvement of yard areas and creation of the favorable urban and natural environment are made.
Key words: reconstruction, remodeling, renovation.

Construction in the mid-60s was aimed at solving the housing problem in the shortest possible time, the formation of new systems of enclosed courtyard spaces, regional and district development with integrated public buildings.

Currently, a large number of similar buildings are located on the territory of the town. It is impossible to demolish all these buildings, so they are reconstructed to facilitate the lives of citizens.

Residential areas of Naberezhnaya Street are closed systems, situated near other buildings of other periods, with adjacent recreational area along the river Tsna. Disadvantages of the quarter are pedestrian permeability, lack of organized platforms inside courtyards, parking areas, fire driveways do not correspond to regulations [1].

This territory is considered comfortable for living, near the beach and park zone. However, the buildings themselves are in poor condition. The project provides for overhaul with the reinforcement of load-bearing structures, modern design of premises, improvement of the yard area, taking into account the needs of the population. Measures for the reconstruction of buildings and apartments will allow residents of these houses to change the living conditions without changing their place of residence.

Houses built in the 1960s and 1970s are standard 4- or 5-storey brick residential buildings located in the center of the city.

While remodeling houses it is recommended to dismantle the walls in double and triple apartments, to combine kitchens and living rooms, replacing gas stoves with electrical; in double and triple apartments replacing combined bathrooms into separate ones, redevelopment of one-bedroom apartments is not recommended.

Structural transformation includes strengthening of bearing structures (foundations, walls), insulation of walls, superstructure of additional floors, roof reconstruction, extension of lifts, lobbies device.

Redesign of apartments includes increasing the area of the bathroom and

kitchen, creating a more comfortable layout by replacing internal partitions. In the center of the building one-room apartments are joined in to two-bedroom apartments, because they do not meet the norms of insolation.

Accomplishment of territories near houses requires an individual approach, as a consequence of the features of the relief (strong bias) and a small area. This includes passages device in accordance with the standard organization of sites for various purposes in accordance with [1] and [2] and DBC 58-88 [3], demolition of dilapidated houses, the resettlement of residents from dilapidated housing in new residential high-rise building in the quarter, the organization of zones of landscaping.

Fig. 1 – Cultural and leisure area of Naberezhnaya Street in Tambov.

It is worth noting the value of Naberezhnaya Street to Tambov in the urban development plan (Figure 1). This is the cultural and recreational zone of the city, along which there are numerous parks, alleys, playgrounds, catering, cultural centers, in the southern part of the organized beach area, including organized sports grounds, swimming areas, rent of (Figure 2).

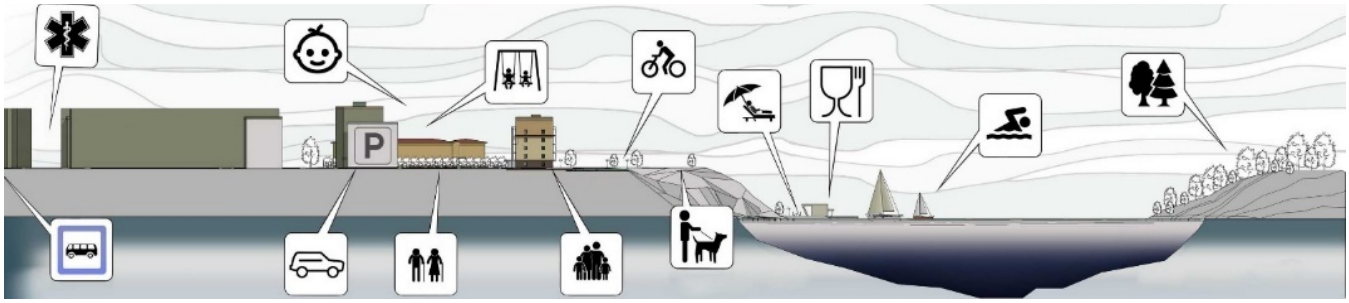

Fig. 2 - Development scheme. Recreational development.

Integration of the quarter to the urban environment must take into account the natural dominant of river Tsna. It will create the finished look of Naberezhnaya Street, will rise the quarter (district) indication of the comfort of living in Tambov. And for the human visitor and resident of Tambov the development of this area can become a kind of attraction, and undoubtedly a great contribution to the modernization and transformation of Tambov.

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РЕКОНСТРУКЦИЯ ЖИЛОЙ ЗАСТРОЙКИ В ГОРОДЕ ТАМБОВЕ

К.Е. Яковлева
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: ki.o.m@mail.ru

Аннотация

В статье представлена характеристика домов застройки 60-70-х годов XX века в квартале в границах улиц Пионерская, Набережная, Уборевича, Андреевской в г. Тамбов. Представлены решения по реконструкции зданий, благоустройстве дворовой территории и созданию гармоничного слияния городской и природной среды.

Ключевые слова: перепланировка, реконструкция, реновация.

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ББК 38.54

DESIGN CONCEPTS FOR STEEL FRAMES OF AGRICULTURAL BUILDINGS

T. O. Averina
Tambov State Technical University, Tambov, Russia
e-mail: tat-aver@mail.ru

Abstract

Modern Russian construction market offers a large number of design concepts for steel frames of agricultural buildings that makes it necessary to systematize the most effective concepts for the use in the Tambov region. The aim of the research is to analyze design concepts for steel frames of agricultural buildings and structures. The research included several stages: studying the classification of agricultural buildings and structures, outlining advantages of steel frames used in them, examining of Russian construction related to the application of design concepts for steel frames of agricultural buildings. As a result of the research, steel frames of agricultural buildings were systematized in a tabular form, their main advantages were highlighted and ways of using the proposed design concepts in the Tambov region were outlined.

Key words: agricultural buildings and structures, design concepts, steel frames.

Introduction

At present there are many design concepts for steel frames of agricultural buildings offered by Russian manufacturers. The choice of a specific concept is determined by the scope of application of agricultural buildings and the technological equipment located in them.

The relevance of the research is that agricultural buildings and structures play an important role in the production of agricultural products. Productivity, expiry dates and other indicators of agricultural production depend on the use of modern materials and technologies in the construction of agricultural buildings and their state.

The aim of the research is to analyze design concepts for steel frames of agricultural buildings and structures.

To achieve this aim, it is necessary to solve the following tasks:

– study the classification of agricultural buildings and structures;

– outline advantages of steel frames in the construction of agricultural buildings;

– examine Russian construction and design concepts for steel frames of agricultural buildings used now;

– study the prospects for the development of agriculture in the Tambov region.

Characteristics of design concepts for steel frames of agricultural buildings and structures

Agricultural buildings and structures are intended for various branches of agricultural industry. The following main types of agricultural buildings and structures are distinguished: buildings for livestock and poultry; veterinary buildings; structures for the storage of silage and haylage; warehouses; structures for cultivation; buildings for processing of agricultural products; buildings for the repair and storage of agricultural machinery [1].

Today in our country metal structures are primarily used in the construction of industrial and agricultural facilities. This is due to a number of advantages:

– the use of lightweight steel structures instead of heavy reinforced concrete structures allows to significantly reduce their own weight as well as the weight of the entire building due to the high strength characteristics of these materials;

– in connection with the use of small spans and the length of structural steelwork, the problem of the stability of compressed elements, which is the main one when metal is used, can be solved without a significant increase in the construction ratio;

– lightweight load-bearing metal structures allow to use the machinery of small-capacity and high mobility during their installation;

– the use of load-bearing metal structures in conditions of large-scale construction of agricultural facilities has great advantages due to their relative ease, transportability and high degree of industriality;

– metal structures best meet the requirements of assembly and demolition of buildings and structures. This makes it easy to dismantle steel structures and flexibly change the purpose of the building;

– saving of material in metal structures of agricultural buildings and structures is achieved by using the most cost-efficient rolled and bent profiles;

– the steel profile can be exposed to temperature change [2].

Currently, the Russian factories of steel structures offer different types of design concepts for agricultural buildings. It is suggested to use pipes and C-shaped, Z-shaped and Σ-shaped cold-formed galvanized steel profiles which are mainly cross-sections of structural elements.

In the agricultural construction relatively small spans of buildings not exceeding 30 m are used with the space of bearing structures from 3 m to 6 m.

Design concepts of agricultural buildings which are briefly described are summarized in Table 1.

The choice of design concepts is also relevant for the Tambov region since it is an agrarian and industrial region that has the necessary raw material base, manpower for the development of agro-industrial complexes. In accordance with the "Strategy of social and economic development of the Tambov region for the period until 2020", the construction of agricultural buildings and facilities meeting modern requirements will continue in the region.

Conclusion

Thus, as a result of the research, the steel frames of agricultural buildings were systematized in the tabular form, their basic characteristics were determined,

the modern market of manufacturers of steel frames of buildings was analyzed and their advantages were revealed.

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КОНСТРУКТИВНЫЕ РЕШЕНИЯ СТАЛЬНЫХ КАРКАСОВ ЗДАНИЙ СЕЛЬСКОХОЗЯЙСТВЕННОГО НАЗНАЧЕНИЯ

Т. О. Аверина

Тамбовский государственный технический университет, Тамбов, Россия

e-mail: tat-aver@mail.ru

Аннотация

Современный российский строительный рынок предлагает большое количество конструктивных решений стальных каркасов зданий сельскохозяйственного назначения, что вызывает необходимость систематизации наиболее эффективных решений для применения в Тамбовской области. Целью исследования является анализ конструктивных решений стальных каркасов сельскохозяйственных зданий и сооружений. Исследование включало несколько этапов: изучение классификации сельскохозяйственных зданий и сооружений, выявление достоинств используемых в них стальных каркасов, рассмотрение российского опыта строительства в применении конструктивных решений стальных каркасов зданий сельскохозяйственного назначения. В результате исследования была произведена систематизация стальных каркасов зданий сельскохозяйственного назначения в табличной форме, выявлены их основные преимущества и намечены пути использования предлагаемых конструктивных решений в Тамбовской области.

Ключевые слова: конструктивные решения; сельскохозяйственные здания и сооружения; стальные каркасы.

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DISADVANTAGE OF EMPIRICAL METHOD FOR BLAST LOAD CALCULATION

Alaa Jaleel Naji
University of AL-Qadisiayh, Qadisiayh, Iraq
e-mail: alaa.alnsray@qu.edu.iq

Abstract

In the past, the blast process was limited by military installations in war or chemical factories when errors occur during working or storage material, and now no one is excluded from the blast process: buildings, people and property. With increasing incidents of terrorism all over the world, there is a feeling among the people towards the weakness of buildings to resist blasts. One of the most serious problems in this field is how to calculate blast load on the structures. In this paper, we will discuss empirical method of calculating blast load and creating procedure of determination the blast load for car carrying quarter ton TNT stopping at distance 10 m and show disadvantage of this method. Empirical method for calculating blast load is very simple, all calculations were done manually and the results are larger than the real loads, empirical method may be the basic for developing software to calculate blast load for structures.

Key words: blast, empirical, load, TNT, shock, disadvantage, wave.

Introduction

Rebecca Dick defines the blast load as follows: “Blast loads are pressure waves caused by the rapid release of energy during a chemical reaction; the wave propagation is spherical in nature and dissipates with distance from the blast initiation.”Wider methods used to determine the blast loads are empirical method; this method developed by the US military in 1960 and published it in a book issued by the US Department of Defense. The process determination blast loads is indicated in Handbook for Blast-Resistant Design of Buildings Edited by Donald o. Dusenberry as: “Although research into the effects of explosions dates back to 1870, most development to determine the blast loading on buildings and other similar structures was started in the 1950s and 1960s by the U.S. military. Several publicly available military manuals were distributed during this period (TM 5-856 and TM 5-1300) that presented empirically-derived charts and equations. Several papers and publications published during that period (Newmark 1956, Biggs 1964, ASCE 1985) also provided information for design.”

Blast phenomena

Paul F. Mlakar and Darrell Barker define blast in Handbook for Blast-Resistant Design of Buildings Edited by Donald o. Dusenberry: “Blast is a pressure disturbance caused by the sudden release of energy”, the blast sources varied, including solid and liquid and gaseous, While Vasilis Karlos and George Solomos say: “An explosion can be defined as a very fast chemical reaction involving a solid, dust or gas, during which a rapid release of hot gases and energy

takes place.” When the explosion generated spherical wave called a shock wave that travels from source blast to the surface of the building and during the transmission of the shock wave caused pushing air molecules resulting dynamic compression pressure (q_o) is like the wind pressure added to the shock wave that travels to the surface of the building, When the shock wave hit of the surface building reflected the shock wave result pressure (P_{so}) called t Peak positive pressure transmitted from the blast source to the surface of the building during the time (t_o) called Positive phase duration and reflected wave has pressure (P_{so}^-) called Peak negative pressure transmitted during the time (t_o^-) called negative phase duration. The reflected wave pressure does not effect on the blast load during the positive phase.

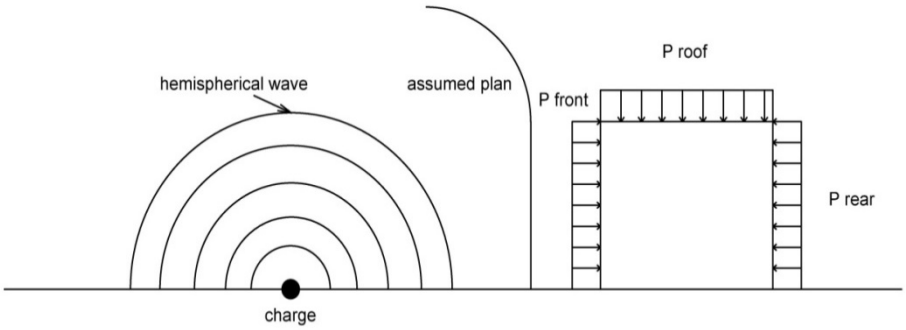

Fig. 1 – Blast phenomena

1. Blast type

Determination of the load blast depends on location of the explosion and the horizontal distance from the building and vertical distance from the surface of the earth, there three main type of explosion according location (Vasilis karlos George solomos):

1- Free-air blast: this type of explosion has been on air, blast wave travel direct on the building surface without Obstacles, as shown in the figure (6.2-a).

2- Air blast: this type of explosion has been on air, but blast wave hit with the ground before travel on the building surface, as shown in the figure (6.2-b).

3- Surface blast: this type of explosion has been at ground, blast wave interact with the ground after than travel on the building surface, as shown in the figure (6.2-b).

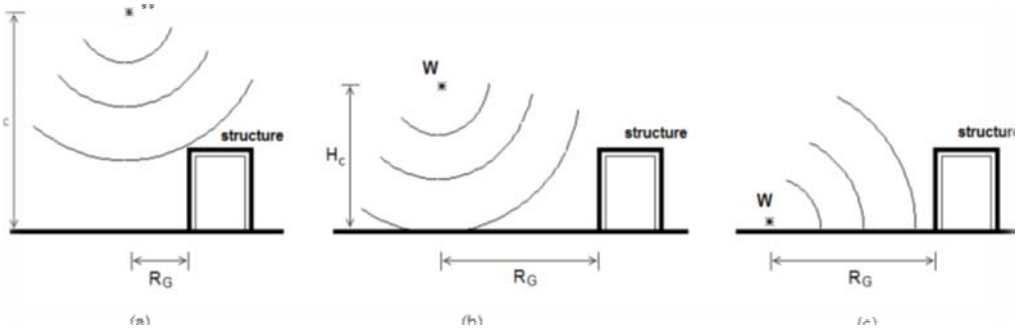

Fig. 2 - Type of Explosion

The shock wave is transmitted from the explosion source on a spherical shape or a hemispherical and when calculates the blast load, we assume the shock wave transmitted linearly.

Empirical method for determination of blast load

Empirical method includes equations, table and charts, determines the type of explosive material, weight and distance from the building, there are procedures to calculate load:

a. Scaling law

Through experiments conducted by Hopkinson in 1915 put the most important law to measure the properties of the blast wave is called the scaling law or cube root scaling. In 1926 Cranz conducting experiments to determine the properties of the blast wave and got the same results, Hopkinson-Cranz law is the law that is used to detriment Wave blast parameters.

$$Z = \frac{R}{W^{\frac{1}{3}}} \qquad (1)$$

Z: Scaling distance (m/$kg^{\frac{1}{3}}$)

R: Distance from center of blast source to the point touch surface (m)

W: weight of TNT (kg)

b. **Wave blast parameters**

1. Atmospheric pressure (P_0): is the atmospheric pressure in blast place (Kpa).
2. Peak positive pressure (P_{so}): is maximum value for blast wave pressure in the positive phase (Kpa).
3. Peak negative pressure (P_{so}^-): is maximum value for blast wave pressure in the negative phase (Kpa).
4. Time (t_0): is the positive phase duration (ms).
5. Time (t_o^-): is the negative phase duration (ms).
6. Peak reflected pressure (P_r): is maximum value for reflected wave pressure by surface (Kpa).
7. Wave velocity (U_s): is the velocity blast wave in the positive phase (m/ms).
8. Length wave (L_w): is the length blast wave in the positive phase (m).
9. Impulse (I_S): is the positive phase specific impulse, (Kpa.ms).
10. Impulse (I_S): is the positive phase specific impulse, (Kpa.ms).
11. Impulse (I_S^-): is the negative phase specific impulse, (Kpa.ms).
12. Impulse (I_r): is the reflected phase specific impulse,(Kpa.ms).

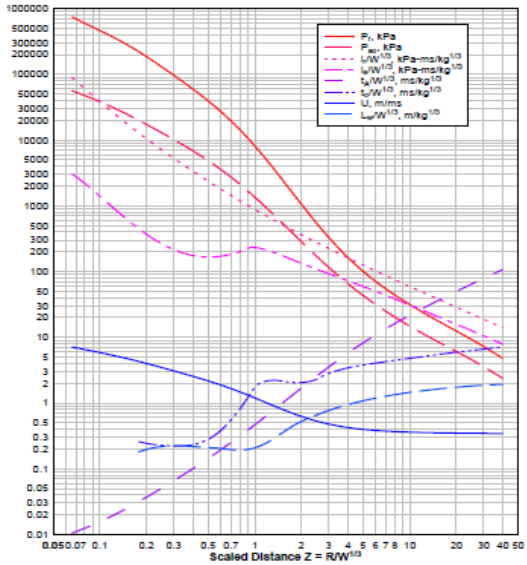

Fig. 3 – Blast waves properties for TNT with surface of blast

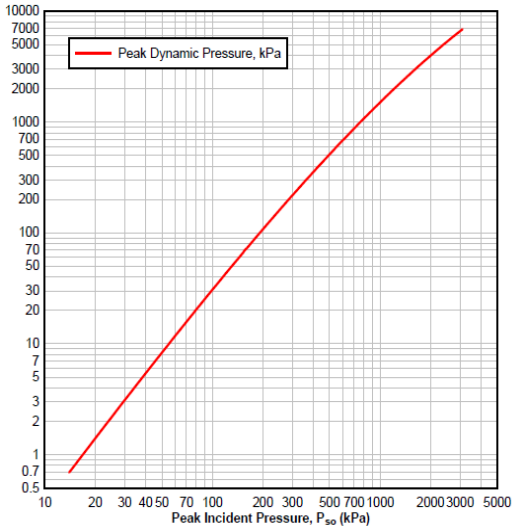

Fig. 4 - Variation of peak dynamic pressure versus peak incident pressure

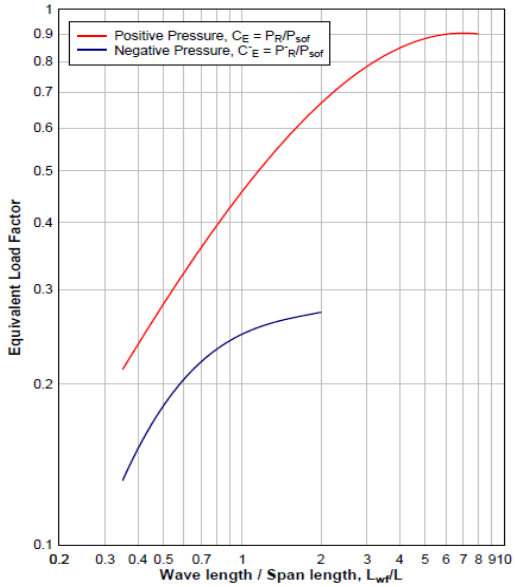

Fig.5 - Load factors for positive and negative phase of blast loading for the roof and sidewalls of a structure

c. calculation of blast load

1. Front load

Front wall load can be calculated by using the formula:

$$P_{sof} = P_{so} + C_d * q_o \qquad (2)$$

P_{sof}: Front wall pressure (Kpa).

P_{so}: Peak positive pressure (Kpa).

q_o : Dynamic pressure (Kpa).

C_d : Drag coefficient, given in table (2)

Tables 1 - Drag coefficient C_d values for roof, rear wall and side walls.

Peak dynamic pressure (kpa)	Drag coefficient C_d
0 – 170	-0.4
170 – 350	-0.3
350 – 900	-0.2

d. Roof, rear and side load

The load applied on roof of the building as a result of the blast is less than the front surface load , the roof load calculating be using the following formula :

$$P_{sor} = C_E * P_{sof} + C_D * q_o \qquad (3)$$

P_{sor} : Roof load pressure (kpa).

C_E : Load factor coefficient

P_{sof} : Front load pressure (kpa).

C_D : Drag coefficient.

Load factor coefficient determent be using figure (5) and depending of ratio: $\frac{L_w}{L}$ Where: L_w is the length of blast wave and L is the span length.

Calculation blast load for two story building

Sports center is protected by a detector system against explosives at a distance of 10 m from the perimeter of the building. We assume that a car loaded 250 kg of TNT material within 10 m of the building, as shown in Figure 6.

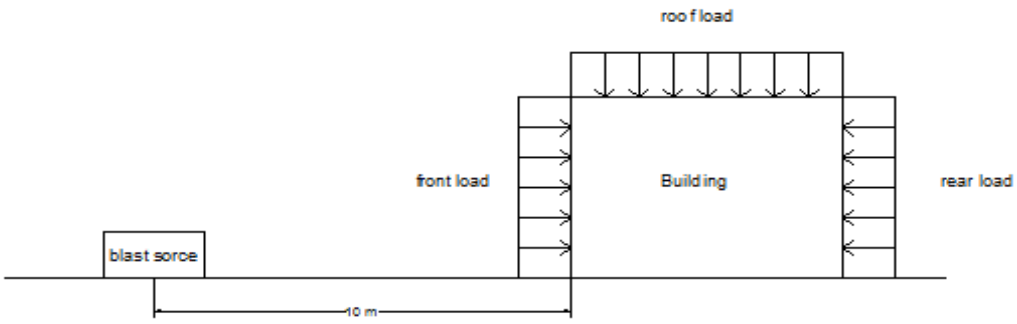

Fig. 6 - Building under blast load

W = 250 kg

R = 10 m

By using equations (1), we can calculate scaling distance **Z:**

$$Z = \frac{10}{250^{1/3}} = 1.6\,{}^{m}/_{kg^{1/3}}$$

By using figure (3) we can determent wave blast parameters:

$P_{so} = 500kpa$, $P_r = 2500kpa$, $I_r = 350\text{Kpa.ms}$,

$I_s = 125\text{Kpa.ms}$, ${}^{t_A}/_{W^{1/3}} = 1\ {}^{ms}/_{kg^{1/3}}$, ${}^{t_o}/_{W^{1/3}} = 2.25\ {}^{ms}/_{kg^{1/3}}$, U = $0.75\,{}^{m}/_{ms}$, ${}^{L_w}/_{W^{1/3}} = 0.4\ {}^{m}/_{kg^{1/3}}$

a. Calculation of front wall load

By using formula (2)

$$P_{sof} = P_{so} + C_d * q_o$$

When peak positive pressure is $P_{so} = 500kpa$, dynamic pressure is $q_o = 500kpa$ from figure (4) and drag coefficient taken $C_D = 1$

$$P_{sof} = 500 + 1 * 500 = 1000\ \text{kpa}$$

The distributed load resulted from 250 kg of TNT blast on distance 10m from front surface of the building is 1000 kpa

b. Roofload

By using formula (3)

$$P_{sor} = C_E * P_{sof} + C_D * q_o$$

Find load factor from figure (5) $\frac{L_w}{L}$ Calculate ratio

Length of span L = 12 m and W = 250 kg TNT

$${}^{L_w}/_{W^{1/3}} = 0.4\ {}^{m}/_{kg^{1/3}}$$

$$L_w = 0.4 * 250^{\frac{1}{3}} = 2.5\ m$$

$$\frac{L_w}{L} = \frac{2.5}{12} = 0.2$$

From figure (5) load factor $C_E = 0.1$

$P_{sor} = C_E * P_{sof}$

$P_{sor} = 0.1 * 500 = 50\ kpa$

When $P_{sor} = 50kpa$ the dynamic presser is $q_o = 50kpa$ from figure (4)

Drag coefficient $C_D = -0.4$ from table (1).

$P_{sor} = 50 + -0.4 * 50 = 30\ kpa$

c. Rear wall load

R = 10 + 12 = 22 m

Z = $\frac{22}{250^{1/3}} = 3.5^{m}/_{kg^{1/3}}$

By using figure (3) we can determent the wave blast parameters:

$P_{so} = 80\ kpa$, $P_r = 250\ kpa$, $I_r = 200$Kpa.ms, $I_s = 70$Kpa.ms

$^{t_A}/_{W^{1/3}} = 5^{ms}/_{kg^{1/3}}$ $^{t_o}/_{W^{1/3}} = 4^{ms}/_{kg^{1/3}}$

U = $0.45^{m}/_{ms}$,

$^{L_w}/_{W^{1/3}} = 0.9^{m}/_{kg^{1/3}}$

$L_w = 0.9 * 250^{1/3} = 5.6m$

$\frac{L_w}{L} = \frac{5,6}{12} = 0.47$

From figure (5) load factor $C_E = 0.275$

$P_{sore} = 0.275 * 80 = 22\ kpa$

When $P_{sore} = 22kpa$ the dynamic presser $q_o = 1.6kpa$from figure (4)

Drag coefficient is $C_D = -0.4$ from table (1).

$P_{sore} = 22 + -0.4 * 1.6 = 21.36kpa$

Scale distance & R

In fig. 6, to calculate blast load for three points on the front faced of the structure we have three values for R, it means three values for scale distance, and three points have different calculation.

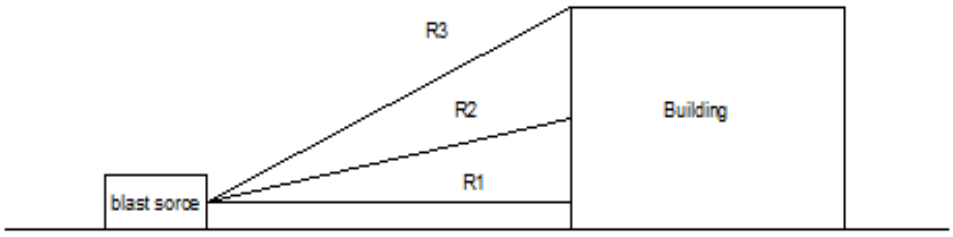

Fig. 7 - Distance of blast load

Conclusion

1. We calculated the blast load by using empirical method, although the empirical method is very simple method and gives results within a few minutes manually but the results of calculated loads by this method were prominent than the real load.

2. We determined the loads applied to the building on the base of the blast type and the blast conditions (distance of the blast source from the building, height of the blast source from the ground, type of the blast material and the mount of blast material).

3. Although empirical method provided the possibility to calculate the blast load in a few minutes and reasonable results, we need to develop specialized software programs to calculate the blast pressure and loads applied to structures using accurate mathematical model of such finite element method.

4. We expect the blast position and the amount of blast material effect on the structural design of blast and we think it will failure, so we must provide a system of protection around the building and provide a safe distance that it will be used in design.

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НЕДОСТАТКИ ЭМПИРИЧЕСКОГО МЕТОДА РАСЧЕТА БЛОКИРОВКИ

Алаа Джалиэль Наджи
Университет Аль-Кадисияха, Аль-Кадисия, Ирак
e-mail: alaa.alnsray@qu.edu.iq

Аннотация

В прошлом взрывы происходили преимущественно на военных или химических заводах в результате ошибок хранения или использования военных установок. Подобные ошибки имеют место и в настоящем, однако с ростом числа случаев терроризма во всем мире, у людей возрастает потребность в укреплении конструкций зданий, способных противостоять взрывам. Одна из важнейших проблем в этой области - это расчёт взрывной нагрузки на структуру здания. В статье рассмотрен эмпирический метод расчета взрывной нагрузки и создана процедура определения взрывной нагрузки для автомобильной перевозки четверть тонны динамита на расстояние 10 м и продемонстрирован недостаток данного метода. Эмпирический метод расчета взрывной нагрузки очень прост, все вычисления проводятся вручную, а результаты больше реальных нагрузок. Эмпирический метод может быть базовым для разработки программного обеспечения для расчета нагрузки взрыва для конструкций.

Ключевые слова: взрыв, эмпирический метод, нагрузка, динамит, удар, недостаток, волна.

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APPLICATION OF WOOD COMPOSITES IN CONSTRUCTION

A. V. Basalajev, A. V. Erofeev
Tambov State Technical University, Tambov, Russia
e-mail: 1artembasl@gmail.com

Abstract
The article briefly describes the use of popular wood composites in construction, depending on their properties, as well as the raw materials and manufacturing techniques used.
Key words: application area, chipboard, Medium Density Fiberboard, oriented strand board, properties of wood composites, Wood-fiber plates, wood-polymer composite.

Introduction

Each material has a whole complex of various properties that determine the area of its rational use. Knowing the operational conditions in which the construction structure will work, it is possible to establish what properties a material intended for the construction of this structure should have. The quality, durability and cost of structures depend greatly on the proper choice and application of the materials and technologies for erecting structures and their individual parts.

Wood composites

Wood composites are materials obtained as a result of combining wood raw materials and various types of binder component. The amount of wood waste, as well as the type of binder component, determines the main characteristics of the composite material.

Chipboards are a sheet material obtained by hot pressing wood chips and a non-mineral binder with the introduction of special additives, if necessary [1]. The material was created in the late 40-es of the twentieth century after the end of World War II, when there was not enough natural wood for furniture. Nowadays it is more widely used in the furniture industry, but there are also examples of the use of chipboard in construction - they make removable formwork and interior partitions, flooring under coverings, linoleum or carpet covering, walls and ceilings. Waterproof chipboard is used for finishing rooms with high humidity, in particular, kitchens and bathrooms. In addition, chipboards are indispensable in the external cladding of houses, often used for the construction of temporary fences.

Wood-fiber plates (Fibreboard). For the production of fiberboard waste wood processing and products of sawmill, chipping, are used [1]. Wood raw materials are processed into fiber in defibrators by steaming and grinding. As a binder, synthetic resins are added to the compressible mass. Their number depends on the ratio of coniferous and hardwood fibers and varies, as a rule, in the range of 4-7%. In the case of the production of soft boards, there is no need to introduce the binder, since wood fibers contain lignin, which has gluing properties at high

temperatures. To increase moisture resistance ceresin, paraffin or rosin is introduced in the mass. In addition, other special additives are used in the manufacture of slabs, in particular antiseptics. Depending on the properties, wood-fiber plates are divided into several types:

- Soft plates of fiberboard. The material is characterized by weak strength, high porosity and low thermal conductivity. In the production of soft boards, the binder might not be used because of the gluing of the lignin, which is a part of the fibers, at high temperatures. The thickness of the plate can be from 8 to 25 mm. The material density values are in the range from 150 to 350 kg / m^3. Depending on the density, the following grades of soft fiberboard - plates: M-1, M-2, M-3 are distinguished. Most often they are used as sound and heat insulation material in the construction of walls, floors, roofs, etc.
- Semi-solid fiberboard - plates (medium-density MDF). This type of board has strength and density values significantly higher than soft ones. The average density of semi-solid sheets of fiberboard is not less than 850 kg / m^3. The thickness of the fiberboard is 6-12 mm. In general, MDF is used in the production of furniture, because it has a homogeneous structure, absorbs sound well and is easily processed, it is used for the interior decoration, for example, in the form of wall panels, and laminate flooring. MDF is also used for the production of packaging.
- Solid fiberboard options. The density of solid plates is in the range of 800 to 1000 kg / m^3[1]. The dimensions of the carpet thickness are from 2.5 to 6 mm. It is used for leveling the surfaces and cladding of the frame partitions[2].
- Super hard plates. This material is characterized by high quality of execution, easy processing and installation. It has the increased density, the values of which are not less than 950 kg / m^3. The material acquires high hardness due to the impregnation of the fiberboard sheet with pectol. Pectol is a by-product from the processing of tall oil. Ultra-hard plates are used in the construction for the manufacture of doors, arches, partitions, various types of fiberboard packaging.

Plates from oriented wood chips (OSB-slabs) were developed in the 80s of the XX century. This material was developed in the era of mass construction of prefabricated frame houses. Today millions of citizens of Canada, the United States and Europe live in such houses. For a wooden frame, a light and durable covering was required, able to resist the effects of moisture and solar radiation. Traditional chipboard was not suitable. It is too heavy and can be damaged by moisture. Natural wood is suitable for exterior decoration, but its installation is not technological, as it takes a lot of time. The solution was found when instead of messy mixing of sawdust and shavings; the technology of oriented layer-by-layer covering of long chips was applied. The binding agent was glue based on formal dehyde resins.

Wood chips treated with an adhesive mixture are laid in the outer layers of the OSB in the longitudinal direction, and in the inner layer - in the transverse direction. After that, it is processed by the thermal press. Here the process of

polymerization (hardening) of the glue takes place and the plate turns into a solid wood conglomerate of minimum thickness and maximum strength. Since the chips are laid in mutually perpendicular directions, the deformation of the OSB plate under the effect of alternating soaking and drying is minimal. This fact is of paramount importance for the qualitative covering of framework walls and roofs.

The wood-polymer composite (WPC, wood-plastic, liquid wood) combines the practical properties of plastic and the properties of wood. These are materials where wood is mixed with monomers, which are then polymerized and mixed with wood during extrusion to obtain the required properties. Usually, this material is used to produce boards. Many characteristics of which are not inferior to either a conventional wooden boards or ceramic tiles.

Conclusion

A brief review of wood composites made it possible to establish that the properties of the material and the field of their application directly depend on the production technology.

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ПРИМЕНЕНИЕ ДРЕВЕСНЫХ КОМПОЗИТОВ В СТРОИТЕЛЬСТВЕ

А. В. Басалаев, А. В. Ерофеев
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: 1artembasl@gmail.com

Аннотация

Кратко описано применение популярных древесных композитов в строительстве в зависимости от их свойств, а также используемого сырья и технологии изготовления.

Ключевые слова: ДСП; ДВП; ДПК; МДФ; область применения; ОСБ; свойства древесных композитов.

УДК 697
ББК 38.42

ANALYSIS OF METHODS OF ENHANCING THE ENERGY EFFICIENCY OF RESIDENTIAL BUILDINGS

P. R. Bortnikova
Tambov State Technical University, Tambov, Russia
e-mail: polina.bortnikova@yandex.ru

Abstract
The article provides an overview of the main methods for increasing energy efficiency in new construction. The options for solving the problems of reducing the energy consumption of new facilities due to their rational use are presented. The ways of solving the problem of introduction of energy-efficient technologies in the construction of residential houses are suggested.
Key words: energy efficiency, energy saving, per-facade auto-regulation, resistance to heat transfer.

The problem of energy efficiency of residential buildings is very relevant today. Energy efficiency is a complex of organizational, economic and technological measures aimed at increasing the value of rational use of energy resources in the production, household and scientific and technical spheres. In Russia, the cost of heating the premises is an average of 72% of the total energy. With a steady increase in energy prices, which inevitably cause higher prices for utilities, the complex requirements for energy efficiency of buildings are becoming higher.

The main areas of energy conservation in new construction are:

- strengthening the thermal protection of buildings;
- increase in efficiency of automatic regulation of heat supply for heating,
- reduction of the heat consumption for heating the outside air, which is necessary for ventilation in the apartment,
- reduction of heat and water losses in hot water supply systems, bringing the sources of its preparation closer to the places of consumption.

According to the Department of Architecture of the Russian Federation, when calculating the heat loss of a residential house, it was established that: buildings lose 45% of their heat through walls, 33% through windows, and the remaining 25% through roofs.

In order to achieve a reduction in the specific heat consumption for heating and ventilation, it is possible to develop and implement measures for energy efficiency, one of which is the increase of the thermal protection of the outer enclosing structures of multi-apartment residential buildings to the reduced resistance to heat transfer from 1.01.2016:

- exterior walls - up to 4,0 $m^2 \cdot °C/W$;

- overlapping attic (in a cold attic) - up to 5,2 $m^2 \cdot °C/W$;

- co-coatings - up to 6,0 $m^2 \cdot °C/W$;

- windows, translucent part of balcony doors, stained-glass windows (except for staircase-elevator units) - up to 1,0 $m^2 \cdot °C/W$.

Increasing the resistance to heat transfer of non-translucent fences is achieved by choosing a more efficient insulant and applying technical solutions to increase the thermal engineering uniformity of the structure by reducing the influence of heat-conducting inclusions. To ensure the required normative indicators, the outer walls of residential buildings are built in multi-layer, consisting of a bearing and heat-insulating layers. The technology of external wall insulation provides maximum protection of the structure against heat losses through walls, due to the fact that it takes on the cold influence of the environment.

A significant part of the heat loss through the building envelope (more than 33%) occurs through unsealed windows and doors. In connection with this circumstance, it is necessary to increase the heat-insulating qualities of windows.

At present, the following basic methods for improving the energy efficiency of translucent structures are applied in Russia:

- application of a thermal film (heat-absorbing glazing);

- transition from one- and two-chamber double-glazed windows to three and more chamber;

- filling of insulating glass with inert gases.

The heat transmission capacity of the glazing depends on the angle of incidence of the sun's rays and the thickness of the glass.

Reduction of heat loss through windows is achieved by the following methods: glass is covered with metal or polymer films with one-way transmission of short- and long-wave radiation. As a result, in winter sunlight passes into the room, and the heat from the room does not go away, in the summer the reverse effect occurs. The coefficient of heat transmission of such glasses is 0.2 ÷ 0.6. The use of windows with heat-reflecting glasses can reduce heat loss through them to 40%.

To obtain additional heat savings in buildings with an individual heating point, whose heating systems are oriented to the sides of the world, a per-fader automatic control is applied. The signal of the per-facade auto-adjustment is the temperature of the internal air of the heated rooms.

Perframed auto-regulation allows reducing the heat consumption due to the use of solar radiation, and also provides additional supply of heat in the wind only in the premises located on the windward facade of the building. For buildings above 9 floors in a number of cases, along with per-facade regulation, it is necessary to apply vertical zonal regulation. The savings in thermal energy for facade regulation are up to 20% of its estimated annual consumption.

The task of an energy efficient ventilation system is to ensure the thermal comfort of living in conditions of increased hermeticity of buildings, as well as to reduce the cost of heat for heating infiltrating air. In most residential buildings, a

ventilation system with natural air circulation is provided, the operation of which is carried out by the natural draft resulting from the difference in pressures and temperatures. In winter, when the ventilation system is operating, the temperature inside the building is lowered, and the costs for heating the housing are significantly increased. With ventilation air from the room takes away from 30 to 75% of the heat, which is a lack of natural ventilation and does not meet modern energy conservation requirements.

The heat consumption for heating the air and the intensity of air exchange should have the optimum ratios. By standards, the air entering the building must be replaced with fresh air in the volume of 30 m3 / h and have a temperature of at least 18 ° C. The economical version of the air exchange device in the premises is the supply and exhaust ventilation system with air recuperation. The principle of operation of the supply and exhaust system with heat recovery is as follows. Heated air is taken by means of air intakes in the rooms, passes through the heat exchanger of the recuperator, where it retains some of the heat. Ventilation heat recuperators return part of it back to the room by heat exchange between the incoming and outgoing stream. The system with recuperation is most effective with a significant temperature difference between the outside and inside the room. In regions with a long cold season, additional costs for the heat exchanger quickly pay off. Despite the rather high cost of such a technological solution, the complexity of calculation and installation, the cost of energy for heating the air is reduced to 80%.

To date, the situation is that energy-efficient solutions, which are incorporated in the design, during the erection of a building, most often, are not realized. This is due to the fact that the customer has no incentive to invest in energy-efficient technologies. The main factor hampering the introduction of energy efficient technologies in construction is the increased cost of an energy efficient house. To solve this issue, it is necessary to build energy-efficient houses within the framework of the federal program, with partial financing of innovative technologies by the state. Thus, it can be concluded that for the wide introduction of energy-efficient technologies, a legislative base and real government programs are needed that would stimulate energy-efficient construction in our country.

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АНАЛИЗ СПОСОБОВ УВЕЛИЧЕНИЯ ЭНЕРГОЭФФЕКТИВНОСТИ ЖИЛЫХ ЗДАНИЙ

П.Р.Бортникова
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: polina.bortnikova@yandex.ru

Аннотация

Статья содержит обзор основных методов для повышения эффективности использования энергии в новом строительстве. Представлены варианты для решения проблем сокращения потребления энергии новых объектов за счет их оптимального использования. Предложены пути решения проблемы введения энергосберегающих технологий в строительстве жилых домов.

Ключевые слова: энергоэффективность, энергосбережение, пофасадное авторегулирование , сопротивление теплопередаче.

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ББК 37.712

THE MAIN PROPERTIES OF IMPACT-RESISTANT POLYSTYRENE

V.V Ermakov, A.I. Chekanov
Tambov State Technical University, Tambov, Russia
e-mail: vladvilla7@mail.ru

Abstract
The paper considers impact-resistant polystyrene, its properties, characteristics, production technology.

Key words: discrete phase, shockproof polystyrene, thermoplastic polymer, thermal stability, thermoplastic polymer, vacuum forming

Introduction

Polystyrene is a product of the polymerization of styrene, vinylbenzene and is a thermoplastic polymer with the chemical formula shown in Figure 1 [1]. Because of its high strength, moisture resistance, low weight and decorativeness, it is widely used as pillars, signs and signs, information stands, promo stands, shelftokers, wobblers, posters, mobiles, as well as in the construction of sheds, awnings and greenhouses how.

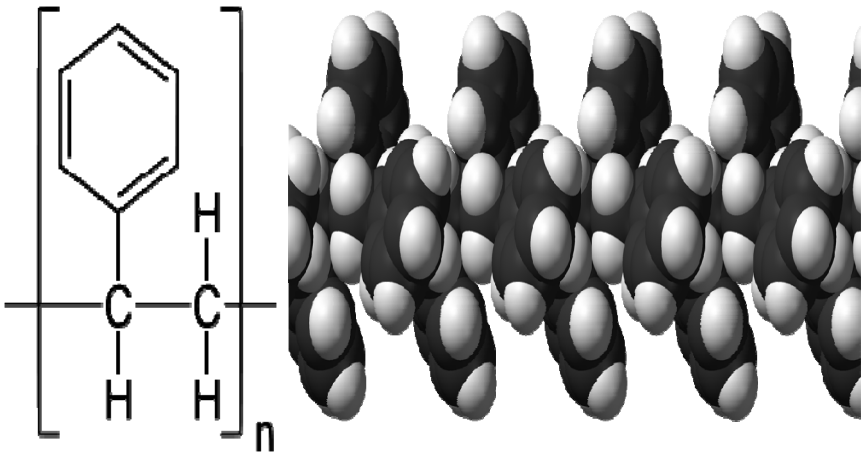

Fig. 1 - Chemical formula of impact-resistant polystyrene

Properties of impact-resistant polystyrene

Impact-resistant polystyrene is manufactured in accordance with GOST 28250-89 (01.01.1991) "Impact-resistant polystyrene" and, depending on the purpose, it is has in different grades, divided into three groups by according to the value of the impact strength index: top-impact polystyrene, polystyrene high impact resistance and polystyrene of average impact strength [2]

For the manufacture of large-size products and consumer goods of complex configuration, including those used for the needs of the construction industry, the most widely used is polystyrene of the grade UCS-1002, which has higher thermal

stability. However, it is worth noting that polystyrene of the grade UMP is also applied. The main reference characteristics of impact-resistant polystyrene are given in Table 1.

Table 1 Reference properties of impact-resistant polystyrene [2]

Name of indicator	Standard values for a grade		Test method
	UPM	UPS	
1. Density, g / cm3	1,04 - 1,06	1,04 - 1,06	GOST 15139
2.Ultimate strength during static bending, MPa	35 - 50	45 - 55	GOST4648
3. Modulus of elasticity during static bending, GPa, not less than	2,0	2,5	GOST 9550
4. Impact strength on samples with a notch, kJ / m2 (kgf • cm / cm2)			GOST 4647
at the temperature:-20 ° C	Decrease in the initial value by 30% - 40%		
at the temperature:-40 ° C	The same by 50%		
during storage, which is equal to the influence of solar radiation, for 3 years	The same by 30%		
5. Vicat softening temperature in liquid medium (P = 5 kgf), ° C, not less than	85 - 88	88 - 90	GOST 15088
6. Moisture absorption for 24 h at 20 ° C,%, not more than	0,05	0,05	GOST 4650
7. Molding shrinkage,%	0,4 - 0,7	0,4 - 0,7	GOST 18616
8. Rockwell hardness	HRR105	PRR115	GOCT 24622
9. Temperature of thermal deformation under the load of 1.85 MPa (18.5 kgf / cm2), ° C	75 - 80	75 - 80	GOST 12021
10. Specific electrical resistance, Ohm • m	$1 \cdot 10^{14}$	$1 \cdot 10^{14}$	GOST 6433.2
11. Dielectric loss angle tangent with the frequency of 106 Hz	$(3 - 7) \cdot 10^{-4}$	$(4 - 8) \cdot 10^{-14}$	GOST 22372
12. Dielectric loss angle tangent with the frequency of 106 Hz	2,6 - 2,7	2,6 - 2,7	GOST 22372
13. Breaking strength, MPa (kgf / cm2)	19,6 - 24,5 (200 - 250)	21,6 - 24,5 (220 - 250)	ГОСТ 11262

The continuous phase (matrix) is formed by polystyrene. Discrete phase (microgel) – are oval-shaped rubber particles with dimensions of 2-5 μm. The

rubber particles are surrounded by a thin film of the grafted styrene copolymer on the rubber, and the particles also contain occluded polystyrene, thereby increasing the effective volume of the rubber phase. The properties of impact-resistant polystyrene largely depend on the volume of the latter. Shock-resistant polystyrene is produced as a stabilized substance, in the form of white granules. The main processing methods are injection molding and sheet extrusion followed by pneumatic or vacuum molding [3, 4].

Conclusion

The study of the properties of polymers, including polystyrene, will help to select adequately the field of their application, which in turn will improve their service life.

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ОСНОВНЫЕ СВОЙСТВА УДАРОПРОЧНОГО ПОЛИСТИРОЛА

В.В Ермаков, Чеканов А.И
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: vladvilla7@mail.ru

Аннотация

В данной статье ставится задача рассмотреть ударопрочный полистирол, его свойства, характеристики, технологию производства

Ключевые слова: вакуумформование, дискретная фаза, термопластичный полимер, термостабильность, термопластичный полимер, ударопрочный полистирол

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ENVIRONMENTAL ASPECTS OF PRODUCTION AND APPLICATION OF THE EXTRUDED POLYSTYRENE FOAM (XPS)

S.S. Gnipyuk, A.A. Mamontov, V.P. Yartsev
Tambov State Technical University, Tambov, Russia
e-mail: legion68rus@yandex.ru

Abstract
The use of XPS insulation panels contributes to reducing environmental stress of the construction. The reduction of materials consumption of products by optimizing of their density will enhance this effect.

Key words: apparent density (volume weight), extruded polystyrene foam, rigidity, strength, thermal conductivity, thermal expansion, water absorption.

Introduction

Nowadays the building industry is under threat due to the ecological control of the specialized institutions and centres. Poor energy efficiency of the existing buildings as well as considerable consumption of energy resources cause many economic and environmental problems.

One of the main ways of the making construction ecofriendly greening is the use of materials and technologies which prevent unproductive losses of heat through the structures of buildings. The priority has been given to specially designed complex façade and roofing systems, a critical component of which is a highly efficient heater.

Environmental aspects of production and application of the PENOPLEX

A favourable combination of mechanical and thermophysical properties, weather and biopersistence, durability and environmental sustainability, and also easiness in technological processing and installation contribute to a wide use of XPS insulation panels PENOPLEX®.[1,2]

The development of the XPS panel production technology is impossible without improving an environmental component. The ozone damage problems have resulted in the need to replace the early used foamed concrete halocarbon mixtures with the cheap inert gases (nitrogen and carbon dioxide), paraffin hydrocarbons (butane, pentan, isopentane) and alcohols [3].

It is possible to reduce the negative impact of production on the environment through the reduction in material consumption of the products made of foamed polystyrene. This is becoming particularly relevant today in the context of the current rise of petroleum products price.

Since the specific feature of foamed plastic is the dependence of the physical and mechanical properties on packed density [4], this indicator may be a criterion for the optimization of the expenditure of polymeric materials.

From a scientific and practical point of view it happens to be an interesting challenge to determine the density according to which XPS panels as heat-insulating materials will differ from each other to the maximum mechanical behaviour and the minimum heat conductivity.

It is claimed [4] that there is a correlation between the weight and size of the panel cells that is not an exception for XPS foam PENOPLEX®. It is confirmed by the data obtained through photographs of the surface of the samples made by the optics microscope with the density of 29.1 and 44.9 kg/m^3 (fig. 1).

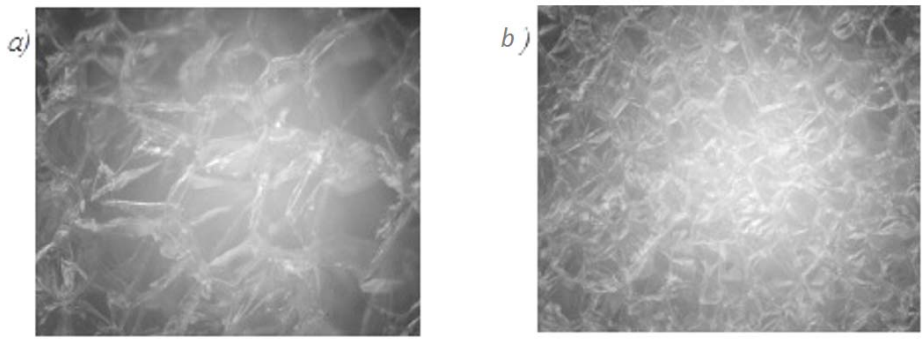

Fig. 1- The micrograph of the sample surface of XPS foam with the density 29.1 (a) and 44.9 kg/m^3 (б)

Fig. 1 shows the increase of, the XPS foam density and the decrease of the size of the cells. This definitely affects the properties of the material.

After the dependency between physical properties of the studied foam on the volume weight had been determined, the testing was carried out on water absorption and heat conductivity of the series of samples with the various density values [5].

Water absorption was determined through putting the samples into the water at the room temperature for 24 hours. The average value of the volume water absorption for each series was accepted as the final result (fig. 2, *a*).

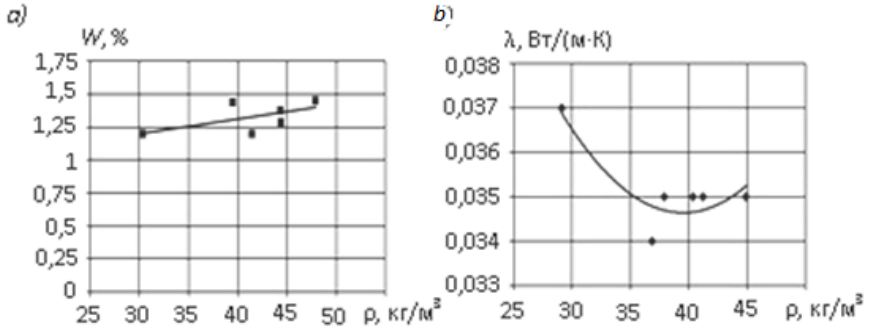

Fig. 2 - The relationship between the value of the volume water absorption (a) and heat conductivity coefficient (b) of XPS foam PENOPLEX® on the volume weight [5]

Fig. 2 *a* shows that water absorption of the XPS foam PENOPLEX®almostdoesn't depend upon the average density within the range under study. With its increase from 30 to 50 kg/m^3 the water absorption changes to 0,25%.

The volume weight effect on the thermal properties of polystyrene foam has been measured by the heat conductivity coefficient, which is determined by the Thermal Conductivity Tester "ITP MG-4 100" for samples with the known density (fig. 2, *b*) [5].

One can see that the heat conductivity coefficient decreases as the density increases to 38kg/ m^3. The coefficient is constant in the range of 38…45 kg/ m^3, so there is no need to change the indicated value. Such behaviour of the material can be explained by characteristics of heat transferring in foams that happens at the expense of thermal conductivity of the plastic films, thermal conductivity and convection of the gaseous phase, radiation between the cell walls. Due to the increased density, the reduction of the cell size reduces the proportion of heat exchange resulting in the thermal conductivity reduction. But according to figures [6,7], the foam has such a value of volume weight, when thermal conductivity coefficient is large. Probably an increase in the density of the XPS foam above 45 kg/ m^3 will lead to the deterioration of heat insulation properties.

The paper [5] deals with the influence of the volume weight of the XPS foam PENOPLEX® properties on its mechanical properties, based on the results of short-term tests at bending, compressing and penetrating.

The affection of density on bending strength was measured by the change in the tensile strength (R_{art}), which is taken through test series of the samples with the known volume weight (fig. 3, *a*).

Fig. 3 *a* shows that the increase in the density of the PENOPLEX® foam results in its bending strength increase. This is related to the growth in the proportion of the polymer basis in the whole foam volume [7]. Fibres and films of the polymer comprising the polystyrene foam are becoming thicker and it takes more effort to break them. Maximum values of tensile strength are found among the samples with the volume weight which is approximate to 40 kg/ m^3. There is almost no change in material strength as its density increases further.

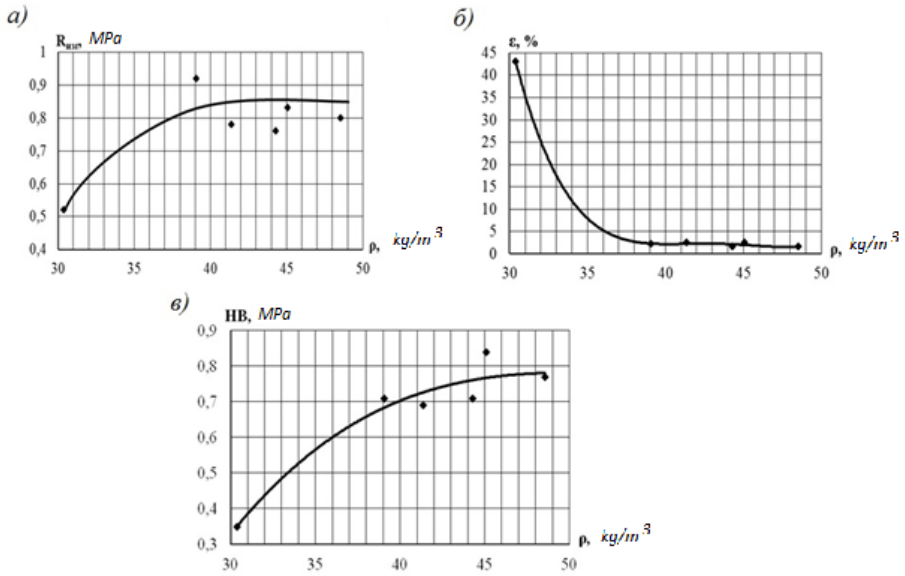

Fig. 3 - The impact of apparent density of XPS foam on bending strength (a), relevant compression deformation value (b) and rigidity (c) [5]

The described [5] impact of the volume weight of XPS foam on its deformation properties has been studied by means of the single-axis compression of the samples of different density (ε, %) in a constant voltage within a specified time period. The graphical interpretation of the research results is presented in Fig. 3, *b*.

It is shown that the increase of foam density is accompanied by the reduction of, it`s compressibility. The relative compression deformation of the samples with the volume weight of around 40kg/ m^3 was about 2% that is 20 times less than with the samples of 30kg / m^3. The reason of it is the increase in the volume fraction of polymers that in turn reduces the amount of cavities in the foam, cell fibres and films are getting more sustainable [7]. The further growth of the density does not almost change the deformation behaviour of materials.

The samples of PENOPLEX® with the different volume weight at penetration have the strength that has been measured by the local tension quantities while pressing a steel ball with diameter of 10mm during the specified time under the continuous load [5]. The relation between the strength of XPS foam and the apparent density (ρ) is illustrated in fig. 3.

It is evident that with the increase of the foam density local tension quantities also grow, just like its surface hardness. The samples with the volume weight of about 45kg/ m^3 have the highest value of the indicator that is also connected to the increased substance of the polymer basis.

Conslusion

Thus, the research has shown that with the increase of the density of XPS foam PENOPLEX® its strength and durability also increases heat conductivity changes according to the parabolic law. The analysis of the results allows determining the apparent density value that is about 40kg/ m^3, which corresponds to the optimum proportion of mechanical and thermal properties of the insulation. The production of panels with such density will promote the reasonable use of energy and material resources, which will reduce the environmental problems.

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ЭКОЛОГИЧЕСКИЕ АСПЕКТЫ ПРОИЗВОДСТВА И ПРИМЕНЕНИЯ ЭКСТРУДИРОВАННОЙ ПОЛИСТИРЕННОЙ ПЕНЫ (XPS)

С.С. Гнипьюк, А.А. Мамонтов, В.П. Ярцев
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: legion68rus@yandex.ru

Аннотация
Использование изоляционных панелей XPS способствует снижению экологического стресса конструкции. Снижение потребления материалов продуктами путем оптимизации их плотности повысит этот эффект.

Ключевые слова: кажущаяся плотность (объемная масса), экструдированный пенополистирол, жесткость, прочность, теплопроводность, тепловое расширение, водопоглощение.

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COMPARATIVE ANALYSIS OF THE APPLICATION EFFICIENCY OF HEAT-INSULTING MATERIALS IN FRAME HOUSE BUILDING

Zh.S. Karakhanyan, A.A. Mamontov, V.P. Yartsev
Tambov State Technical University, Tambov, Russia
e-mail: zhorikarm@mail.ru

Abstract

The article concerns the issue of choice heat-insulating materials for enclosing structures of frame houses. The findings of laboratory studies of mineral wool boards, non-pressed expanded polystyrene boards and extruded polystyrene foam boards are outlined in the article. The temperature-humidity condition of insulations during the heating period and stability of its thermophysical properties are investigated through in-place tests. A comparison is made between technical and economic application of mineral wool board P-75, non-pressed expanded polystyrene boards PSB-S15 and extruded polystyrene foam boards PENOPLEX®. It is shown that extruded polystyrene foam PENOPLEX® has a high reliability and maximum economic efficiency.

Key words: mineral wool boards, non-pressed expanded polystyrene, extruded polystyrene foam, frame construction, the effectiveness of heat insulation.

In recent times, energy-efficient houses built in accordance with the timber-frame construction are becoming more widespread. This is facilitated by short construction period, relative simplicity and cheapness of construction and installation work due to the high grade of manufacture of mountable structures. Maintainability of fences significantly increases the service life of such type of houses. The walls made by using frame technology are characterized by high heat insulation properties, have a smaller thickness in comparison with the traditional enclosing structures that increases the useful area of the premises with the same construction footprint.

In connection with the fact that heat insulating elements from mineral wool, non-pressed expanded polystyrene and extruded polystyrene have found most practical use in domestic practice of frame construction, there is a problem of an economically viable choice of heat insulation that provides the greatest thermal efficiency and operational dependability of enclosing structures.

Making the right decision is possible only in the case of detailed analysis of both the materials and applied structural concepts taking into account operational features of fences and processes taking place in it.

The study includes a comparative analysis of operating abilities of mineral wool boards, non-pressed expanded polystyrene and extruded polystyrene foam, providing a preliminary selection of the most suitable insulation for frame houses.

Based on the available data, the authors have shown that the mineral wool boards have significant shortcomings despite its simplicity of production,

incombustibility, good heat-insulating and sound-proofing properties, a small hydroscopy and possibility of insulation of surfaces with high temperatures. The low tensile strength of mineral wool boards requires further measures to protect against mechanical influences. The boards are compacted under load, part of fibers breaks and turns into dust, which makes the material environmentally unsafe.

The data presented in the article [1] shows a good functional performance of extruded polystyrene boards. This type of heat insulating material has a beneficial combination of a small volumetric weight with low conductivity and quite high strength properties. The plates are distinguished by stability of heat-insulating properties in conditions of non vapor proof barrier and waterproofing, with cyclic temperature-humidity influences; high chemical resistance and environmental compatibility. The fire resistance of the plates increases at the production stage by introducing additives that suppress self-combustion, which is possible only with direct contact with fire. It is worth noting the simplicity of technological processing and installation of this heat insulation material.

However the nature of polymer and the peculiarity of construction of non-pressed extruded polystyrene affect its reliability. The relatively low strength of pellet sintering leads to a gradual degradation of the foam on the intergranular surfaces in the case of mechanical and atmospheric influences. It is necessary to comply with the temperature range of operation within -50 ... + 75 ° C, protect from the effect of solvents and ultraviolet.

The authors of the article [1] note the increased mechanical and thermophysical properties of the extruded polystyrene PENOPLEX®. The material is characterized by minimal vapor permeability and very low water absorption, which is 10 times smaller than that of extruded polystyrene and 200 times less than that of mineral wool boards. Extruded polystyrene foam PENOPLEX® through its uniform closed-cell structure is characterized by high resistance to negative temperatures and humidity, maintaining the thermal conductivity and strength at the stated level. In addition to that, during use of this material, it is necessary to take into account its working temperature range (from -50 to + 75 ° C) and susceptibility to solvents, the possibility of destruction of the surface layer with prolonged exposure to intense sunlight.

The comparative analysis of the operating abilities of heat insulation materials [1] showed that the most suitable materials for frame houses insulation are extruded polystyrene boards PENOPLEX®, which have high physical and technical characteristics. Non-pressed expanded polystyrene boards by a combination of mechanical and thermophysical properties are slightly inferior. At the same time, both materials are resistant to atmospheric influences in contrast to the mineral wool insulation. This fact positively affects the life of the enclosing structures.

The effectiveness of a heat insulation material in enclosing structures should be determined not only on the basis of the results of laboratory studies of physical

and technical characteristics, but also taking into account the actual operating conditions.

Fig. 1 - Experimental frame house

To this end, the in-place tests of the model frame house built in Tambov in 2013 (Figure 1) were done during the heating period. The house is heated by an oil cooler with a thermostat through electricity, the consumption of which was accounted for by a meter.

The building envelope of a house is a panel consisting of a wooden frame, internal plastering from gypsum plaster sheets, a vapor seal covering, heat insulation and external cladding made of decorative cement-chipboards. Extruded polystyrene boards PENOPLEX 35, expanded polystyrene boards PSB-C M15, mineral wool boards P-75 with external hydro-windproof covering and without it were used as heat-insulating materials. The required thickness of heat insulations was determined by heat-technical calculation and amounted to 100 mm for polystyrene and 150 mm for mineral wool plates. The mineral wool plates were installed in the panel in three layers 50 mm thick each with overlapping of the seams, and in panels with expanded polystyrene there was an air gap of 50 mm between the heater and the external skin.

The temperature and humidity conditions of both the heat insulations and the premises were investigated during the tests.

Determination of the temperature and air humidity inside the room was carried out through a Psychrometric hygrometer WIT-2. The relative air humidity outside the building was set according to the reports of the Hydrometeorological Center of Russia, and the temperature was measured by a street thermometer with an accuracy of 1 ° C, fixed on the wall from the shadow side of the building. The received data were recorded daily in the log of observations.

The temperature of the heat insulation was measured using a digital multimeter Mastech M838 and open type chrome-alumel thermocouples installed in the material according to a certain scheme. Two thermocouples were placed at each point: one at a distance of 1 cm from the inner one and the other from the outer boundary of the thermal insulation layer. The readings were taken daily at the same time, and recorded in the observation log.

The humidity of heat insulations was determined once a week on samples selected in accordance with recommendations [2], from the middle part of each wall at a height of 1.5 m from the floor level.

Based on the results of in-place tests, the authors conduct an analysis [3] of the moisture conditions of operation of these heat insulations. It is noted that the moisture content in the heat-insulating material is affected not only by its structure, but also by the structural concept of fences.

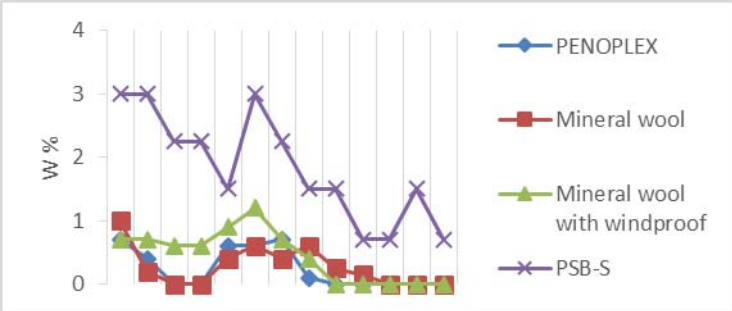

Fig. 2 - Change in humidity W of the thermal insulation materials of the frame house during the heating period T [3]

From Fig. 2 it can be seen, that the presence of a hydro-windproof covering in walls insulated with mineral wool plates without an air gap contributes to the accumulation of moisture, and hence to a decrease in its thermal and technical efficiency. At the same time, the greatest value of humidity was observed at the first layer of plates from the side of the room. The moisture content of expanded polystyrene PSB-C M15, which macrostructure is characterized by a high content of intergranular voids, had the maximum value from the materials under consideration.

Extruded polystyrene PENOPLEX® with a homogeneous closed fine-meshed structure is characterized by the least accumulation of moisture, which certainly increases the efficiency of its use in frame construction.

It is known that heat insulation properties of insulants are characterized by the temperature difference on its surfaces. The results of temperature measurements are presented in [5].

Table 1 - The average temperatures over ten days of the heating season on the inner and outer surfaces of heat-insulating layers.

Fencing type and heat insulation material	Temperature near the inner face °C	Temperature near the outer surface °C	Temperature difference °C	Relative temperature differential ° C / cm
The wall, mineral wool boards with hydro-windproof covering	21,61	8,36	13,25	0,,88
The wall, PENOPLEX®				

boards	22,20	12,,26	9,94	0,99
The wall, mineral wool boards with hydro-windproof covering	22,29	10,21	12,08	0,81
The ceiling, mineral wool boards	23,25	9,52	13,73	0,92
The floor, PENOPLEX® boards	18,93	10,60	8,33	0,83

The energy efficiency calculation of enclosing structures with various heat insulations showed that, heat insulation from extruded polystyrene foam reduces the financial costs of heating at 15% per year as opposed to mineral wool board P-75 and non-pressed expanded polystyrene PSB-C M15.

The paper is dedicated to cost-effectiveness analysis of the use of heat insulating boards from mineral wool P-75, non-pressed expanded PSB-C m15 and extruded polystyrene foam PENOPLEX®. Technical and economic comparison of heat insulations was made taking into account the cost of materials, their durability and energy efficiency, the cost of insulation and repair of fences. As an example, the calculation is done for a heated frame house with a total area of 100 m2, with an area of enclosing structures (walls, basement and attic floor) of 300 m2 and a standard service life of 75 years. Graphical interpretation of the results is shown in Figure 3.

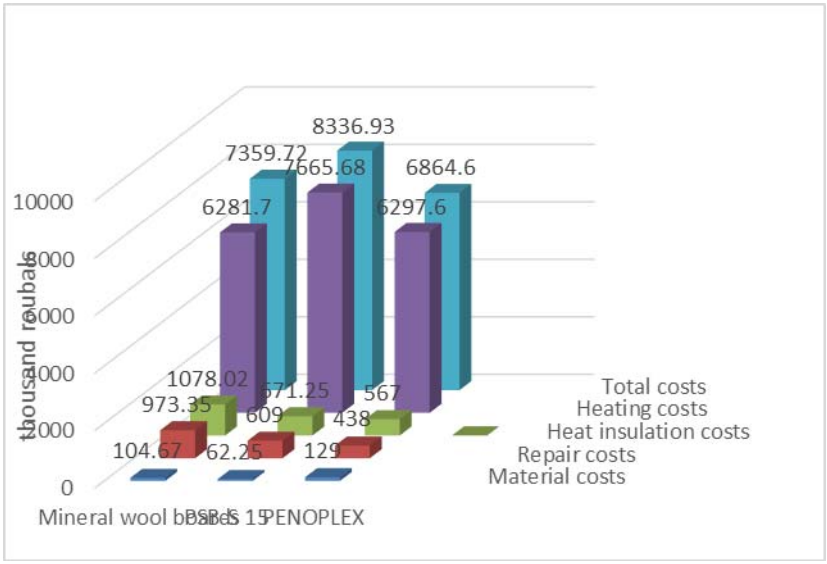

Fig. 3 - Technical and economic comparison of the insulations of the frame house with different heat insulation materials.

It can be seen from the diagram that, the insulation of the frame house with extruded polystyrene foam PENOPLEX® has the greatest economic effect despite its prevailing cost. This is due to the high energy efficiency and the maximum durability of the materials, which makes it possible to reduce the number of forced repairs. Non-pressing expanded polystyrene PSB-S M15 has the lowest direct costs

at the stage of installation, but characterized by minimal energy efficiency and much less durability.

The necessary condition for cost-effectiveness of heat insulations is to provide the required resistance to the heat transfer of the enclosing structures over a long period of their operation.

In order to study the stability of the heat insulation properties of the materials under consideration over time, the values of the coefficient of thermal conductivity were determined using the ITP-MG 4-100 meter, according to the procedure described in the manual for the instrument, on samples taken from the enclosing frame structures. The test results are shown in Table 2.

Table 2 - The values of thermal conductivity coefficients of heat-insulating materials, determined at different stages of operation of the frame house.

Material	The values of the coefficient of thermal conductivity, W / (m · ° C)		
	Initial (2013)	After 1 year of operation (2014)	After 3 years of operation (2016)
Mineral wool boards with hydro-windproof covering	0,036	0,037	0,037
Mineral wool boards with hydro-windproof covering	0,036	0,037	0,036
Boards PSB-S M15	0,042	0,052	0,054
Boards PENOPLEX®	0,033	0,034	0,034

The findings show the stability of thermophysical characteristics of the foamed polystyrene boards PENOPLEX®.

Thus, the results of laboratory and long time in-place tests of widely held heat-insulating materials presented in this article lead to the conclusion that, extruded polystyrene foam boards PENOPLEX® are the most effective in the frame house building industry.

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СРАВНИТЕЛЬНЫЙ АНАЛИЗ ЭФФЕКТИВНОСТИ ПРИМЕНЕНИЯ УТЕПЛИТЕЛЕЙ В КАРКАСНОМ ДОМОСТРОЕНИИ

Ж.С. Караханян, А.А. Мамонтов, В.П. Ярцев
Тамбовский государственный технический университет, Тамбов, Россия
e-mail:zhorikarm@mail.ru

Аннотация

В статье затрагивается проблема выбора теплоизоляционного материала для ограждающих конструкций каркасных домов. Представлены результаты лабораторных исследований минераловатных плит, плит беспрессового и экструзионного пенополистирола. Посредством натурных испытаний экспериментального каркасного дома исследовано температурно-влажностное состояние утеплителей в течение отопительного периода, а также стабильность их теплофизических показателей. Выполнено технико-экономическое сравнение применения минераловатных плит П-75, плит беспрессового пенополистирола ПСБ-С15 и экструзионного пенополистирола ПЕНОПЛЭКС®. Показано, что экструзионный пенополистирол ПЕНОПЛЭКС® отличается высокой эксплуатационной надежностью и максимальной экономической эффективностью.

Ключевые слова: минераловатные плиты, беспрессовый пенополистирол, экструзионный пенополистирол, каркасное строительство, эффективность утепления.

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DEFINITION OF HISTORICAL BUILDINGS AGE BY BRICKS AND CONSTRUCTIVE PECULIARITY

G. V. Kartashova
Tambov State Technical University, Tambov, Russia
e-mail: glkart95@mail.ru

Abstract
There are many old buildings in Tambov. These buildings are historical, cultural and architectural monuments. Buildings, which should be registrated, have been revealed. Monuments have to be inspected for their safety. The age is an important evaluation index of monuments.
Key words: brick, historical buildings, masonry type, solution.

The information about important historical and cultural buildings gives supplementary information about town live. Information about the construction period contains data about design features of bearing structures of the building, typical for this period, without detailed inspection of building. This allows making expedite evaluation constructive peculiarity of building, which needs for composite passport of building.

Knowledge of the period of construction of the building and its elements provides an opprotunity to forecast the residual period of bearing elements and work out actions to save the monuments. This causes the need to work out ways of evaluating the buildings' age. The majority of old buildings in Tambov and the Tambov region have walls made of bricks. Information about the construction materials can be used for quick evaluation of the building's age. These indicators include characteristics of bricks and brick's solution, treatment method of masonry scams, and type of brick laying.

Tambov's historical brick buildings were built in the period from the 19th century to 1917 year. Two kinds of bricks were used - handmade and machine-made.

Handmade bricks were produced using wooden forms. The bricks came out with different size, uneven surface and rounded edges. There are few objects made of handmade bricks in Tambov, for example the building of Russians bank (Octyabr'skaya Street). More late buildings made were of machine bricks. This bricks have more even surface and keen edges.

Also the structure after kilning can give the information about bricks age. In that period in Tambov kilning was made in floor and rounded furnace. Floor furnaces were fundamental in Tambov brick factories until 70s years of XIX century. Further until 1917 year kilning was made in rounded furnace more often. The difference between the "kinds" depending on kilning temperature regime is also the indicator of floor kilning. Bricks were divided to five kinds: "iron", "half-

hearted", "red", "scarlet" and "white" (raw) [1]. In practice the raw product was discarded. Bricks had three kinds: iron, red and scarlet. Kinds of bricks were defined to sound and look of fracture. Quantity of brick correlation in one thousand was nearly 1/3. So, this correlation in evaluation of buildings age can be only indirect indicator. Using scarlet bricks was prohibited in main important building. Iron was used basically in making basements walls and foundations. Bricks grading was observed in urban building only. This rule was violated very often in villages.

Brick size may be the indirect indicator of constructions period. In handmade period (after 1820 year) in Tambov's region brick size was 260 (±20-30) × 133 (±10-20) × 66 (± 3-5) mm. Later, its size was (262-265)×(125-128)×(67-70) mm. So, big size's differences don't allow this indicator consider as basic. But the size differences of bricks can say about early period of building.

Appearance of treatment masonry seam is often using in periods masonry. This indicator is important for big cities, for example St. Petersburg and Moscow [2, 3]. This indicator is not important in towns, for example in Tambov. Appearance of treatment masonry is changed after 50-200 years. For example, in Tambov buildings with well-known age's appearance of treatment masonry pruning can't be defined. This joint processing was found in research of small protected wall section.

The composition of treatment masonry is more reliable indicator. In the first half of 20th century up to the 1970s years the limes treatment was used. In this composition "tsemyanka" – pounded bricks crumb or slag or charcoal's dust was often added. The presence of "tsemyanka" in solution is noticeably in to bricks crumbs blotches. In the end of XIX century and beginning XX century the compound solutions were used. It was lime-cement solution with using coarse sand. Compound solutions have heavy gray color and big strength.

Type of dressing bricks joints is important indicator. In historical buildings in Tambov it was used in Old Russian (gothic), Crest Chain, pinched, Dutch, and English types of masonry [3, 4]. Gothic masonry discovered in buildings of 80s years of XIX century, for example in building monument 'guest yard' (1837 year). In last XIX century in Tambov the pinched masonry was used. In the first half of XX century single row masonry was popular.

Generally, every indicator can't be exact the indicator of building age. The complex simultaneous evaluation can give more reliable evaluation. Region's peculiarity must be registrated. Other facts should be used.

So, currently there is a need in new technique of evaluation of historical buildings in Tambov.

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ОПРЕДЕЛЕНИЕ ВОЗРАСТА ИСТОРИЧЕСКИХ ЗДАНИЙ ПО КИРПИЧНОЙ КЛАДКЕ И КОНСТРУКТИВНЫМ ОСОБЕННОСТЯМ

Г.В. Карташова
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: glkart95@mail.ru

Аннотация

В провинциальных городах, в том числе и в Тамбове, имеется большое количество исторических зданий. Эти здания являются памятниками истории, культуры и архитектуры. Кроме них имеются также вновь выявляемые здания, которые необходимо вносить в реестр памятников.

Для сохранения зданий-памятников в надлежащем состоянии необходимо производить их обследования. Таким важным оценочным показателем зданий-памятников является их возраст. В статье рассмотрена необходимость этого.

Ключевые слова: исторические здания, кирпич, раствор, тип кладки.

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SYSTEM OF ENGINEERING DESIGNS MONITORING (SEDM)

M.V. Kachnov, A. S. Gorbachev
Tambov State Technical University, Tambov, Russia
e-mail: kmv_68@list.ru

Abstract
The control method and preventions of a building collapse under the influence of natural and technogenic loadings with use of system of engineering designs monitoring (SEDM) is considered.
Key words: load-bearing frames, monitoring, natural and technogenic loadings, safety.

Introduction

The sudden collapses of structural objects which happened in our country and abroad (for example, domes "Transvaal park" in, Moscow in 2004, sections of the airport in Paris in 2005 of a pool roof in Perm in 2006, roofs of skating rinks in Germany and Austria in 2006, etc.) put monitoring of technical condition of load-bearing frames of the operated buildings and constructions on one of the first places in the system of their complex safety.

High-rise and unique buildings fall into categories of those city facilities the critical conditions of which can cause unpredictable catastrophic consequences. Therefore, the complex security system for each of such building has to be realized. One of the most important elements of this system are measures for the prevention of a building collapse under the influence of natural and technogenic loadings, especially such as wind load capacities and the production dynamics of ground conditions change under an object.

System of engineering designs monitoring

The system of engineering designs monitoring (SEDM) which controls indexes of reliability of the building (construction) for the purpose of well-timed prevention of situations wen values of the recorded parameters will exceed their marginal sizes is designed to solve this problem. The basis for the development of SEDM is GOST R 22.1.12-2005 according to which, SEDM are subject to obligatory installation on potentially dangerous, especially dangerous, technically composite and unique objects.

Requirements for the creation of SEDM are regulated by the following normative documents:

*GOST 31937-2011 Buildings and constructions. Rules of inspection and monitoring of the technical condition;

* GOST R 54257-2010 Reliability of constructions and foundations. Basic principles and requirements;

* GOST R 22.1.12-2005 Safety in emergencies. Structured system for monitoring and control of building / construction engineering equipment. General requirements;

* SP 13-102-2003 Rules of inspection of bearing structures of buildings and facilities;

* SP 20.13330.2011 Loads and actions;

* SP 22.13330.2011 Buildings and structures foundations;

* TSN 50-302-2004 Designing the foundations of buildings and structures in Saint Petersburg;

* MDS 13-22.2009 Technique of geodetic monitoring of technical condition of high-rise and unique buildings and constructions.

Object of monitoring of SEDM are load-bearing frames of buildings and constructions. Eventually load-bearing frames of buildings and constructions accumulate defects which arise for various reasons: because of non-compliance with service regulations of buildings and constructions, because of poor quality of structural materials, as a result of mistakes during projection or violation of manufacturing techniques and installation of building constructions and also as a result of influences of natural character.

The saved-up defects can lead to accidents, which do not only cause the significant economic damage, but are also often followed by death and injury of people.

SEDM carries out monitoring and filing during all serviceable life of changes of conditions of the base, walls, the bearing wall panels, beams of overlappings and other structural elements of an object which perceive the main loadings: weight of the designs, wind pressure, weight of snow which are in the building with people, inventories, the soil pressure upon underground parts of the building, etc. The scheme of controlled parameters in is shown figure 1.

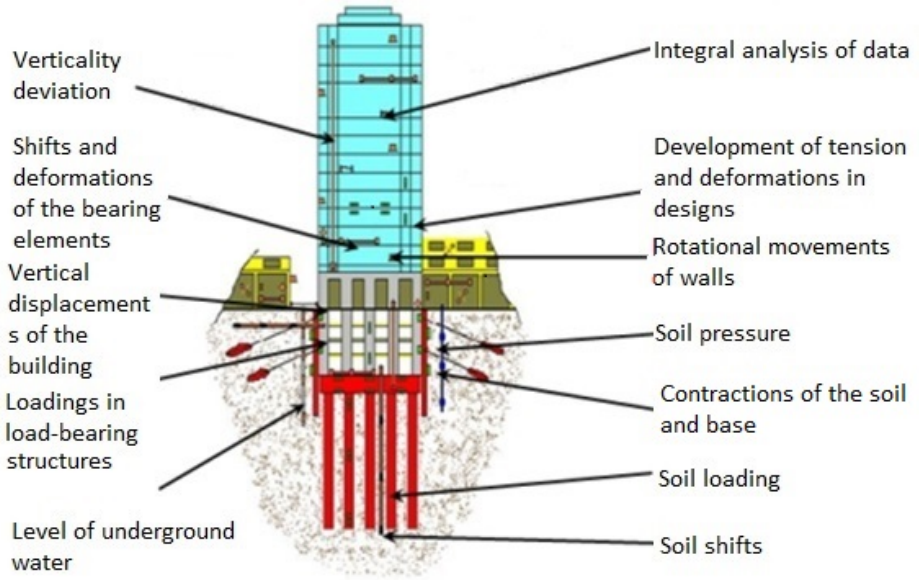

Fig. 1 - Scheme of controlled parameters

The information on changes of conditions of SEDM designs is transferred to the duty department in real time.

Well-timed detection of defect at an early stage of its emergence gives the chance to prevent the accident, reduces risk of properties loss by a load-bearing frame of which define its reliability.

The example of such a system is the automated system of monitoring of a straining condition of load-bearing frames. The system is developed by LLC SODIS Lab and installed on the Shayba Arena of the Olympic Park of Sochi.

During the earthquake, which occurred on December 23, 2012 of SEDM allowed to estimate the influence of a seismic event on building constructions, make operational conclusions on the absence of damage to load-bearing frames, obtain the valuable data on the dynamic response of a construction.

Conclusion

Thus the broad application of SEDM will allow increasing the level of reliability and safety of infrastructure of objects and reducing operating costs and insurance.

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СИСТЕМА МОНИТОРИНГА ИНЖЕНЕРНЫХ КОНСТРУКЦИЙ (СМИК)

М. В. Качнов, А. С. Горбачев
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: kmv_68@list.ru

Аннотация

Рассмотрен метод контроля и предупреждения обрушения здания под воздействием природно-техногенных нагрузок с использованием системы мониторинга инженерных (несущих) конструкций (СМИК)

Ключевые слова: безопасность, мониторинг, несущие конструкции, природно-техногенные нагрузки.

УДК 69.04=111
ББКН 113.6 + з 996-5
К - 891

INVESTIGATION OF ENERGY EFFICIENCY OF BUILDINGS AND STRUCTURES BY A THERMAL SCAN BASED ON "TAMAK" COMPANY

V. A. Kuznetsov
Tambov State Technical University, Tambov, Russia
e-mail: Kuznetsov_Vladislav_Andeevich@mail.ru

Abstract
This article is based on the research conducted by the TAMAK construction company. This company is engaged in the design and construction of frame – panel and beam house. Thermal imaging of the enclosing structures of a private residential building are provided using the thermal scan Testo 875-2. The calculation results are presented in tabular from and histograms.
Key words: energy efficiency, thermal scan, thermal insulation.

Energy efficiency is the beneficial use of energy resources. Today energy efficiency is a trend of modern low-rise construction and lifestyle in general. Building and Design Technologies of energy-efficient houses are just beginning to develop in Russia, while in Europe this kind of house building is very popular.

A large number of companies are engaged in the design, construction and research of efficient homes in Russia, Europe (in such countries as Germany, Switzerland, Austria, Poland, etc.), the United States and other countries. One of such companies in Russia is the construction company "TAMAK". Prefabricated buildings are in high demand by customs. According to engineers, reliability, durability, biosecurity, efficiency, environmental friendliness and energy efficiency are the main components of an ideal home.

TAMAK is one of the largest enterprises in the field of construction and woodworking technology with 100% of Austrian capital.

The use of ecologically pure wood, the desire to meet fully the needs of people in modern housing is one of the basic principles of the enterprise. In addition to reliability, economy, aesthetics, and longevity, TAMAK houses are highly energy efficient. Effective thermal insulation, special joints, features of the materials used and specially designed "pie" of walls provide significant energy savings to maintain a comfortable temperature inside the house. The standard external wall panel of the company "TAMAK" has a calculated resistance of heat transfer R = 2,985 $m^2 \cdot °C/W$, a brick cladding – R = 3,216 $m^2 \cdot °C/W$, ventilated façade KOMAK PLAT – R = 4,010 $m^2 \cdot °C/W$, cladding of plates (clinker plate with styrofoam) – R = 4,675 $m^2 \cdot °C/W$. A calculated resistance of heat transfer R is figured out in accordance with [5]. The confirmation of the energy efficiency of

the TAMAK structures is realized objects not only in the central European part of Russia, but also in other extreme climatic regions.

We will consider a single-family home at the address: Tambov region, Raduzhny village, Seleznevskaya Street, 235. We will conduct a thermal imaging of this house, which was implemented by TAMAK.

The study was carried out in the following sequence: object inspection, measurement using a laser rangefinder, thermal scan Testo 875-2, thermometer – Testo 605-H1hygrometer. Normative and technical literature, calculations using licensed IRSoft software, photographic fixation using a digital camera were used [1, 2].

The quality of the thermal insulation of envelopes is determined during the survey, which includes: thermal imaging of the outer surfaces of envelopes, measurements of outdoor temperature variations with respect to indoor air temperature in indoor rooms.

The inspection allows revealing defects in wall panels and in joints between panels and corner joints, and also to identify areas of increased exfiltration and infiltration in joints between panels or in fillings of light apertures, etc. In addition, dangerous areas with regard to the dew point on the inner surface and freezing can be detected.

As a result of the thermal imaging, it is possible to determine the locations and sizes of areas, on which it is necessary to perform work to restore the required heat-shielding qualities of structures. It will reduce heat losses and save resources [4,5].

Let us consider sections of a frame-panel house, testing by a thermal scan Testo 875-2 (images 1-4).

According to the results of thermal imaging of external enclosing structures, it is fixed that the resistance of heat transfer of the outer walls is below the required value [3], but at the same time it corresponds to an allowable reduction level (37%), provided that the standard level of heat consumption is maintained.

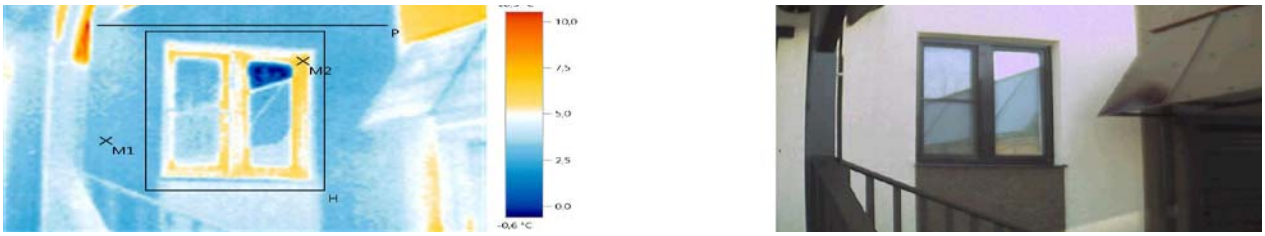

Fig. 1 - Thermal imaging. Fragment 1.

Table 1 - Results of thermal imaging. Fragment 1.

Measurable objects	Temperature, °C	Radiation	Reflected temperature,°C	Notes
1	2	3	4	5
Measuring point 1	3,3	0,95	23,0	
Measuring point 2	6,4	0,95	23,0	

Fig. 2 – A histogram and a profile line. Fragment 1.

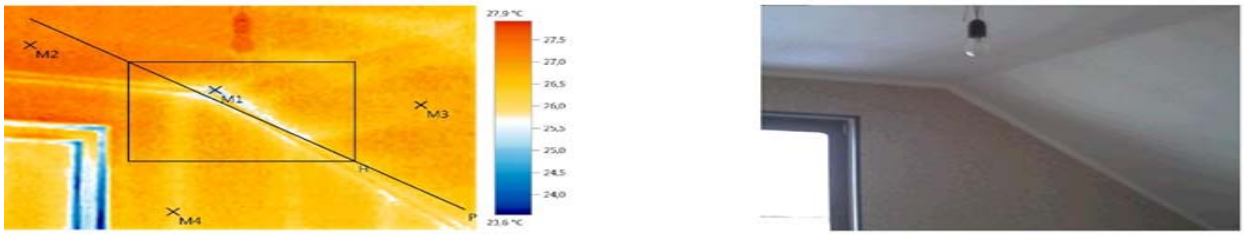

Fig. 3 - Thermal imaging. Fragment 2.

Table 2 - Results of thermal imaging. Fragment 2.

Measurableobjects	Temperature, °C	Radiation	Reflected temperature,°C	Notes
1	2	3	4	5
Measuring point 1	25.2	0.95	23.0	
Measuring point 2	27.4	0.95	23.0	
Measuring point 3	26.8	0.95	23.0	
Measuring point 4	26.3	0.95	23.0	

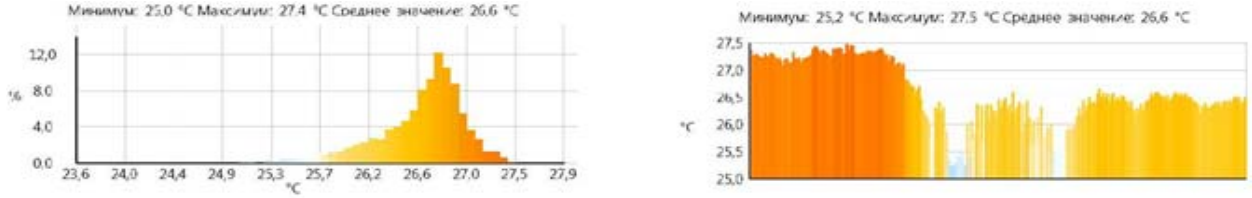

Fig. 4 – A histogram and a profile line. Fragment 2.

Carefully designed high-quality projects of energy-efficient houses of TAMAK Company allow us to reduce heating costs by half in comparison with similar buildings of various designs. Today energy efficiency is one of the basic characteristics of prestigious high-quality houses. This saving is one of the key factors in the sale of houses and contributes to a minimum cost reduction in time.

In Russia certain parameters of heat-energy characteristics of enclosing structures are developed for each region. The wall panels of the company "TAMAK" noticeably exceed most of the current standards.

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ИССЛЕДОВАНИЕ ЭНЕРГОЭФФЕКТИВНОСТИ ЗДАНИЙ И СООРУЖЕНИЙ ПРИ ПОМОЩИ ТЕПЛОВИЗЕРА НА ОСНОВЕ КОМПАНИИ «ТАМАК»

В. А. Кузнецов
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: Kuznetsov_Vladislav_Andeevich@mail.ru

Аннотация

Данная статья основана на исследованиях, проводимой строительной компанией «ТАМАК», занимающейся проектированием и возведением каркасно – панельных и брусовых домов.

Приведены тепловизионные расчеты ограждающих конструкций частного жилого дома при помощи тепловизораTesto 875-2.

Результаты расчета представлены в табличной форме и на гистограммах.

Ключевые слова: Энергоэффективность, тепловизор, теплоизоляция.

УДК 69.07
ББК 38.711

MONITORING OF WALLING PARAMETERS OF RESIDENTIAL BUILDINGS

A.O. Merkushev, N. P. Merkusheva
Tambov State Technical University, Tambov, Russia
e-mail: natasha_monastyreva@mail.ru

Abstract
The nature of monitoring of load-bearing building envelopes is considered in the article. In actual operating conditions, the enclosing structures, as a rule, provide protection of the internal space from a whole range of impacts. This circumstance creates significant difficulties in their design, construction and subsequent operation.
Key words: monitoring; walling; residential buildings; building

The quality of the building as a whole and its individual bearing and enclosing elements is determined at all stages of the building's existence. In this regard, design, construction and operation are a single process that provides the necessary quality indicators of the building and its individual elements, including enclosing structures.

The interrelation and mutual influence of all three stages of the building's existence, allowing to ensure the required operational qualities of the facilities, should be carried out by reliable and continuous exchange between design, construction and operating organizations of the information obtained in the monitoring process produced at all stages of the building's existence.

The most important measures to ensure the proper quality of construction products are the organization and monitoring of tasks at the construction stage and subsequent operation.

Monitoring of the technical condition of buildings and structures is carried out for:

- monitoring the technical condition of buildings and structures and taking timely measures to eliminate emerging negative factors leading to a deterioration of this condition;
- identification of objects on which changes in the stress-strain state of bearing structures occurred and for which a survey of their technical condition is necessary;
- ensuring the safe operation of buildings and structures due to the timely detection at an early stage of a negative change in the stress-strain state of the structures and grounds of the grounds, which may lead to the transfer of objects in a limited operational capacity or in an emergency condition;
- tracking the degree and speed of changes in the technical condition of the facility and taking, if necessary, emergency measures to prevent its collapse. [1]

When choosing a system of observations, it is necessary to take into account

the purpose of monitoring, as well as the speed of the processes and their change in time, the duration of measurements, measurement errors, including through changes in the state of the environment, as well as the impact of interference and anomalies of natural and man-made character. The monitoring program is coordinated with the customer. In it, along with the list of types of works, establish the frequency of observations taking into account the technical state of the object and the overall duration of monitoring.

The methodology and scope of the monitoring system, including measurements, should ensure the reliability and completeness of the information received for the preparation of a valid conclusion by the contractor about the current technical condition of the facility.

In the course of long-term observations and changes in external conditions, it is necessary to take into account changes in conditions and compensatory corrections (temperature, humidity, etc.) for measuring devices. Measuring instruments and equipment used for observation must be certified, verified (calibrated) and certified by authorized bodies. As a result of each monitoring phase, sufficient information should be obtained to prepare an informed opinion on the current technical condition of the building or structure and issue a short-term forecast of its condition for the next period.

The initial stage of monitoring the technical condition of buildings and structures (with the exception of general monitoring of the technical condition of buildings and structures) is a survey of the technical condition of these buildings and structures. At this stage, establish the categories of technical condition of buildings and structures, fix the defects of structures, for the change in the state of which (as well as the appearance of new defects) will be monitored during monitoring.

The principles of monitoring the most important group of building elements are discussed below, namely, the inclusion of structures at the stages of their installation and operation.

All the building elements can be divided into two groups according to their functional purpose: on the carrier and on the enclosing structures.

The main function of load-bearing structures during operation is the perception of loads acting in the building, and then their transfer through the structure of interconnected load-bearing elements on the foundation. Therefore, in the design, construction and subsequent operation of structural support structures of an object, the main task is to provide the necessary indicators of their strength, rigidity and stability. Enclosures are usually elements of the shell of the building that protects the internal space or its individual volumes from external influences against the protected volume, for example, from low temperatures, wind, insolation, noise, fire and smoke, etc.

In actual operating conditions, the enclosing structures, as a rule, provide protection of the internal space from a whole range of impacts. This circumstance creates significant difficulties in their design, construction and subsequent

operation.

The division of building elements into load-bearing and enclosing structures is rather conditional. A large number of load-bearing structures simultaneously combine carrier and enclosing functions. First of all, such structures include walls and ceilings. Providing in a single design different, often contradictory requirements creates difficulties in its design and subsequent operation.

In a small number of cases, when designing load-bearing structures for the main functional purpose, namely, to ensure the requirements of strength, rigidity and stability, it is possible to provide without special constructive measures and meet the requirements imposed on them as enclosing structures. An example of this can be internal load-bearing walls, which, as a rule, ensure the requirements for sound insulation, due to the large surface density obtained when they are designed for carrying capacity.

In most situations, when designing such structures, complex designs are created, including elements that separately are responsible for the carrier and enclosing functions. In this case, in a number of cases, the bearing elements take on themselves the fulfillment of some of the enclosing functions. For example, brick walls with additional thermal insulation ensure the requirements of thermal insulation not only due to a specially designed thermal insulation layer, but also due to the thermal insulation properties of the brickwork designed in this case by the provision of the wall with the required bearing capacity. Another similar example is the structure of the floor, the supporting part of which, in addition to perceiving and transferring the load to the walls, provides, together with the floor, protection against penetration of air and impact noise from the adjacent vertical volume.

Conclusion: The above features of structures that combine the bearing and enclosing functions should be taken into account when monitoring at the stages of erection and operation of buildings [2].

For structures that combine carrier and enclosing functions, indicators that determine both functions should be evaluated during monitoring. For purely enclosing structures, for example, window fillings, during monitoring, the main indicators determining their protective functions, for example, resistance to heat transfer, sound insulation, etc., should be investigated, as well as indicators that ensure their preservation as a structural element. For example, for stained-glass windows and showcases, the strength and stability of structures should be evaluated during monitoring.

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ХАРАКТЕР МОНИТОРИНГА НЕСУЩИХ ОГРАЖДАЮЩИХ КОНСТРУКЦИЙ ГРАЖДАНСКИХ ЗДАНИЙ

А.О.Меркушев, Н. П. Меркушева
Тамбовский государственный технический университет, г. Тамбов, Россия,
e-mail: natasha_monastyreva@mail.ru

Аннотация

В статье рассмотрен характер мониторинга несущих ограждающих конструкций зданий. В реальных условиях эксплуатации ограждающие конструкции, как правило, обеспечивают защиту внутреннего пространства от целого комплекса воздействий. Данное обстоятельство создает значительные сложности при их проектировании, строительстве и последующей эксплуатации.

Ключевые слова: мониторинг, ограждающие конструкции, жилые здания

УДК 691
ББК 38.34

COMPARATIVE ANALYSIS OF BUILDING MATERIALS USED IN THE CONSTRACTION OF SPORTS AND RECREATION FACILITIES

M.O. Mikhalev
Tambov State Technical University, Tambov, Russia
e-mail: Avatar-t90@yandex.ru

Abstract
This article examines and compares the advantages and disadvantages of steel and reinforced concrete structures for the construction of sports and recreational facilities in dense urban conditions with the minimum possible time and cost. As a result of research, conclusion has been made that the use of steel is more expedient than reinforced concrete.
Key words: material, reinforced concrete, reinforced concrete structures, steel, steel structures.

Introduction

Physical culture and sport is one of the most important strategic resources for the development of a full and healthy society and an individual, the formation and expansion of a range of leisure activities, creating conditions for the socialization of the individual. For this purpose, state programs are adopted for the regions of our country. Our region is no exception. The state program is developed on the basis and in accordance with the Strategy of social and economic development of the region for the period until 2020, approved by the Law of Tambov region of December 4, 2013 N 317-З. Such activities receive limited budget grants; because of this it is very important to properly spend them. The construction often takes place in conditions of limited territory and time of erection. The purpose of my article is to review and select the most economically and technically sound building materials for the construction of sports and recreation facilities in the Tambov region.

Comparison of materials

To date, there is a wide variety of building materials for the erection of buildings, but reinforced concrete and metal structures are often used.

Reinforced concrete is concrete reinforced with a composite or metal to increase its strength characteristics. Buildings made of reinforced concrete are divided into two types: monolithic or prefabricated structures. When erecting a monolithic building, a reinforcement casing is first coveted, which in place is poured with the concrete mix. Elements of the prefabricated reinforced concrete structure are manufactured at the factory, delivered to the construction site where they are mounted.

The advantages of reinforced concrete structures include:

- low cost;

- fire resistance - reinforced concrete structures are used for buildings of the first degree of fire hazard;

- resistance to corrosion - concrete is practically not exposed to the damp environment.

- strength - the reinforcement compensates for the tensile strength in the concrete, thereby suppressing the appearance of cracks.

The disadvantages of reinforced concrete structures are:

- expensive transportation - because of the massive and difficult delivery of reinforced concrete products to the construction site it is much more expensive than metal structures;

- the mechanical effect on concrete elements leads to the rapid loss of the original appearance and destruction of elements; the replacement of the reinforced concrete structure is a difficult task;

- concrete hardening for 28 days is a long process for which the required number of molds is needed at the factory; otherwise, the manufacture of all building structures will be delayed for a long time;

- the construction of a monolithic building requires a lot of building materials and equipment: concrete pumps, mixers, stations, fittings, formwork, tools.

Metal structures are building structures made of metal. They are subdivided into steel and light alloys. By the nature of the joint elements they are divided into welded, riveted and with bolted connections. Metal structures have high strength, are reliable in operation, have a small mass (in comparison with reinforced concrete).

The advantages of metal constructions are:

- Terms of construction.

- Collapsible frame. Due to this function of metal structures, the construction team can easily replace a damaged bolt, link or even a column.

- Transportation and delivery. In comparison with reinforced concrete, steel structures are light and compact. Their transportation is much cheaper.

- Expenses for erection. For the installation of metal structures, three people are required, and often one crane is sufficient.

- Winter construction. The technology of erecting a building made of metal structures in winter does not change at all in comparison with the summer period.

Disadvantages of the construction made of metal:

- Expensiveness in comparison with concrete products.

- Exposure to corrosion.

- Low fire resistance. Steel structures do not burn, but the fire severely deforms them.

Optimal material selection

Having considered all the advantages and disadvantages, we can say what kind of material is more advantageous for the construction of sports and recreation facilities. And here metal structure is in priority because of the speed of

construction and the possibility to place the structure almost anywhere. This is achieved by the fact that the structures are manufactured in the factory, so they can only be assembled on site and mounted. Economically, the high cost of metal structures and the costs of protection from corrosion and high temperatures are compensated for by reducing the cost of the foundation due to the lighter construction of the building, transportation and installation of structures.

Conclusion

In the course of the logical analysis, it was concluded that for the construction of sports and recreational facilities it is more effective to use metal structures because of the rapid speed of construction and the possibility to build then in dense urban conditions while the cost of the project will not be very different from the analog of reinforced concrete.

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СРАВНИТЕЛЬНЫЙ АНАЛИЗ ПРИМЕНЯЕМЫХ СТРОИТЕЛЬНЫХ МАТЕРИАЛОВ ПРИ ВОЗВЕДЕНИИ СПОРТИВНО-ОЗДОРОВИТЕЛЬНЫХ СООРУЖЕНИЙ.

М.О. Михалёв
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: Avatar-t90@yandex.ru

Аннотация

В данной статье рассматриваются и сравниваются преимущества и недостатки конструкций из стали и железобетона для возведения спортивно-оздоровительных сооружений в условиях плотной городской застройки с максимально минимальными затратами времени и средств. В результате изысканий мы приходим к выводу, что применение стали целесообразней, чем железобетона.

Ключевые слова: ЖБИ, железобетон, материал, сталь, стальные конструкции.

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INFLUENCE OF SPACE-PLANNING DECISIONS OF RESIDENTIAL BUILDINGS FOR HEAT CONSUMPTION

S.Yu. Mordovina, E.Yu. Mordovina
Tambov State Technical University, Tambov, Russia
e-mail: mordovina_s@mail.ru

Abstract

The article considers the factors that affect the energy efficiency of the building. The energy efficiency of the building complex is possible only through a combination of work related to ensuring energy efficiency in the building and for ensuring energy efficiency in the systems of engineering equipment of buildings. We study the main directions of reducing of energy consumption of buildings, which include the following: the effect of height, reducing the magnitude of the negative impact of the outdoor climate due to the orientation of the building to the cardinal points, its shape and size, areas of glazing. To increase the efficiency of a building must fulfill a set of architectural and technical measures.

Key words: building, high-rise, space-planning, decision, diagram, thermal efficiency, energy efficiency.

The development of new projects of energy efficient housing is of a technical nature, but and economic and social fabric, designed to provide the residents the most comfortable living conditions.

The existing socio-economic environment of today actively influence used in housing construction and architectural solutions. On the market at the same time presented to the panel (budget), blocky, monolithic houses, objects and facilities of low-rise construction. All of them in combination have an impact on total energy usage.

Through the implementation of architectural and technical measures for municipal housing have the opportunity to significantly reduce energy consumption. For commercial buildings the use of such events has much less effect. This is connected not only with a larger area of the apartments, but also the allocation of area under commercial infrastructure. Significant energy capacity required and installed in buildings engineering equipment (ventilation systems, Central air conditioning and so on).

In addition, owners of commercial apartments in much larger quantities use electrical appliances, install underfloor heating, decorative ceilings with lots of lights that use multiple means of telecommunications. In the result average electricity consumption per dwelling is much greater than in public housing.

In the context of integrated architectural and engineering activities expected to increase the overall energy efficiency of an object through rationalization of planning, the transition to using energy-saving materials, the introduction of metering and regulation of energy resources, the use of alternative energy.

For a housing stock, space-planning decisions have a significant impact on energy efficiency indicators. The influence is exerted by the most numerous factors.

The calculations of Russian specialists conducted in the framework of a large-scale research work show that for buildings with a height of 17-25 floors, a significant natural impact is characteristic. In particular, wind loads (vortex flows) on the upper floors contribute to the cooling of apartments and prevent the formation of an optimal microclimate in the premises. In such houses there is an increased load on the structures on the windward side, infiltration and transfer of the exhaust air from the lower floors to the upper ones. Elimination of this phenomenon is possible in architectural and technical ways, by installing additional compacted doors. You can eliminate the effect and through exhaust ventilation in the apartment, but this is already the prerogative of the housing owners themselves.

In many cases in elite houses even before the entrance to the apartment there are one or two doors, which generally correspond to the recommendation of specialists. The presence of several doors positively affects the ventilation mode, allows reducing heat losses and more effectively protecting against the penetration of noise into the room.

Studies show that, within the framework of urban development, an expedient solution is the construction of windproof houses of low storeys, acting as a protective barrier for the following high-rise buildings. The "closed yard" technology contributes to the increase of heat efficiency, which allows protecting the internal space not only from the wind, but also from a significant part of the noise generated in the external environment.

Do not belong to the number of energy-efficient and low-rise buildings. This is explained by the unfavorable proportion between the area of external surfaces and the internal volume of the building.

For today, for capital construction objects, we use the compactness coefficient, which shows the ratio of the surface of external fences with the total heated volume. At the same time, the standards provide for different amounts of energy consumption for heating houses, taking into account their number of storeys. As a result, for the set of characteristics, houses in 9-16 floors are recognized as the most effective, which is proved by the calculations of specialists.

The most rational compactness is found in houses with wide hulls. Their compactness coefficient is higher, and the microclimate in the rooms is characterized by increased stability due to a lower susceptibility to blowing out heat. As a result, in the presence of opportunities and free space, it is necessary to strive for the use of expanded buildings that guarantee the growth of the coefficient of compactness and heat efficiency.

There are other architectural and planning solutions that allow increasing the energy efficiency of housing facilities. One of them is the beam arrangement

of apartments. With this scheme, up to 12 apartments can be accommodated on each of the floors while minimizing the required volume of communications outside the apartments. This scheme guarantees a reduction in the area of external walls per unit volume, a reduction in communication lines, and an increase in the utilization of elevator equipment, which in sum positively affects the energy efficiency of the structure.

Still one solution in the area of increasing heat efficiency at the level of a separate flat is the rational choice of the ratio of length and width of premises. Calculations show that square-shaped rooms are 50% less resistant to external cold, and rooms with a large elongation experience a lack of natural light and problems with airing. As a result, rooms with an elongation in the range of 1.4-1.6 are considered optimal. They are optimal in terms of maintaining the temperature regime.

Still one solution is the control of the temperature regime in the various rooms of the apartment. Researches of experts show that during the night sleep it is possible to reduce the air temperature in the room to 15 degrees without the risk of negative impact on the organism.

Benefits carries of the staircase-elevator unit in the center of the building is also advantageous, and not with one of the outer sides. This solution provides an increase in the number of apartments on the floor, and also reduces heat losses due to the rejection of light-transmitting structures in common areas.

Calculations of specialists show that buildings with flat facades require 12-15% less heating than buildings with numerous protrusions on the outer surface of a residential house.

Decrease in heat-efficiency of buildings occurs also in consequence of arrangement on the upper floors of buildings of penthouses. The large area of their glazing leads to significant heat losses, especially in the Russian natural climatic conditions, and requires a huge waste of energy for heating.

The use of glazing balconies positively affects the level of heat efficiency, but by 30% reduces the amount of natural light that penetrates into the living rooms from the street. The quality of ventilation deteriorates, and the opening flaps are not able to fully remedy the situation.

In this case necessary into account that according to the requirements of SNiP, the resistance to heat transfer of translucent structures, even with triple glass, is 5.6 times lower than for walls (0.56 against 3.15 m2K / W). At the same time, it is technically impossible to create glasses that are more efficient in terms of thermal conductivity. To reach even the values of 1.2 m2K / W of heat transfer resistance is not possible. As a result, the current standard for the maximum glazing area of the building at a rate of 18% of the total surface area of the building will not be revised in the near future.

In the frames of improving the overall efficiency of the building in terms of heat losses, it is necessary to take into account the direction of the winds,

varying the glazing area depending on the side of the world. For example, on the south side, the glazing area may be higher than on the north side.

Use all of the above methods can be for housing objects of any category, whether it is municipal construction or commercial buildings.

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ВЛИЯНИЯ ОБЪЕМНО-ПЛАНИРОВОЧНЫХ РЕШЕНИЙ ЖИЛЫХ ДОМОВ НА РАСХОД ТЕПЛОВОЙ ЭНЕРГИИ

С.Ю. Мордовина, Е.Ю.Мордовина
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: mordovina_s@mail.ru

Аннотация

В статье рассмотрены факторы, от которых зависит энергоэффективность здания. Повышение энергоэффективности строительного комплекса возможно только путем сочетания работ, связанных с обеспечением энергетической эффективности в здании, и работ по обеспечению энергоэффективности в системах инженерного оборудования зданий. Изучены основные направления снижения энергопотребления зданий, к которым отнесено следующее: влияние этажности, снижение величины негативного влияния наружного климата за счет ориентации здания по сторонам света, его формы и размеров, площади остекления. Для увеличения энергоэффективности здания необходимо выполнять комплекс архитектурно-технических мероприятий.

Ключевые слова: здание, многоэтажные, объемно-планировочное, решение, схема, теплоэффективность, энергоэффективность.

УДК 691
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THE CHOICE OF MECHANIZATION MEANS FOR CIVIL FACILITIES RECONSTRUCTION

V.V. Popov, O.N. Kozhukhina
Tambov State Technical University, Tambov, Russia
e-mail: 14vladimir95@gmail.com

Abstract
This paper considers the types of mechanization used in the constrained conditions of reconstruction.

Key words: dismantling, installation, jib cranes, reconstruction, the constrained conditions

Introduction

The choice of mechanization means for the reconstruction of buildings and structuress depends on the nature of reconstruction, space-planning and design solutions of buildings, character and methods of execution of reconstruction works. Also, in some cases it is impossible to use traditional cars and mechanisms, or transport large items across the territory of the company. This has a significant effect on the choice of mechanization means. In this regard, when choosing mechanization means, it is necessary to consider the following basic provisions:

— mechanization means have to be universal, i.e. carry out installation and construction works and operations, various in character, volume and specifics, in the constrained conditions;

— the used machines and mechanisms have to have whenever possible small weight, small dimensions, be transferred quickly from transport situation in working and vice versa, to have the replaceable hinged assembly and transport equipment or with changeable dimensional characteristics;

— for protection of coverings of roads, floors in shops and platforms expediently that the running gear of hoisting-and-transport mechanisms was on pneumowheel to the course or on rubber caterpillars;

— it is necessary to use methods and means of mechanization preventing emergence during their work of dynamic influences (it especially belongs to the choice of means of mechanization at the device of the pile bases, tongue-and-groove protections, performance of work on dismantling and destruction of various designs, consolidation of soil, etc.);

— when choosing cars and mechanisms for assembly and dismantling works depending on conditions of reconstruction and assembly characteristics of designs it is necessary to use more widely easy roof cranes, cranes with telescopic arrows, the monorail and rope systems and mechanisms used directly at operation of the enterprises, buildings and constructions (for example, bridge and cable cranes, bridge jib cranes, universal and small-sized loaders, hydraulic elevators);

— to consider the sizes of working zones of cars and mechanisms, access roads, a possibility of their movement in buildings and across the territory of the reconstructed enterprise or a construction;

— to use mechanization means with the systems of remote control on in advance set programs;

— to use machines manipulators and robots, especially at reconstruction of shops and the enterprises with harmful conditions of production (gas contamination, dust content, fire - and potential of explosion).

The choice of optimum means of mechanization for reconstruction

It is expedient to execute the choice of optimum means of mechanization for conditions of reconstruction of buildings and constructions in such sequence:

1) proceeding from the set conditions of reconstructive works and possible restrictions establish rational ways of production of installation and construction works;

2) develop structure of technological processes for which mechanized performance select possible types, brands of cars and the equipment taking into account their inscribe in limited parameters of working zones of drives;

3) define technical capability of use of cars, mechanisms and the equipment in the conditions of reconstruction taking into account their technical parameters;

4) form sets of cars and mechanisms for performance of all complex of reconstructive works;

5) define technical and economic indicators of sets of cars and on the basis of their comparison choose the most rational option for these conditions.

The choice of cars and mechanisms on technical characteristics for dismantling (installation) of structures of buildings depends on the assembly mass of elements, height of lowering (rise) of a design and depth of an assembly zone.

Now the assembly organizations have a wide choice of production load-lifting cars. However, in the conditions of reconstruction such characteristics of means as their mobility, a dimension in transport situation and own lot, simplicity of re-equipment, ability of maneuvering with freight on a hook in limited space, etc. have essential value. Our industry doesn't release technologically specialized cranes for reconstruction conditions yet. Therefore it is necessary to use the existing serial load-lifting mechanisms.

When organizing installation works in the constrained conditions it is desirable to carry out installation of building constructions from vehicles. It will allow reducing the platforms allocated for warehousing of designs, to reduce unproductive expenses of machine time of assembly cranes, to reduce labor input and to reduce works terms.

The efficiency of the use of self-propelled jib cranes at installation of the attached, built in and connecting flights increases at equipment by their tower and boom equipment which provides big freedom of maneuvering at turns of an arrow and its bigger departure. Use of such cranes allows carrying out installation of

designs from the parking located out of the constrained mounted flights, and provides considerable economy of expenses by preparation of the platform for production.

The scope of self-propelled jib cranes at reconstruction increases also at equipment by their telescopic boom equipment. Small dimensions of such cranes in transport situation, fast reduction in the working condition, simplicity of change of length of an arrow create favorable conditions even by production of intra shop installation works.

In CRDOMTAC the equipment for the MKG-6,3 crane representing the hinged parallelogram mounted instead of an arrow on the rotary platform of the crane with sliding in single file in the form of the top link of a parallelogram is developed.

Crane loading capacity depending on a parallelogram tilt angle to the horizon is from 2.7 to 3.2 t, an arrow departure — from 2.06 to 8.96 m, height of raising of a hook — to 7,6 m. The equipment allows giving assembly elements to places, remote for the ordinary jib crane, provides separate horizontal and vertical cargo transfer, facilitates journey of the crane under obstacles.

On some cranes (for example, SKG-30) special types of arrows with bifurcate headrests are used to lift high columns; the slings are attached higher than the middle and placed in a bifurcate headstall of an arrow. Such design of an arrow allows reducing the height of rising of a hook, necessary for the set columns, and using the crane of smaller loading capacity and also creates favorable conditions at installation and dismantling of columns at restriction of a high-rise dimension with the existing designs and communications.

One of the ways of increasing technological capabilities of jib cranes is use of the additional inventory devices capable to assume the increased loadings (“derrik-effect”). For example, it is expedient to use the device in combination with caterpillar cranes with a loading capacity of 25, 40, 63 and 100 t on installation of large-size designs and the equipment, - the mass of which exceeds the nominal loading capacity of the crane. Application of it allows increasing crane loading capacity by 1.5-3 times. The use of the device in the conditions of reconstruction gives the chance to mount heavy designs when the use of more powerful cranes is impracticable or it is inefficient.

Conclusion

For reconstruction mechanization options based on small-sized, universal and mobile cars are expedient. These systems of cars work in the constrained conditions at the optimum modes, have universal purpose, and can be transferred quickly to any site of the reconstructed enterprise.

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ОСОБЕННОСТИ ВЫБОРА СРЕДСТВ МЕХАНИЗАЦИИ ПРИ РЕКОНСТРУКЦИИ ГРАЖДАНСКИХ ОБЪЕКТОВ

В.В Попов, О.Н Кожухина
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: 14vladimir95@gmail.com

Аннотация
В данной статье ставится задача рассмотреть виды механизации, используемые в стесненных условиях при реконструкции

Ключевые слова: демонтаж, монтаж, реконструкция, стреловые краны, стесненные условия

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UTILIZATION OF OPTICAL DISCS IN FINE-GRAINED CONCRETE

A. D. Seleznev, N. V. Kuznetsova
Tambov State Technical University, Tambov, Russia
e-mail: selezen95@yandex.ru

Abstract

The paper focuses on the possible method of powdered optical discs use in fine-grained concrete as inert filler and an alternative to sand. Approximate volumes of optical discs production and their waste are presented. The relevance and possibility of the use of optical discs as fillers in fine-grained concrete are explained. Examples of similar polymeric materials as filler in fine-grained concrete are given.

Key words: cement mixture, fine-grained concrete, optical discs, planning of experiment, utilization.

Introduction

Optical discs have been being extensively used for the last 30 years on the market of information devices because of the intensive development of computer and multimedia technologies. According to the data [1], during 2012 more than 350 million optical disc drives were sold that implies that the number of optical discs was greater by 100 times (at least 35 billion pieces). To prove this fact, we can analyze the production volumes of such large companies as Verbatim and Moser Baer which amount to 3 billion pieces of optical discs per year [2, 3], and there are more than ten of such manufacturers in the world. In Russia the volume of optical disc sales is about 550 million pieces per year.

Despite the decrease of their popularity and consequently reduction of their production recently, there are still a great number of optical discs that must be utilized. More than 5.5 million discs are thrown into landfills damaging the environment all over the world every year [4].

Existing methods of optical disc utilization

At present, some discs of this kind are being recycled for the production of polycarbonate materials [5, 6]. Due to the fact that optical discs do not consist only of polycarbonate but also such coatings as aluminum, printing, lacquer etc, the technology of their recycling into polycarbonate is complex and energy consuming.

A rather common type of secondary use of optical discs is the creation of various handicraft items: drink coasters, candlesticks, watch dials, photo frames and so on [4]. However, this way of their use only helps to avoid the necessity of disc recycling for some period of time and is applicable only for small volumes.

Polymeric materials in fine-grained concrete and cement mixture

We suggest a method of the optical discs utilization as inert filler in fain-grained concrete. It should be noted, that in this case discs do not have to be

thoroughly cleaned to remove the aluminum coating as well as others unlike the process of recycling [5]. Thus, the suggested method of utilization is less energy-consuming and more cost-effective. According to the Russian classification of wastes polycarbonate is referred to V class [7] that allows the use of optical discs which must be utilized as inert filler in fine-grained concrete.

The example of the utilization of polymeric materials in fine-grained concrete is described in Ru Wang's work [8]. The author proposes to use the polymer component of printed circuit boards (PCB) waste as a filler in fine-grained concrete instead of sand. According to the research, the proportion of polymeric materials in the cement mixture increases, its water retention capacity grows up, porosity become significant and density decreases. There is also a decrease in the compressive strength, bending strength and extension strength of the concrete composite with a non-metallic PCB component filler. According to the study, the use of a non-metallic component of PCB waste produces fine-grained concrete for structural and structural and heat-insulation materials [8].

Another example of the use of polymeric materials in cement mixtures can be plugging Portland cement with the addition of light-weight materials, such as hollow polymeric microspheres [9]. Solutions with hollow microspheres have low density and are almost incompressible, and that ensures efficient and durable well construction [10].

Conclusion

It can be concluded that it is possible to use crushed optical discs as a filler in fine-grained concrete because they are also polymeric materials. Moreover, similar results of the study of physical and mechanical properties of the composite material are expected. It is also quite probable that powdered optical discs can have a positive effect on physical and mechanical properties of concrete because of the gradation composition optimization of mortar.

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УТИЛИЗАЦИЯ ОПТИЧЕСКИХ ДИСКОВ В МЕЛКОЗЕРНИСТОМ БЕТОНЕ

А. Д. Селезнев, Н. В. Кузнецова
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: selezen95@yandex.ru

Аннотация

В данной работе предлагается использовать измельченные до порошкообразного состояния оптические диски в качестве инертного заполнителя в мелкозернистом бетоне. Представлены примерные объемы производства оптических дисков и их отходов. Обоснованы актуальность и возможность утилизации измельченных оптических дисков в качестве заполнителя в мелкозернистом бетоне. Приведены примеры использования аналогичных полимерных материалов в качестве заполнителя в цементных смесях.

Ключевые слова: мелкозернистый бетон, оптический диск, полимерный заполнитель, утилизация, цементная смесь.

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LVL AND ITS PRODUCTION PROSPECTS IN THE CENTRAL CHERNOZEM REGION

A.I. Surnenkov, V.O. Mesheryakova
Tambov State Technical University, Tambov, Russia
e-mail: Lerochek68@mail.ru

Abstract
The relevance of wooden constructions is considered; the use of these constructions in different countries is analyzed. The advantages and disadvantages of the construction material LVL, its history, places of production in the territory of the Russian Federation and its development prospects in the territory of the Central Chernozem region are mentioned.

Key words: wooden constructions, LVL (Laminated Veneer Lumber), multistory housing.

Introduction

The growing interest in the economic, social and environmental spheres of society has brough about such a notion as “sustainable development”. At present, the most popular and demanded buildings and structures are energy-efficient, energy-saving, environmentally friendly and socially adapted. No other building material except wood meets these requirements. With technological progress, more and more new techniques and processing technologies are constantly being developed. These techniques maintain the properties and qualities of natural wood as well as eradicate defects. The third millennium has been marked by a significant increase in the use of wood, both in low-rise and multi-storey housing construction.

At present, the developed countries have following quantity of wooden housing structrues: in the USA - 67%, in Canada - 50%, in Sweden - 47%, in Japan - 45%. Great Britain was one of the first countries that built a 9-storey residential building in London. In other countries high-rise, wooden buildings are built with a height of 18-30 floors (for example, Canada, Vancouver).

Similarly, the development of wooden housing structures can be observed in Russia. On May 17, 2016, Russian President Vladimir Putin approved a list of instructions on the results of the meeting of the State Council. One of them was the development of a set of measures for the development of wooden housing constructions in the Russian Federation [1]. While fulfilling the assignment, projects for the timber industry development till 2030 were prepared by A. Khloponin and D. Kozak. According to which, the increase of the quantity of the wood-based housing constructions in the total building volume in Russia will have reached 20% by the end of 2025. Our country also follows the path of development of multi-storey wooden housing constructions, the first timber-based house - is 19.5 meters high has been erected. In the future it is expected to obtain permission

to build buildings up to nine floors. One of the innovative approaches in the construction of multi-storey and unique buildings and structures is the use of LVL.

LVL (laminated veneer lumber) is a structural material manufactured by bonding together peeled thin softwood veneers (pine, spruce, larch). It is one of the types of glulam wooden constructions. The wood fibers of the adjacent veneer layers are arranged predominantly longitudinally to each other, which distinguishes the LVL from the plywood. This material was developed in 1935 by the federal forestry in the United States. But because of its technological characteristics in production, laminated wood has not become very popular. In Russia, LVL production was launched in 2009. And the first official mention of this construction material appeared in 2011 [4]. For our country this material is relatively new. And in the 21st century there are all resources and opportunities for extension and modernization of production capacities.

The advantages of LVL include high resistance to moisture, fire resistance, biostability, high design resistance to external factors [5, Table. 3, 5 and 7], easy installtion, and stability of technical characteristics, environmental compatibility, aesthetic qualities, and wide size range.

The main disadvantage of LVL is the cost. This is the most expensive wood-based material. Despite this, glulam laminated timber LVL is the leader in the world construction market when designing unique buildings and structures, both large-span and multi-storey ones.

In Russia, LVL is produced by two factories, using their patented technologies:

1. “Taleon Terra” is a factory in Torzhok, the Tver region. It is the largest LVL production factory in Europe. The brand name of the material is LVL-Ultralam. Its main consumers are the USA, Europe and Russia.

2. “LVL-Yugra” is a factory in Nyagan (Khanty-Mansi Autonomous Okrug). The brand name of the material is LVL-Yugra.

The thickness of the peeled veneer in the LVL-bar is about 3 mm, and the length of the bar can be 20-24 m, which is much larger than the length of veneer sheets. In this regard, a certain technological process of production is organized. The first stage, consisting in obtaining a dry veneer, does not differ from the technology of plywood production. The second stage is the assembly of packages and their hot pressing. To obtain construction (structural) LVL at the second stage, special equipment is required. A detailed diagram of the LVL production technology is shown below in figure.

In the Central Chernozemye region there are 47 woodworking industries. The largest one is JSC “Tamak” in Tambov. None of them is engaged in the production of plywood, therefore, the LVL production on the existing base is impossible, it is required to open a new technological line.

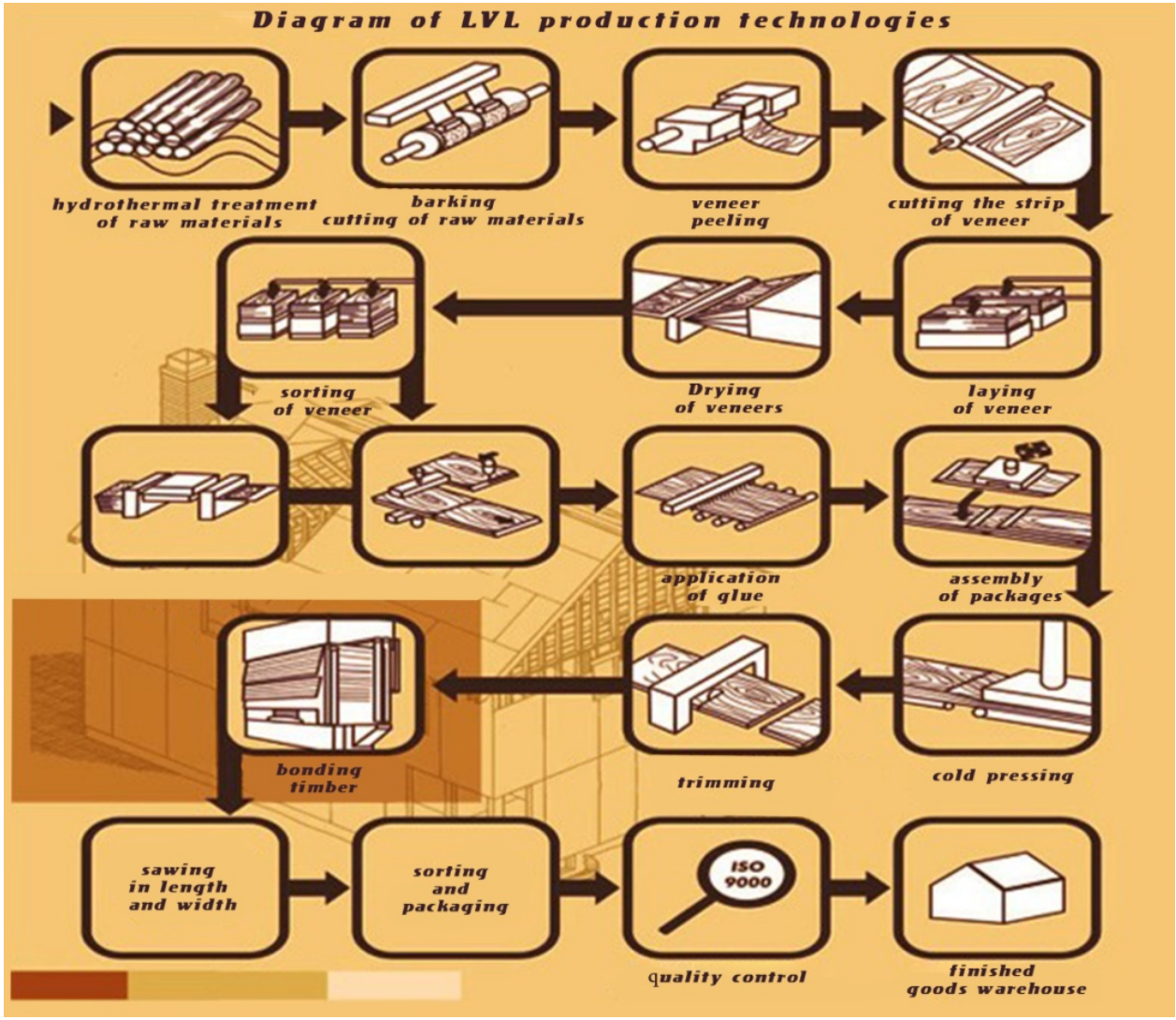

Fig. 1 – Diagram of LVL production technologies

Conclusion

On the territory of the Central Chernozem Region the production of such structures does not make economic sense, as this territory does not have a sufficient volume of softwood material base. This problem can be solved by creating this base, the predominant hard coniferous species, while simultaneously carrying out the production process, processing technologies, using the raw materials of the nearest areas. The second solution of this problem can be the opening of the workshop for the assembly of such structures, which will increase the productivity of major suppliers.

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LVL И ПЕРСПЕКТИВЫ ПРОИЗВОДСТВА В ЦЕНТРАЛЬНОМ ЧЕРНОЗЕМЬЕ

А.И. Сурненков, В.О. Мещерякова
Тамбовский государственный университет, Тамбов, Россия
e-mail: Lerochek68@mail.ru

Аннотация

В данной статье рассмотрена актуальность применения деревянных конструкций, проведен анализ применения этих конструкций в разных странах. Приведены достоинства и недостатки конструкционного материала LVL, история его возникновения, места его производства на территории Российской Федерации и перспективы развития на территории Центрального Черноземья.

Ключевые слова: деревянные конструкции, клееный брус, многоэтажное строительство

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ENVIRONMENTAL SAFETY OF PLYWOOD AS A MULTILAYER BUILDING MATERIAL

A.V. Suzyumov, M.A. Popov, D.A. Sitnikova
Tambov State Technical University, Tambov, Russia
e-mail:popovma@yahoo.com

Abstract
The article discusses the eco-friendly building materials, using the example of the four types of plywood. The analysis of the environmental friendliness of each species and their operational effectiveness was carried out.

Key words: environmentally safe materials, multilayer building materials, plywood, albumin and casein glue, carbamide-based glue, formaldehyde glue, bakelite glue.

In modern construction for the erection, restoration and re-construction of buildings and structures, a huge number of building materials and structures is used. Both natural and technogenic raw materials are used for their production (for example, industrial waste, etc.).

As a rule, the main criteria for the selection of building materials and products are operational and economic parameters. Another important indicator is the environmental safety of the product. Numerous studies have shown that many building materials, both natural and man-made have radioactivity and toxicity. The use of such materials in the construction and repairs of buildings can negatively affect the overall health of a person and even cause a number of diseases. Therefore, the problem of choosing environmentally friendly multi-layer composite building materials is topical in nature and the search for its solution is in demand in the conditions of the development of the modern market.

One of the most common materials used in construction is plywood. Currently, there are many different types of plywood slabs, differing in their composition, characteristics and performance properties. The fact of frequent use of this material in construction raises questions about its environmental safety, because often the products of plywood are used for interior finishing of the premises. Continuous exposure to a room with a high concentration of harmful substances (phenol, ammonia, formaldehyde, etc.) increases the risk of human diseases.

Plywood is an environmentally friendly product as the material for its production is natural wood. Various types of impregnation and adhesive compositions, through which veneer layers are collected in a separate sheet, influence the degree of environmental safety of finished products. Gluing is an indispensable process in the production of plywood slabs, because it is through impregnation that they acquire qualities that are uncharacteristic to the natural materials - strength, durability and resistance to moisture. From this, it follows that the main difference between the modifications of plywood slabs is the composition

of additives used for manufacturing. Thus, the more natural the ingredients are, the better ecological qualities the finished products possess.

The most natural plywood produced at this point is the plywood of the brand FBA. It is made of environmentally friendly materials that do not pose any danger to the human body. The basis of this product is albumino-casein glue, which is completely natural material. Its components are derived from dairy products (casein) and animal blood (albumin). Such plywood is not moisture resistant and can be used to create small and medium-weighted furniture designs, as a finishing material for rooms in which air humidity does not exceed the normative parameters (children's bedroom, bedroom, etc.). FBA plywood refers to the products of the middle price category, which makes it an optimal choice for those who prefer environmental friendliness and safety for health.

Another environmentally safe material is the FK plywood. Carbamide-based glue made on the basis of carbamide resins is used as a glue composition. This impregnation contains formaldehyde, but its bound state does not do harm to human health. The physical and economic properties of the FK plywood are comparatively better than the FBA analogs; however, in construction it is used only for interior construction and in furniture production. It is allowed to use products based on carbamide glue when constructing the formwork for strip foundations, but due to poor performance, its turnover is low.

FK plywood sheets are deformable when moisture gets to the surface; and then when exposed to drying they tend to loosen or curl. To improve the moisture-resistant properties of the material when impregnating veneer, resin formaldehyde glue is used. Thus, there is one more kind of plywood - the plywood of the brand FSF. When dried after a short wetting, this kind of material returns to its original dimensions, and this practically does not affect its appearance and physical properties. However, the content of phenols in the composition of the glue poses a risk when using such a material in living quarters, so it is used for exterior decoration of buildings and for the construction of a form where ecological characteristics do not play such a large role.

FB plywood has the best performance characteristics among the above varieties. This plywood is called bakelized, and apart from construction it is used in the shipbuilding, aircraft and automotive industries. It does not lose shape, does not soak, does not warp, provides high quality of surface, can withstand even a hundredfold use as a formwork. However, from the ecological perpsective, FB plywood is inferior to its analogs.

Thus, we can conclude that the choice of plywood for certain construction works directly depends on the purpose of the finished structure, the degree of humidity affecting the surface of the environment and the mode of operation of the material.

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ЭКОЛОГИЧЕСКАЯ БЕЗОПАСНОСТЬ МНОГОСЛОЙНЫХ СТРОИТЕЛЬНЫХ МАТЕРИАЛОВ НА ПРИМЕРЕ ФАНЕРЫ

А.В Сузюмов, М.А. Попов, Д.А. Ситникова
Тамбовский государственный технический университет, Тамбов, Россия
e-mail:popovma@yahoo.com

Аннотация

Рассмотрены экологически безопасные строительные материалы на примере фанеры четырех типов. Произведен анализ экологичности каждого вида и их эксплуатационной эффективности.

Ключевые слова: экологически безопасные материалы, многослойные строительные материалы, фанера, альбумино-казеиновый клей, карбамидный клей, формальдегидный клей, бакелитовый клей.

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CONDITIONS AND PROSPECTS OF RUSSIAN CONSTRUCTION INDUSTRY DEVELOPMENT

A.Y. Tetushkina
Tambov State Technical University, Tambov, Russia
e-mail: annatetyshkina@yandex.ru

Abstract
The article analyzes residential construction and dynamics of its main indicators. The research shows the amount of residential buildings constructed during the last years. The article also estimates the amount of construction of residential buildings and structures in Russia and presents the technology of prefabricated buildings construction.
Key words: buildings and structures; construction; dynamics; residential construction.

Introduction

The prosperity of any region mostly depends on the infrastructure development. The most important factor is a well-organized construction activity as one of the most important parts of economy which contributes not only to the regions prosperity, but also to the increase in reproduction. Construction industry plays a significant role in forming gross domestic product, which is a very important indicator. Finding the best strategy for developing innovations in the construction industry is the most important objective of the government which should help the analyzed industry to reach a new level.

Relevance and aim of research

The aim and relevance of our research is the analysis of the state and development of construction industry in Russia. The novelty of this article lies in the fact that we have offered the technology which can reduce the time and costs of buildings construction in Russia.

Being an independent economy realm, construction industry is characterized by commissioning new buildings and structures, facilities, repair, technical upgrading of functioning facilities and reconstruction of old production and non-production facilities.

Compared with Europe, Russian construction industry is determined by geographic, demographic, territorial characteristics of any region. That is why permanent control, analysis of the changes of main indicators which show the growth or decline in construction, the changes of supply and demand in a certain area are the main objectives of the construction authorities. They must also determine the correlation between the main indicators of construction and investment activity [2].

Considering the amount of construction investments in 2013, we can see a decrease in 2014-2016, an increase in the next two years can be explained by different international sports events held in Russia.

The construction and reconstruction of residential buildings and structures, which must conform to the modern safety, comfort and ecology requirements, play the main role in the construction complex.

Over the past 3 years there has been a certain decline in Russian residential construction. In 2014 approximately 82 million m^2 of residential buildings were constructed, in 2015 - 85 million m^2 but in 2016 about 80 million m^2 of buildings were constructed [1].

Industrial residential construction, which is characterized by apartment buildings, decreased by 4% in 2016, individual residential construction decreased by 10%. It can be explained by the fact that citizens do not have enough money to build private residences and mansions, because they are much more expensive than flats [1].

Nowadays, Russian economy is unstable, the demand for various residential buildings is constantly ranging. In 2016, 81 million m^2 of buildings were constructed in Russia, mostly in Central Russia [1].

The largest amount of residential buildings can be found in Republics of Tatarstan and Bashkortostan and Moscow and Moscow Region.

The total construction works in these regions comprised about half of the total amount of constructed buildings. Various types of complex projects, which are aimed at constructing environment-oriented and safe houses, are widely used. All of them have become available due to modern construction technologies such as production of brand-new facing materials, creation and production of innovative technologies for constructing wooden buildings and structures, development of innovative technologies for constructing energy resource effective buildings, etc. The amount of constructed buildings is expected to increase by the end of 2017 due to the availability and implementation of innovative technologies.

Due to the conventional conditions, competitive performance of construction organizations became the important requirement for their subsequent development. A permanent development increase is accompanied the in construction and installation work, the implementation of new technologies, the construction of sophisticated and unique facilities and the implementation of national projects. We can see a rapid development of housing and public utilities system, that is why public service and living standards are rising.

In order to increase the quality and reduce the time and costs of residential construction in the Russian Federation, we could follow the model of Chinese developers who construct secure and affordable buildings and structures in a short period.

If this technology is used, the classical construction (buildings construction, construction and installation work) becomes a complex process which includes:

- manufacturing the fabricated blocks of the future construction;
- subsequent assembly of the blocks at the construction site.

The majority of the basic components (including large ones) are manufactured in the assembly line production that is why standardization, quality

control and material control are improved. The technology makes it possible to reject various construction trades becoming irrelevant, unnecessary and technically incompetitiveand helps to reduce the impact of a human factor on the quality and ease the process of construction.

The implementation of this innovation in Russia would increase the competitive performance of construction industry in our country. It would also increase the quality and speed of buildings and structures construction and reduce the construction cost.

The research in construction and commissioning of new residential buildings gives an opportunity to determine the direction of forming this economy realm. Nowadays, this kind of activity is characterized by dynamic growth, an increase in investments, implementation of new plans and innovative technologies.

Conclusion

As a result, we can mention that the Russian construction industry has reached the high level andthe quantity and quality of works continue to increase. However, the indicators can be raised by implementing Chinese technologies of prefabricated buildings construction, because perfection knows no limits.

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СОСТОЯНИЕ И ПЕРСПЕКТИВЫ РАЗВИТИЯ СТРОИТЕЛЬНОЙ ОТРАСЛИ РОССИЙСКОЙ ФЕДЕРАЦИИ

А.Ю. Тетушкина
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: annatetyshkina@yandex.ru

Аннотация

В статье анализируется уровень жилищного строительства и динамика его главных показателей, отмечен объем введенного в последние года жилищного строения. Оценивается уровень строительства жилых зданий и сооружений в России. Представлена технология возведения быстровозводимых домов.

Ключевые слова: здания и сооружения; строительство; динамика; жилищное строительство.

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DESIGN CONCEPTS FOR MULTI STOREYED BUILDINGS WITH STEEL FRAMES IN TAMBOV

D.A. Tolmachev
Tambov State Technical University, Tambov, Russia
e-mail: dmitrytolmachev@rambler.ru

Abstract
The number of design concepts for multi-storey frame buildings makes it necessary to identify the most effective concepts that meet the requirements of the 21st century. The paper is aimed at the identification of the most appropriate design concepts for multi-storey buildings with steel frameworks in the city of Tambov. The following results were received: the available information on multi-storey buildings with steel frames was analyzed and the most efficient and cost-effective building design concept was chosen. The research consisted of four stages: finding general information, analyzing the information, comparing possible options for design concepts, choosing the most effective concept.
Key words: design concepts, multi-storey buildings, steel frames.

Introduction

Recently, there has been a significant increase in prices for land in large and medium-sized cities of the world. In this regard, there is a need for high-rise buildings to reduce the cost and rent of the land. Since most of the soils in the Tambov region are unsuitable for bearing significant loads, it is decided to use the metal frame of the building to unload the foundation. In our country as well as in foreign countries, there is a variety of design concepts for such buildings. The main goal of our research was to choose the most efficient and cost-effective design concept.

Possible design concepts for multi-storey buildings

High-rise buildings are structures such as 12-storey buildings. It is reasonable to design high-rise multi-storey buildings as skeleton structures with load-bearing elements made of high-strength steel and lightweight wall panels produced of effective materials. The most material consuming structures in such buildings are columns (40-60%) and beams (30% or more). As the space between columns increases, the total weight of columns decreases, whereas weight of the beams increases. In buildings with the height equal to 30-40 storeys, the optimal space between columns is 4-6 m. The design models of buildings must provide the spatial rigidity of a building. There are such design models as frame-models, bond-models and frame-bonded constructive schemes.

In frame systems consisting of transverse and longitudinal frames, spatial rigidity is provided by rigid frame units. Horizontal loads are carried mainly by the elements of the frame, it is recommended to take into account the increased deformability of buildings with a height of more than 12 storeys and with small dimensions in plan in that design as well as the uneven distribution of the bending

moments caused by horizontal loads. This makes it difficult to unify the elements of the frame and reduce the technical and economic indicators when the height of buildings increases. Such systems are rational for relatively low buildings. In frame works of a column, as a rule, a closed square or circular section is designed which is equally stable regarding the principal axes. In this case columns are calculated at the elastic stage of operation in accordance with the requirements of Building Regulalations II-23-81 [1].

It is recommended to make girders of welded and rolled I-beams, including bimetal, and I-beam with a ribbed web. Welded joints of I-girders with columns which have a closed cross section and I-sections can be designed in two types: with coverplates, connection flanges of girders to columns, and without coverplates. Connections without coverplates are more preferable and reliable that allows creating zones of controlled plastic deformations. It is required to increase the accuracy of manufacturing and installation as well as use additional operations (milling of the ends of girders, etc.).

In frame-bonded systems, spatial stiffness is made by bonding in transverse and longitudinal directions. The predominant part of horizontal loads is transferred to special vertical stiffening elements (diaphragm plates, bond blocks, end walls, staircase walls, lift shafts, etc.), Some of horizontal loads are carried by frames. The application of this scheme usually leads to the reduction in the values and equalization of the bending moments in the frame elements caused by horizontal loads which makes it easier to unify the frame elements.

In bond models, with the hinged connection or yielding connection of columns and girders, in which most of the loads are carried by ties, diaphragm plates, stiffening cores, and the frames only carry vertical live and dead loads.

In frame-models and bond-models frameworks of the column, it is recommended to design them from H-girder, cross, closed, square and tubular sections (the first concept should be preferred in the design of bond-models frames). It is advisable to design girders of tied and frame-bonded frames from rolled H-girders or welded I-beams with a ribbed web. Node connections and ties must provide a scheme for the operation of skeletons in earthquakes in accordance with the design dynamic models and design concepts adopted at the design stage. During the construction of buildings with a height of 100-200 m, both steel and reinforced concrete frames are used. Each of these concepts has its advantages and disadvantages. However, since the 1960s, buildings have been constructed with the bigger height, which is 300-400 m. As the height of buildings increases, loads increase considerably, horizontal forces become especially dangerous. This complicates the provision of horizontal stiffness and the overall stability of buildings.

When designing buildings and structures, it is necessary to use such design concepts that have to meet the requirements of economy and industrialization of construction. Local conditions of construction must be taken into account - climatic, engineering-geological, seismic, ecological, etc. The design concept and

choice of materials for its implementation are largely determined by the dimensions of buildings and structures, their purpose and functional characteristics, the required durability, architectural and aesthetic, economic and other considerations.

Tambov is a Russian city; it is the administrative, economic and cultural center of the Tambov region. Tambov was founded in 1636 on April 17, on the wooded and marshy banks of the Tzna, where the small Studenets river flows into it. The Tambov region is located in the middle of the zone with a temperate climate, practically in the center of the Russian plain and occupies the greater part of the Oka-Don lowland. Soil in the Tambov region is mostly black earth. The climatic conditions of Tambov are determined by its geographical location. The climate is moderate-continental, with four seasons. Due to its geographic location, the city does not have any earthquakes. The average annual wind speed is 3.2 m / s. Seismic stability and low wind speed in the region favorably affect high-rise construction and do not require additional costs.

Conclusion

Thus, it can be said that all types of design concept of multi-storey buildings as well as geographical, climatic and seismic conditions in the city of Tambov have been considered. In the paper based on the research, the conclusion was made about the most cost-efficient variant of the building frame system

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ПРОЕКТНЫЕ РЕШЕНИЯ МНОГОЭТАЖНЫХ ЗДАНИЙ СО СТАЛЬНЫМИ КАРКАСАМИ В ТАМБОВЕ

Д.А. Толмачёв
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: dmitrytolmachev@rambler.ru

Аннотация

В настоящее время существует большое количество проектных решений многоэтажных каркасных зданий, что вызывает необходимость выявить наиболее эффективные решения, отвечающие требованиям 21 века. Работа направлена на выделение наиболее приемлемых проектных решений многоэтажных зданий со стальными каркасами в г. Тамбове. Были получены следующие результаты: была проанализирована доступная информация о многоэтажных зданиях со стальными каркасами и выбраны наиболее эффективные и экономически выгодные конструктивные решения зданий. Мое исследование состояло из 4 этапов: поиск общей информации, анализ найденной информации, сравнение возможных вариантов конструктивных решений, выбор наиболее эффективного решения.

Ключевые слова: проектное решение, многоэтажные здания, стальные каркасы.

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THE USE OF SOIL PILLOWS IN THE CONSTRUCTION OF LOW-RISE RESIDENTIAL BUILDINGS

A.V. Vlasov
Tambov State Technical University, Tambov, Russia
e-mail: alexey.vlasov.2017@list.ru

Abstract
The analysis of structural concepts of soil pillows is made; the advantages and disadvantages of the materials used in this case are discussed, the design and installation of soil pillows for low-rise residential buildings are considered.
Key words: crushed stone, pillow, foundation, gravel, sand, soil.

Introduction:

The soil pillow serves to create a stable and level platform for the foundation and reduce the level of its settlement. If the pillow is not laid well enough, the foundation will shear or later shift, which will gradually lead to the destruction of the building as a whole. It is the pillow under the foundation that makes it possible to provide an acceptable load on the foundation.

The purpose of the study is to optimize the design solutions for the construction of soil pillows in the construction of low-rise residential buildings.

To achieve this goal, the following tasks were set:

1) Analysis of the design of soil pillows in the construction of low-rise residential buildings.

2) Analysis of the use of soil pillows in the construction of low-rise residential buildings.

3) Analysis of advantages and disadvantages of materials for the use of a soil pillow.

The use of soil pillows in the construction of low-rise residential buildings

The project dealing with the use of soil pillows must indicate: the thickness and dimensions of the pillow in the plan within the individual foundations or buildings and structures; the plan of the pit for the use of soil pillows; recommended types of soils for erecting soil pillows; values of optimum humidity of recommended types of soils; the thickness of back fill layers; types of soil compacting mechanisms and the approximate number of their passages to compact the soils to the required degree of density; the design pressure on the compacted soil of the pillow.

The required thickness of the soil pillow is determined from the condition of complete elimination of the subsidence properties of the soils within the deformable zone caused by the load of the foundations. With a significant thickness of the soil pillow, it is allowed to reduce and use soil pillows only within

the upper parts of the deformed zone. In this case, the possible thickness of the soil pillow with partial elimination of the subsidence properties of the soils within the deformable zone is determined by the calculation of deformations, proceeding from the fact that the total precipitation and subsidence of the foundations of buildings and structures must not exceed the maximum permissible values for them.

When erecting buildings and structures that are not effected by to uneven settlement, and especially low-level ones with the load on the strip foundation up to 150 kN / m, the column type-up to 600 kN, the thickness of the soil pillow can be reduced.

The dimensions of the soil pillows in the plan are assigned depending on the size of the foundations, their configuration in terms of the ground pressure adopted etc. If it is necessary to create a solid low-permeability screen, the soil pillows are arranged within the whole building or structure. Dimensions of soil pillows in this case depend on the condition of draining of emergency waters out of the deformable zone of the ground at the base of the foundations and should protrude from the outer edge of the foundations for the width of at least 1.5 m.

Soil pillows are arranged in open pits to distribute pressure from the foundation to the sick area of a weak ground or to replace weak soil with the small capacity. Before the pillow arrangement, the bottom of the foundation pit is planned and the upper layer of the soil is compacted to the design density. For the arrangement of pillows, local dusty-argillaceous, sandy and sandy gravel soils of optimum humidity are used, as well as gravel, crushed stone and slag. It is allowed to use soils with the content of organic inclusions and clods of frozen soil up to 10 cm in size with the total content of no more than 15%.

When constructing artificial bases in the form of soil pillows, a layer-by-layer compaction of the soil is used. The thickness of the layers to be filled is taken, determined depending on the equipment used for the compaction.

Soil pillows have the thickness of 1.5-5 m. In practice, there are cases of pillows with the thickness of 10-12 m. Most often, soil pillows are used in subsidence soils. The sedimentary primer is replaced with the local soil, laid with the given density.

Draining materials (sand, crushed stone, slag) for the installation of pillows can be used in non-subsurface soils, as well as in subsurface conditions of type of subsidence.

When soil pillows are used to eliminate the subsidence properties of the substrate, the density of dry soil must be at least 1.6 t/m^3. Soil pillows are arranged throughout the area of the excavation or under separate foundations. Soil compacting mechanisms for pillows are chosen depending on the amount and timing of the work and the type of the material used for the pillow.

The sand pillow is distinguished not only by the simplicity of its use, but also by the lowest cost. The main advantage of a sand pillow is the possibility of using the hydro isolation layer without damaging the integrity of the cover. The

disadvantage of a sand pillow is its low carrying capacity. A sand pillow is used in cases: construction of low-rise buildings; deep groundwater level; use of lightweight materials. The disadvantages of the material are high susceptibility to moisture. To avoid this, even under conditions of high groundwater, the drainage layer is used, and if all the conditions are met, then the sand pillow will fully perform the functions assigned to it.

The crushed stone pillow assumes the use of crushed stone fractions from 20 to 40 mm. If the construction requires saving money, secondary crushed stone can be used. The pillow of this material has advantages due to the quality of the rubble: a good margin of safety, resistance to groundwater, the possibility of use under multi-level buildings. The crushed pillow does not have disadvantages of a sand pillow. However, like any material, the gravel pillow has its drawbacks: high cost; the formation of voids between stones; lack of quality waterproofing.

Conclusion

Both types of pillows have advantages and disadvantages. The decision which bulk material to use is taken at the design stage, this decision depends on several important factors: the type of soil in the building, the purpose of the erected structure, the budget provided; for a low-rise residential building, the base under the foundation will be fully provided with a sandy pillow, it will also be more cost-effective in relation to crushed stone.

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ИСПОЛЬЗОВАНИЕ ГРУНТОВЫХ ПОДУШЕК ПРИ СТРОИТЕЛЬСТВЕ МАЛОЭТАЖНЫХ ЖИЛЫХ ЗДАНИЙ

А. В. Власов

Тамбовский Государственный Технический Университет, Тамбов, Россия

e-mail: alexey.vlasov.2017@list.ru

Аннотация

Проведен анализ конструктивных решений устройства грунтовых подушек в целом. Именно подушка под фундамент позволяет обеспечить допустимую нагрузку на фундамент.

Целью исследования является оптимизация конструктивных решений возведения грунтовых подушек при строительстве малоэтажных жилых зданий.

Ключевые слова: гравий, грунт, песок, подушка, фундамент, щебень.

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ANALYSIS OF THE FORCES CALCULATION METHOD FOR THE FOUNDATION DEFORMATION CAUSED BY UNDERGROUND WORKS

T.S. Vyazovova
Tambov State Technical University, Tambov, Russia
e-mail: vyazovenok@gmail.com

Abstract
The calculation of beam structures on elastic foundations taking into account their shear deformation is a current task in the field of structural mechanics. The work of buildings in case of foundation deformation caused by underground works is analyzed through the method proposed by A.N., Pushilin, A.V. Favorov, and V.I. Scheinin. It focuses on shear rigidity of the building which effects the calculation.
Key words: calculation of forces, deformation, foundation, shear rigidity, wall-beam.

Introduction

The study of foundation deformation caused by underground works is important from the practical point of view, because the strength and stability of the foundation during the construction of underground structures (tunnels, subways) provides safety and reliability of the erection, maintenance and repair of constructions and structures in general.

The method of forces calculation

The method of forces calculation in the construction in case of the foundation deformation caused by underground works suggested by A.N. Pushilin, A.V. Favorov, V.I. Scheinin is based on the equation:

$$y(x) = S(x) + U(x) \quad (1)$$

where y(x) is complete deformation;

S(x) is settlement of the "free" foundation surface ("mould of settling") caused by underground works;

U(x) is the foundation deformation caused by the contact between the foundation and the sole of the structure.

The function *U(x)* is determined in the interval (*L*), which is restricted to the extreme points of the building.

In case of the "wall-beam" the solution to the equation (1) is presented as the following differential equation:

$$EI \cdot \frac{d^4 y(x)}{dx^4} - \frac{EI}{GF} \cdot \frac{d^2[k(x) \cdot (y(x) - S(x)]}{dx^2} + k(x) \cdot \big(y(x) - S(x)\big) = q(x) \quad (2)$$

Here the foundation is described by the hypothesis of Winkler taking into account the coefficient of rigidity varying with length. The construction of the great length is modeled as a "wall-beam» with two generalized rigidity characteristics EI and GF.

The “mould” form *S(x)* is set by the exponential function:

$$S(x) = S_0 \exp(-x^2/a^2) \tag{3}$$

where S_0 is the maximum settlement of the “free” foundation surface;

a is a parameter characterizing the intensity of *S(x)* change along the axis *x*.

The solution of the differential equation (2) must meet the conditions of the strength balance as well as boundary conditions:

$$Q(x)\Big|_{x=\pm\frac{L}{2}} = -EI\frac{d^3y(x)}{dx} + \frac{EI}{GF}\cdot\frac{d^2(k(x)U(x))}{dx^2} = 0; \tag{4}$$

$$M(x)\Big|_{x=\pm\frac{L}{2}} = -EI\frac{d^2y(x)}{dx^2} + \frac{EI}{GF}\cdot(k(x)U(x) - q(x)) = 0 \tag{5}$$

The analytical solution of the equation (2) with boundary conditions (4) and (5) is difficult because all boundary values of the forces at the ends of the beam structure are expressed by the combination of derivatives functions.

The best solution of this equation is a numerical method. In this case the software package Mathematica 4.1 is used.

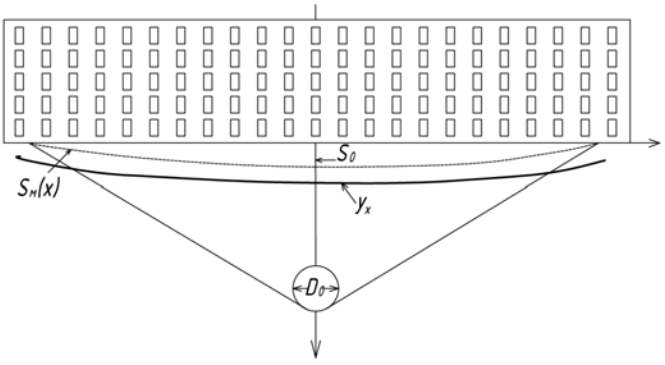

Fig. 1 - General scheme of modeling a building over underground works according to the principle of a "wall-beam"

According to the results of the calculations the analysis of the foundation work at different depth of underground works is made. The cross-sectional diameter of the tunnel is 6m.

Table 1. Influence of the depth of underground works on strength factors of the foundation

H, m	S_0, m	a	B_m, m	Y_{max}, m		M_{max}, m	
				beam	wall-beam	beam	wall-beam
20	0.048	8.913	41.357	0.146	0.123	11017	5649
25	0.058	9.892	49.990	0.143	0.121	9343	5054
30	0.041	11.618	57.017	0.142	0.121	8113	4828
40	0.032	15.142	72.661	0.139	0.120	6058	4411
50	0.026	18.752	88.299	0.137	0.119	4387	3963

H is the depth of underground works; $S_0$is the maximum settlement of the "free" foundation surface; a is a parameter characterizing the intensity of $S(x)$ change; B_m is the width of the "mould"; X_{max} is the maximum deflection; M_{max} is the maximum torque.

Based on the table data we concluded that increase of the depth H from 20m to 50m leads to the following changes in the work of the foundation:

- the maximum deflection Y_{max} decreases by 6% for beams and by 3.3% for the wall-beam;
- the maximum torque M_{max} decreases by 2 times for beams and by 1.5 times for the wall-beam;
- the "mould" form becomes wider and more gentle;
- the influence of shear rigidity is gradually leveled.

Conclusion

It is clear that with the increase in the depth of underground works values of the maximum deflection and the maximum torque decrease that favorably affect the common work of the foundation and structures. However, the increase in the depth of underground works significantly affects the cost of the works, the number of used material resources, and the duration of the building. These factors must be considered together to maximize the economic effect and provide the stable work of constructions.

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АНАЛИЗ МЕТОДИКИ РАСЧЕТА УСИЛИЙ ПРИ ДЕФОРМИРОВАНИИ ОСНОВАНИЙ ИЗ-ЗА ПРОХОДКИ ПОДЗЕМНОЙ ВЫРАБОТКИ

Т.С. Вязовова
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: vyazovenok@gmail.com

Аннотация

Расчет балочных конструкций на упругом основании с учетом их сдвиговых деформаций является актуальной задачей в области строительной механики. В данной статье проведен анализ работы усилий в конструкциях здания при деформировании основания из-за проходки подземной выработки по методу, предложенному А.Н. Пушилиным, А.В. Фаворовым, В.И. Шейниным с учетом сдвиговой жесткости здания, оказывающей существенное влияние на расчет.

Ключевые слова: основание, деформация, расчет усилий, сдвиговая жесткость, «балка-стенка».

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ББК 38.54

THE PERSPECTIVE OF USING METAL STRUCTURES IN CONSTRUCTION OF EDUCATIONAL BUILDINGS

M.A. Zaytsev, O.V. Umnova
Tambov State Technical University, Tambov, Russia
e-mail: ework.max@yandex.ru

Abstract
A classification of educational institutions and the requirements for their construction are analyzed; THE advantages and disadvantages of metal structures are revealed; the issues of design and building of educational institutions with the use of metal frames are discussed.
Key words: efficiency, metal structures, construction timescale.

Introduction

The issues of sustainable development of our country imply the solution of issues of economic, social and ecological spheres which are considered to be priorities for the building branch. Today it is necessary to take into account all spheres of sustainable development in building and structures design. Buildings of preschool and educational institutions take a special place – «a forge» of the future of our country. There is a problem of building of new, modern, comfortable, creatively developed, environmentally friendly educational institutions which could also be economically rational and quickly erectable. Within the scope of this task we need to search new approaches for developing projects of educational institutions.

The study is aimed at the optimization of the structural concepts for educational institutions with metal frames.

For this purpose, the following specific objectives have been set:

– analysis of classification and structural concepts of educational institutions and basic requirements for them;

– analysis of advantages and disadvantages of structures made of different materials used for constructing secondary educational institutions.

– reduction of the influence of disadvantages of metal frames in a skeletal framework of the building of educational institution.

2. The perspective of using metal for frames of educational institutions and their classification.

Classification of educational institutions is shown in Figure 1 [1].

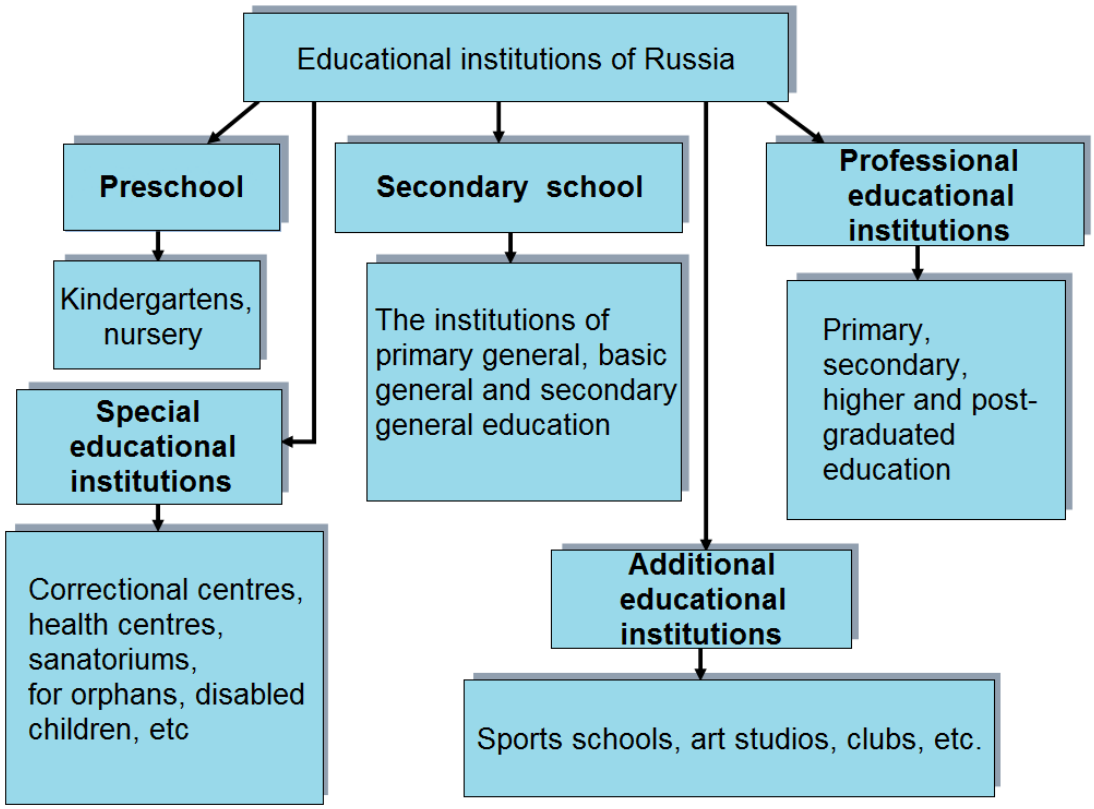

Fig. 1 – Classification of educational institutions in Russia

Based on the above classification (Fig. 1) we assume to analyze the structural concepts for series of educational institutions and offer the project solution for a modern school with a metal frame, finding better solutions for structural concepts.

In the design and construction of schools it is necessary to take account of the student safety issues that are connected with increased requirements for the resistance of building structures as well as issues related to the space-planning decisions and zoning of places for students, teachers and common areas which are calculated according to the standard number of students.

There are specific requirements for systems of firefighting, ecological building materials, fire-resistance of building structures, devices, systems of ventilation and bathrooms, electricity and warning systems. One factor which is no less important for the building construction is the time spent on the erection of a building which affects the estimated value of the construction greatly. The use of metal frames in buildings allows minimizing these terms.

In this regard, the search for new and optimal structural concepts and choice of material for load-carrying structures is an important objective in the design of buildings and their elements.

The main advantages of buildings with metal frames:

- economy. Metal structures provide the minimum cost of a building per square meter with compliance with all safety requirements. It is also less material consuming and more cost-efficient (up to 30%) due to the lower building mass;

- time spent on the building construction. Metal structures require less time for the construction. Here is another advantage of the material - resistance to moisture. In contrast to wood, reinforced concrete or stone structures, metal structures can be built in any weather and all seasons;

- favorable influence on the environment. Buildings of profiled metal are harmless for people, including allergic people and people with asthma; this material does not emit harmful impurities in the atmosphere. Metal is 100% recycled or recyclable, and the structure can be used several times;

- durability. The average durability of the structures made ofrolled metal materials is up to 50 years in the moderately aggressive environment;

- physical properties. Metal structures have a small weight and the high load-bearing capacity. This allows to decrease transport costs and lower material capacity of the constructions;

- competitive ability. Metal structures have minimal allowances while producing structures, full factory readiness that simplifies installation works and minimizes the construction period, improves the quality of the work, sustainable to changes of temperature. Metal structures have great opportunities for architectural concepts.

Disadvantages of metal frames:

- susceptibility to corrosion. This disadvantage can be completely or partially eliminated thanks to new technologies. In order to minimize the influence of atmospheric effects on the quality of the building and increase its durability, metal structures are painted or covered with polymer compounds;

- low fire-resistance. The fire-resistance of structures can be increased in two ways:

1) a constructive method: covering outer walls of a flameproof building with plate materials, installation of fire-resistant screens, applying thick layers of fire-resistant materials, plaster, etc.;

2) the use of fire-resistant paints on the surface of the structure, etc., which are considered to be intumescent coatings after heating

In the last century metal structures were major buildings in our country, but after the decrease of metallurgical production, they lost their popularity.

Since 2000 metal structures have become more popular in Russia. At the moment they are used mainly for the construction of industrial buildings, but they can be also used for civil buildings including educational institutions. For example, in the Krasnodar, Rostov and Stavropol regions decisions have been already made in the sphere of building schools and extensions to them according to the technology of prefabricated buildings with metal frames [2].

Guided by the experience of using metal structures for educational institutions in other regions of our country, we will develop the project of the educational institution with a metal frame for the Tambov region.

3. Conclusion

Thus, the development of the project secondary school with metal frames is acceptable.

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ПЕРСПЕКТИВА ПРИМЕНЕНИЯ МЕТАЛЛА В КАРКАСАХ ОБРАЗОВАТЕЛЬНЫХ УЧРЕЖДЕНИЙ

М.А. Зайцев, О.В. Умнова
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: ework.max@yandex.ru

Аннотация

Проведен анализ классификации образовательных учреждений и предъявляемых к ним требований; выявлены преимущества и недостатки металлических конструкций; рассмотрены вопросы проектирования и строительства образовательных учреждений на основе металлического каркаса.

Ключевые слова: металлические конструкции, период строительства здания, экономичность.

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ББК 32.973.2-018.2

SPECIAL ASPECTS OF METHODS AND MEANS FOR BUILDING INFORMATION SYSTEMS

E. O. Aksenova, M. A. Bakushkina, D. A. Gavrina
Tambov State Technical University, Tambov, Russia
e-mail: margorita950@mail.ru

Abstract
General mathematical theories and models are necessary for calculations and building information systems for the purpose of developing algorithmic, software and information support of IS. Means of information support are represented by hierarchical, network, relational databases and are generalized by the model of a tensor database.
Key words: database, frame, information system, tensor database.

Typically, models of IS are represented as a series of large blocks [1]. Each block performs a certain function, that is, the decomposition is performed over the entire system (Figure 1).

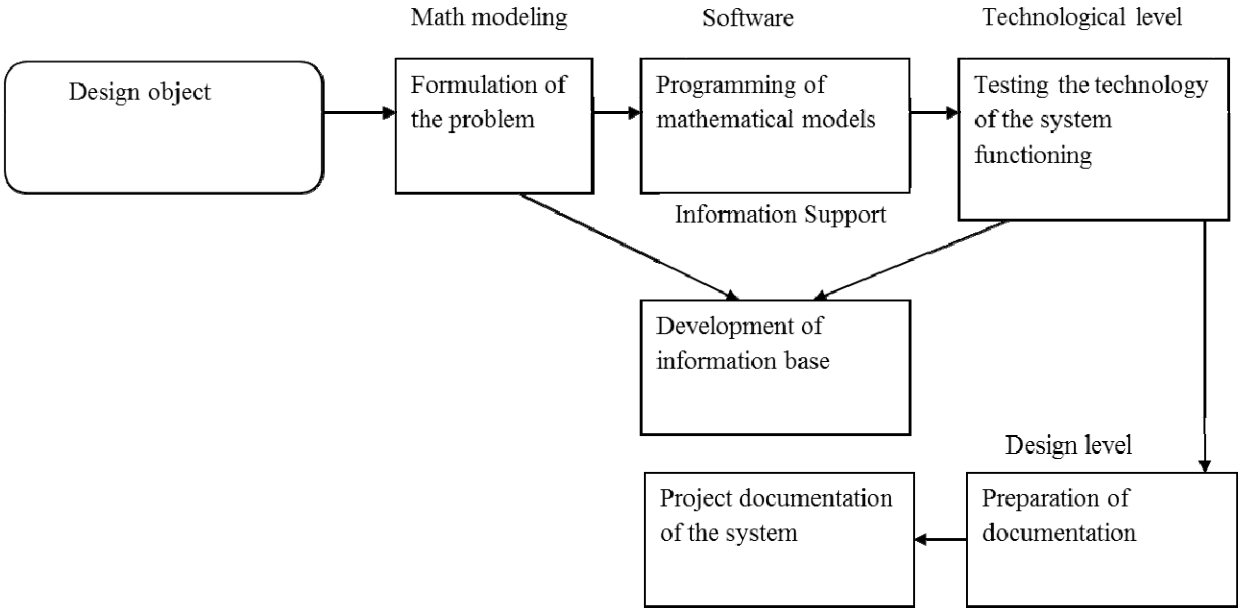

Fig. 1 - Stages of IS building

We introduce the postulate: any algorithm can be reduced to the form:

$$U_{ij} = z_{ij} \cdot i_j, \quad (1)$$

where *ij* is input (initial) data;
Ui is output data;
z_{ij} is an algorithm of transformation.

Interpretation of the quantities *Ui*, *zij*, *ij* is different, so the transition is carried out in a variety of branches of mathematics, but the essence of solving simultaneous equations remains the same.

There is a wide range of solutions to problems, which is represented in the form $U_{ij} = z_{ij} \cdot i_j$. The method of tensor diakoptics is the most common method for solution to such problems [2]. There are four classes of such problems (Fig. 2):

– correct problems (the number of unknowns coincides with the number of equations, the determinant is different from zero);

– problems of incorrect calculation (the total number of variables is not equal to the number of independent variables);

– nonlinear problems (they must be reduced to quasilinear ones);

– always incorrect synthesis tasks.

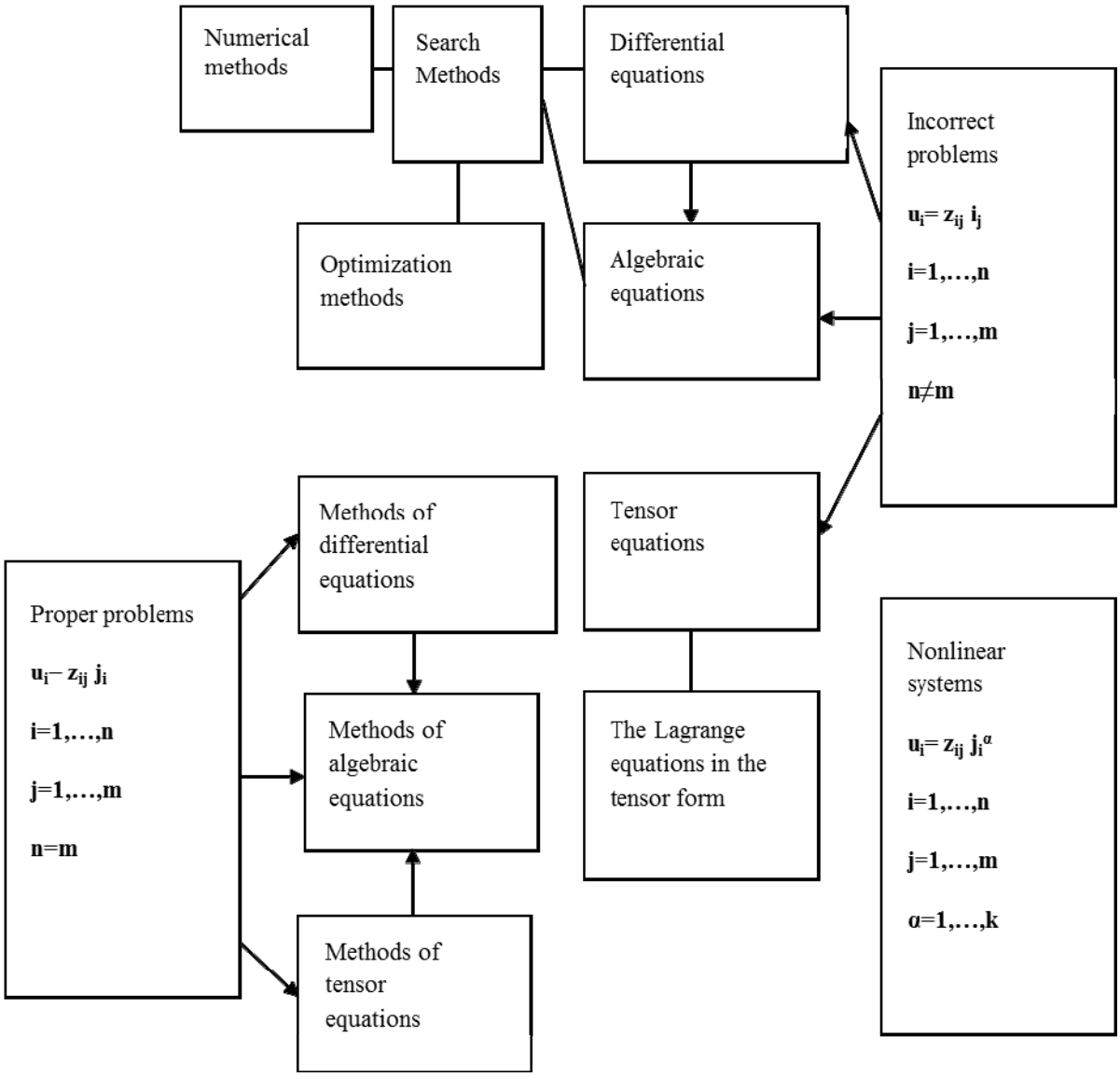

Fig. 2 - Methods of mathematical modeling

Means of information support are represented by hierarchical, network, relational databases and are generalized by the model of a tensor database. Traditional databases have a number of limitations, and the tensor database is their generalization. This is achieved by a technique known in projective geometry, when the proper and improper elements of space are equalized in rights. Data and relationships are represented as equal points in the data space. Dual spaces are formed: coordinate axes represent data, points in space – relationships; coordinate axes – relationships, points in space – data [3]. The algorithm is a curve in such a space between two points, and the problem arises about the shortest distance between two points. Tensor operations can "cut" any subspace in space that corresponds to some conceptual scheme. The references to the tensor database allow defining the data that will act as functions and arguments.

The frame convention is implemented naturally in the tensor database. The database uses it as an invariant object; it is easy to cover various sets of database frames. The tensor database differs from the relational database in that the relational algebra is replaced by a tensor algebra that has only three operations [4]. The relational algebra is intended for structural transformations, and the tensor algebra carries out structural and algebraic transformations.

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ОСОБЕННОСТИ МЕТОДОВ И СРЕДСТВ ПОСТРОЕНИЯ ИНФОРМАЦИОННЫХ СИСТЕМ

Е. О. Аксенова, М. А. Бакушкина, Д. А. Гаврина
ФГБОУ ВО «ТГТУ», Тамбов, Россия
e-mail: margorita950@mail.ru

Аннотация

Общие математические теории и модели необходимы для расчетов и построения информационных систем с целью разработки алгоритмического, программного и информационного обеспечения ИС. Средства информационного обеспечения представляются иерархическими, сетевыми, реляционными базами данных и обобщаются моделью тензорной базы данных.

Ключевые слова: база данных, информационная система, тензорная база данных, фрейм.

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TEXTS CLASSIFICATION ANALYSIS USING SEMANTIC CONFORMITY

A. M. Artamonov
Tambov State Technical University, Tambov, Russia
e-mail: artamonovdev@yandex.ru

Abstract
Methods of machine learning for solving the problem of data classification are considered. The methods of indexing, weighting and classification for a variety of texts have been studied.
Key words: relevance, statistical methods, semantics, classification.

Introduction

Due to scientific and technological progress, the volume of documentation at enterprises is constantly growing. According to a study by IDC in the Digital Universe Study, the volume of accumulated data in companies will be doubled every 18 months. Search is one of the problematic points in the management of large amounts of data. The use of automatic text classification systems will reduce the labor costs of a person to find the necessary information.

Subject area analysis

Knowledge base is a set of software tools that provide search, storage, transformation and recording of complex structured information units. Each document has its own category. There can be a hierarchical relationship between categories.

The first step in solving the task of automatic classification of texts is the transformation of documents. The form of the sequence of symbols that have the form is transformed to a form suitable for machine learning algorithms in accordance with the classification problem. Algorithms of machine learning deal with vectors in space.

The second stage is the construction of the classifying function by means. The quality of the classification depends on how the documents are converted into a vector representation. Also depend on the algorithm that will be applied in the second stage. It is important to note that the methods of converting text to vector are specific for the task of classifying texts. Methods can depend on the collection of documents, the type of text (simple, structured) and the language of the document.

Extracting terms, or extracting features is the process of splitting text into simpler objects.

Semantic analysis is the first step in extracting terms. At this stage, all characters that are not letters are eliminated.

Stop words are words that do not carry any independent semantic load. Stop words include prepositions, conjunctions and pronouns. In order to reduce the dimensionality of space, the indexer does not take into account the stop words and removes them in the analysis. Also, stop words have a strong influence on the selection of keywords. If they are not removed, they clog up the set, since they often occur in the text.

Lemmatization is the reduction of every word in a document to its normal form. In Russian, the normal forms are:

- For nouns and adjectives - nominative, singular, masculine
- For verbs, participles and verbal participles, the verb is in an indefinite form

Stemming is the rejection of the variable parts of words. This technology is simpler, does not require the storage of a dictionary of words or a large set of rules. The technology is based on the rules of the morphology of the language. The lack of stemming is a large number of errors. Stemming is good for English, but worse for Russian.

One of the problems when considering words as terms is their semantic ambiguity, which can be conditionally divided into two groups:

1. Synonyms are the words of one part of speech, different in sound and description, but having a similar lexical meaning.

2. Homonyms are different in meaning, but identical in writing units of language.

You can resolve this uncertainty by using the context of the word in the sentence. For this, the methods of morphological and linguistic analysis are used.

Grouping is the process of combining several consecutive words into one group, which is also called an N-gram. In this case, each N-gram is considered as an independent term of the document.

N-grams are used to search for plagiarism. If you divide the text into several small fragments represented by N-grams, they are easily compared with each other and thus get the degree of similarity of the controlled documents.

N-grams are successfully used to classify text and language.

Using N-grams, you can effectively find candidates to replace words with spelling errors.

The main drawback of using N-grams is the rapidly growing amount of memory needed to store them.

Conclusion

The article describes the fundamentals of the machine learning method for solving the problem of referring text to a certain small knowledge base.

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АНАЛИЗ МЕТОДОВ КЛАССИФИКАЦИИ ТЕКСТОВ НА ОСНОВЕ СЕМАНТИЧЕСКОГО СООТВЕТСТВИЯ

А. М. Артамонов
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: artamonovdev@yandex.ru

Аннотация

В работе рассмотрены методы машинного обучения для решения задачи классификации данных. Проведен анализ методов индексации, взвешивания и классификации для множества текстов.

Ключевые слова: релевантность, статистические методы, семантика, оценка релевантности, классификация.

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TRENDS IN JAVASCRIPT APPLICATIONS DEVELOPMENT

V. A. Chislin
Tambov State Technical University, Tambov, Russia
e-mail: vchislin@gmail.com

Abstract

The language, which first appeared in 1995 and was originally intended to give interactivity to web pages, received a very big boost in its development after it gained popularity due to the widespread use of AJAX technology - asynchronous exchange of browser data with a web server.

At the moment, there is almost no sphere of software development, where JavaScript hasn't appeared - it can be found in the development of server applications, mobile applications, desktop applications and even microcontroller programming.

In order to develop modern applications using this programming language, we need to learn all its features and learn from the experience of large corporations which are using JavaScript language and take part in its development.

Key words: web development, applications, programming, JavaScript

The JavaScript language was designed as a "simple version of the C language" for the web, in which the developer does not need to manage memory and specify types. Due to this, the language has a low entry threshold for beginners, which is one of the main factors of its extremely high popularity. Also a huge contribution to the popularity of the language was the fact that there are a lot of open-source libraries written on JavaScript that can be used for free.

Until some time, many developers and large companies considered JavaScript to be a language not suitable for "real development" due to the lack of static typing, as well as the absence of classes, importing and exporting modules, memory management, and other qualities that are common to other general languages.

During the existence of ECMAScript (JavaScript is one of the implementation of the specification), the specification began to adopt standards that relieve the language of many of its shortcomings, and it has become one of the most popular programming languages in modern development, regardless of platform.

The latest step in the JavaScript development came after the appearance of the engine V8, developed by Google for the browser Chromium. The V8 engine, written in C++, allows compiling the source JavaScript code directly into the machine code, bypassing the conversion stage to the bytecode used previously. Also, it has many built-in mechanisms to avoid memory leaks due to an effective "garbage collector", and also speeds up access to properties and function calls due to caching.

The increased speed of JavaScript code execution allowed using this language in scalable projects, as well as in high-loaded services. One of the modern examples of using JavaScript is Node.js. The software platform is developed by Ryan Dahl in C, C ++ and JavaScript, and uses the Google V8 engine. Node.js allows you to develop server applications (especially web applications that interact with the client in real time) using JavaScript and, unlike browser-based JavaScript, allows to access the file system. It marked the appearance of the JavaScript language outside of web browsers. At the moment there are frameworks (Electron, NW.js and others) that allow creating desktop window applications based on Node.js and Chromium core, as well as applications for mobile operating systems.

Some large companies start using the new features in the JavaScript development environment from the beginning of 2010 and keep one code base for the entire application stack.

For example, the Slack messenger has the same base for the client application in the browser and in the desktop application. The desktop application, in this case, works on the basis of the Electron framework. The main difference is that the desktop application can access the file system thanks to Node.js, and otherwise the interface is displayed in the same way as if it was displayed in the browser - the layout is built in the same way with HTML and CSS.

With the help of such frameworks as Electron, the cost of developing cost can be reduced drastically when native applications for each platform separately, because Node.js and Chromium are available for all mass operating systems.

In scalable projects, the absence of static typing solves add-ons over the TypeScript language (in the development the creator of Delphi and Turbo Pascal was involved) or Dart (developed by Google).

For heavily loaded applications, the WebAssembly standard was developed, which is included in the JavaScript API. It allows you to run machine code written in C, C++ or Rust languages, and has the ability to manage memory, allows you to increase productivity and improve the security of running applications both inside and outside the browser.

As a result, the JavaScript language is an excellent tool for developing scalable applications for all existing platforms. The shared code base for several platforms allows you to reduce development time and create applications with predictable behavior despite of the platform. The Google V8 engine is updated with a look back at Node.js, and all the innovations leave the code executable and stable despite the innovations.

Approach to development with the widespread use of JavaScript has proven itself in a number of companies - such as Microsoft, Google, Slack, Twitch, Shopify, and others.

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ТЕНДЕНЦИИ В РАЗРАБОТКЕ ПРИЛОЖЕНИЙ НА ЯЗЫКЕ JAVASCRIPT

В.А. Числин
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: vchislin@gmail.com

Аннотация

Появившийся еще в 1995 году язык, предназначавшийся изначально для придания интерактивности веб-страницам, получил очень большой толчок в своем развитии после того, как обрел популярность в связи с повсеместным использованием технологии AJAX – асинхронным обменом данных браузера с веб-сервером.

На данный момент нет практически ни одной сферы программной разработки, куда бы не проник JavaScript – его можно встретить в разработке серверных приложений, мобильных приложений, приложений для настольных компьютеров и даже программировании микроконтроллеров.

Для того, чтобы разрабатывать современные приложения с помощью данного языка программирования, необходимо изучить все его особенности и перенять опыт крупных корпораций, использующих и развивающих язык JavaScript.

Ключевые слова: веб-разработка, приложения, программирование, JavaScript.

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ББК 32.973.2-018.2

STATES TRANSITIONS MODEL OF INFORMATION SYSTEMS

D. A. Gusev, R. A. Dolbin, F.S. Elagin
Tambov State Technical University, Tambov, Russia
e-mail: fedor_elagin@mail.ru

Abstract
The cloud computing technology is one of the most promising areas of the information technology development, currently considered as an alternative to the traditional information processing model. The use of cloud computing systems makes it possible to realize the possibility of remote processing of information, ensures the achievement of high rates of fault tolerance and the availability of information infrastructure. The model of IS states transitions is considered on the example of cloud computing systems.
Key words: cloud computing, information technology, states transitions model.

Introduction

For the analysis of threats to information security, we define the mathematical model of the information system of the five spaces (I,T,P,S,F), where I is the space of information processed in the information system; T - space of information technologies and technical means; P - the space of consumers and the provider's personnel; S is the state space of the information system; F is the space of transitions from one state to another; i.e. $F : S \to S$.

Model description

The state $s \in S$ of the information system will be called a set of essential properties (attributes) of the system at a particular moment in time. In order to analyze information security for each state of the system, we introduce three attributes of the security of information processed in the system: c_s - confidentiality; i_s - integrity; a_s - availability, such as $c,i,a \in \{0,1\}$, where $c=1$, $i=1$, $a=1$, if in this state confidentiality, integrity and availability of information processed in the system is ensured. The state $s \in S$ of the system, in which $(c_s,i_s,a_s)=(1,1,1)$ we call the safe state, and denote the space of all safe states $S^+ = \{s \in S \mid (c_s,i_s,a_s) = (1,1,1)\}$.

A state in which at least one of the attributes is zero will be called unsafe, the space of unsafe states will be denoted as $S^- = \{s \in S \mid \exists k \in \{c_s,i_s,a_s\}, k=0\}$.

It is clear that $S^+ \cup S^- = S$.

The security incident *In* in the information system is called the transition of the system from a safe state to an unsafe condition, i.e. $In = f \mid f \in F, f : S^+ \to S^-$.

The model of security threats for information systems can be represented by four spaces (A,O,V,M), where A is the space of threat sources; O - the space of objects of protection; V - vulnerability space; M - the space of ways to implement threats, and it is obvious that $M \subset F$.

It is clear that $O = o \mid o \in I \cup T \cup P$.

The vulnerability of the information system will be called the weakness of the element of the system $e \in T \cup P$, the existence of which in a certain state of the system $s \in S$ in the presence of a source of threat $Ag \in A$ can lead to the implementation of a security incident, i.e. $V = \{v \mid v = e \bullet s \mid Ag \bullet S \Rightarrow In\}$.

A security threat τ is a combination of a protection object $o \in O$ and a source of threats is $Ag \in A$, leading to a system transition to an insecure state $s^- \in S^-$, i.e. $\tau = e \bullet Ag \Rightarrow s^-$.

Conclusion

Note that the above models are common for cloud computing and traditional information systems. However, it should be noted that the characteristic features of cloud computing systems cause the expansion of spaces *T* and *F* compare to traditional information systems. These changes, in turn, lead to the expansion of the spaces *A*, *O*, *V* and *M* and, consequently, the expansion of the entire model of information security threats for cloud computing systems.

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МОДЕЛЬ ПЕРЕХОДОВ СОСТОЯНИЙ ИНФОРМАЦИОННЫХ СИСТЕМ

Д.А. Гусев, Р.А. Долбин, Ф.С. Елагин
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: fedor_elagin@mail.ru

Аннотация

Технология облачных вычислений является одним из наиболее перспективных направлений развития информационных технологий, в настоящее время рассматриваемых в качестве альтернативы традиционной модели обработки информации. Использование систем облачных вычислений позволяет реализовать возможность удаленной обработки информации, обеспечивает достижение высоких показателей отказоустойчивости и доступности информационной инфраструктуры. Рассмотрена модель переходов состояний ИС на примере систем облачных вычислений.

Ключевые слова: информационные технологии, модель переходов состояний, облачные вычисления.

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COMPONENT MODELING IN INFORMATION SYSTEMS

D.V. Karavaev, R.A. Dolbin, V.A. Svishchev
Tambov State Technical University, Tambov, Russia
e-mail: lal-tmb @mail.ru

Abstract
In this article the modeling of structural components of information systems is explored.
Key words: component modeling, information systems.

In this article we explore the modeling of structural components of information systems.

Component modeling involves building a model of a continuous system as a whole from individual continuous components. The continuous component C is a set $C = \{v, v^0, Q\}$ of variables $v = (v_i \in \Re \mid i \in 1..m\}$, initial values v^0, and a system of equations Q in the form of (1) or (2), where $x \subseteq v, y \subseteq v, w \subseteq v$. The difference between a component from an isolated system is that for a component it is often not possible to say anything about the correctness of a system of equations Q outside the context of its interaction with other components.

The result of a simple unification of continuous components A and B is the isolated continuous system $S = A + B$, where $v_S = v_A \cup v_B$ and $Q_S = Q_A \cup Q_B$. Note that here we implicitly use the notion that continuous time t is independent and global [1].

Consider the union of interacting continuous components. It is assumed that the components included in the functional scheme function simultaneously and in parallel. The functional scheme is equivalent to an isolated continuous system S, for which $v_S = v_A \cup v_B$, $Q_S = Q_A \cup Q_B \cup L(A,B)$, where $L(A,B)$ are the constraint equations. The structural component involves splitting the set of variables v into two components: $v = v^E \cup v^S$, where v^E is the vector of external variables, and v^S is the vector of internal variables (state vector). Functional links can connect only external variables of components. A directional structural component implies a representation in the classical formalism of "input-state-output" which means that external variables are divided into inputs and outputs $v^E = v^I \cup v^O$ and behavior is specified by the mapping $(v^I, v^S) \to (v^S, v^O)$. Thus, the input value cannot be changed within the block and the output value, on the contrary, can only be changed within the block. For continuous blocks this means that only the elements of the parameter vector $v^I \subseteq w$ can be inputs and the differential and algebraic variables can only be states or outputs: $v^O \subseteq x \cup y$. For example, let us look at the system constructed of directed blocks A and B which are connected by directional

links. The constraint equations for this system have the form of the simplest formulas

$$\begin{cases} \hat{w}_A = \hat{z}_B \\ \hat{w}_B = \hat{z}_A \end{cases}, \qquad (1)$$

where $\hat{w}_A \subseteq w_A, \hat{w}_B \subseteq w_B, \hat{z}_A \subseteq x_A \cup y_A, \hat{z}_B = x_B \cup y_B$ [2].

In the non-directional (unoriented) structural component no external constraints are imposed on external variables: they can vary both outside the block and inside the block: $v^E \subseteq x \cup y \cup w$. External variables in these blocks are divided into "contacts" and "flows" $v^E = v^C \cup v^F$ according to the type of equations attributed to their connections. The connection joining two contacts a and b is equivalent to an algebraic equation $a - b = 0$. The connection that combines two flows is an equivalent to an algebraic equation $a + b = 0$ (an analog of Kirchhoff's law). Let us look at a system built from non-directional components A and B which are connected by non-directional connections through contacts (Figure 1).

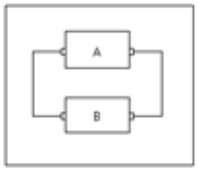


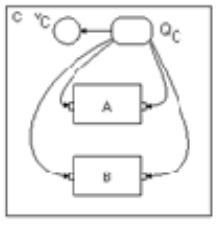
Fig. 1 - System of non-directional components

The constraint equations are

$$\hat{v}_A^E - \hat{v}_B^E = 0, \qquad (2)$$

where $\hat{v}_A^E \subseteq x_A \cup y_A \cup w_A$ and $\hat{v}_B^E \subseteq x_B \cup y_B \cup w_B$.

The more complex case of combining continuous components is also possible, when the container component C also has its own set of variables v_C and a system of equations Q_C in which both the own variables v_C and the external variables of the components A and B are used, i.e. $x_C \cup y_C \cup w_C \subseteq v_A^E \cup v_B^E \cup v_C$ (Figure 2a). For example, a system of equations Q_C can simply reproduce the constraint equations.

a) 

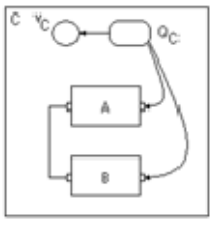
b) 

Fig. 2 - Oriented components

In the case of oriented components A and B in equations Q_C there must be restrictions on the inputs and outputs, i.e. $x_C \cup y_C \subseteq v_A^I \cup v_B^I \cup v_C$ and $w_C \subseteq v_A^O \cup v_B^O \cup v_C$. Blocks A and B can simultaneously interact through links (Figure 2b). Thus, the form of the resulting system of equations depends on the

orientation of the blocks. In the most general case, we obtain a system of equations in the form of (2).

Finally, the case of a local continuous component $C^S = \{v \cup v^S, v^0, Q\}$, which is "immersed" in a container component s and operating both with its own variables and with the variable container component, is possible [3].

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КОМПОНЕНТНОЕ МОДЕЛИРОВАНИЕ В ИНФОРМАЦИОННЫХ СИСТЕМАХ

Д.В. Караваев, Р.А. Долбин, В.А. Свищёв
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: lal-tmb @mail.ru

Аннотация

В этой статье рассмотрено моделирование структурных компонентов информационных систем.

Ключевые слова: информационные системы, компонентное моделирование.

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COMPUTER-BASED EDUCATION SYSTEMS

N.A. Kareva
Tambov State Technical University, Tambov, Russia
e-mail: davydova_n1992@mail.ru

Abstract
Automated training systems (ATS) are the systems which help to learn new material, monitor progress, help teachers to prepare teaching materials, etc. In their professional activities many teachers make extensive use of computer information technologies: training and monitoring programs, internet technologies and multimedia. This article focuses on this issue.
Key words: tutorials, information technology, automated training systems.

At present, computer technologies are being introduced into the learning process. Among them there are training programs. Computer training programs solve many tasks in training. The tasks are presented in 3 groups. The first group is a test of students' knowledge: testing, tests, questions. The second group is the support of software training. The third group is the independent work of students. An important condition is adaptation. The computer system must adapt to the level of knowledge of the student. The result of mastering a student's knowledge is obtained from a number of factors. Factors are built on the simplicity of the presentation of the material, structural and accessibility. For teaching, lecture text, graphics, images, diagrams, tables, and histograms are used. The computer system can contain computer dictionaries, information and bibliographic reviews.

The difficulties in using computer systems are expressed in the complexity of their development for the following reasons:

- lack of qualified specialists;
- organization of development training systems;
- financial expenses.

The existing learning systems have the following disadvantages:

- the computer system does not take into account the different level of the student's preparation;
- the computer system cannot evaluate the creativity of the student;
- insufficient use of computer capabilities.

Despite these shortcomings, a computer is an effective learning tool. With its help, you can involve the student in the learning process, strengthen the student's motivation, exercise control over the training, and provide methodological assistance.

When using a computer training program, the following opportunities are realized in the learning process:

- viewing, studying, summarizing and mastering of educational material on each topic of the chosen topic;

- search and display any topic of the course that are included in the computer training program as an independent block of educational material;

- repeated use of the computer training program with accumulation of personal computers of the data bank in the memory: who passed the training, on what topics (sections) and what assessments were received during training or control.

- self-examination of the degree of mastering the educational material by presenting the student several questions with alternative answers on the topic, of which only one answer is correct;

- control of the degree of mastering of the educational material of the topics (sections) included in the computer training program with an automatic assessment of the sum of the correct answers and the recording of data in the memory of personal computers.

When working with a tutorial, the time of the task is taken into account. The student's knowledge comes from the studied material. The psychological characteristics of the learner, age, and level of knowledge are taken into account.

The composition of computer systems is important for the student. Computer training systems consist of a training material, a control unit, a return to the material covered, an assessment and training statistics. Teaching information is divided into small portions for better perception. There is a possibility to select a block from the information to be learned.

The most effective is the following organization of the trainee's work with a computer training program: the study text, the operating manual for the computer training program is studied; the direct work of the student is carried out with a computer training program under the supervision of the teacher.

Training can be with the help of a teacher, and also without his/her help. The studied topic is selected according to the selected plan. The teacher uses the computer as an assistant - a technical training tool. Computerization of training is used.

The purpose of using the computer in training is an individual educational process, teamwork, simplicity of the educational process, wide information search.

Thus, the computer in the educational process performs several functions: it controls the actions of the student, serves as a means of communication, and provides the student with new cognitive abilities, a tool, a source of information.

For the trainee, the use of the learning computer system increases the interest in learning, enhances motivation through novelty and the combination of more diverse and visual teaching methods in conjunction with traditional methods.

For the teacher, information systems provide an opportunity to realize their teaching experience, make changes to teaching materials, and process statistical data for decision-making. There is an opportunity to manage the activities of the student. Training through the computer allows you to exercise self-control, increase motivation for cognitive activity.

Distance learning is one of the forms of education, which is based on the use of information and telecommunications technologies. The results of implementing software systems in distance learning have shown the promise of this direction. There is a need to create new electronic teaching aids that have made it possible to achieve perfect knowledge.

Electronic learning systems must meet educational standards. In the electronic manual, it is necessary to decipher the discipline, demonstrate the methodologies for creating information support for management processes in a computer system.

Modern educational technologies, with proper implementation in the educational process, improve the quality of education.

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КОМПЬЮТЕРНЫЕ ОБРАЗОВАТЕЛЬНЫЕ СИСТЕМЫ

Н.А. Карева
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: davydova_n1992@mail.ru

Аннотация

Автоматизированные системы обучения (АСО) - это системы, которые способствуют изучению нового материала, получению знаний в области управления производством, помогают обучающим подготавливать учебные материалы. В практической деятельности многие преподаватели широко используют компьютерные информационные технологии: программы обучения и мониторинга, интернет-технологии и мультимедиа. Данная статья посвящена проблеме внедрения обучающих систем в учебный процесс.

Ключевые слова: учебные пособия, информационные технологии, автоматизированные системы обучения.

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PARTICULAR CASES OF THE NORMAL VECTOR ESTIMATION

S.S. Semenov, D.A. Gusev, I.Y. Vorobiev
Tambov State Technical University, Tambov, Russia
e-mail: semenov.spark@mail.ru

Abstract
In this paper, the problem of finding the maximum estimate and conditional mathematical expectation of a random vector are proposed.
Key words: vector, linear dependence, distribution of vector.

The problem of finding the optimal estimate, i.e. the conditional expectation of a random vector, is most simply solved for vectors with a normal distribution. This is due to the fact that the uncorrelation of two normal random vectors simultaneously means their independence. We consider the case of a linear dependence of the vectors $\vec{x}$ and $\vec{z}$.

Let $\vec{x}$ be a normally distributed random vector with distribution parameters $\vec{x}$: N($\vec{m}_x$,X). The vector $\vec{x}$, which is the output of the system Sx, enters the input of the system Sz. The state of the system Sz is determined by the vector z, which is related to $\vec{x}$ by the relation $\vec{z} = \mathrm{H}\vec{x} + \vec{v}$, where H is the known matrix, $\vec{v}$ is the normal random measurement error vector with parameters

$$\mathrm{M}[\vec{v}] = 0;\ \mathrm{M}[\vec{v}\,\vec{v}\,\mathrm{T}] = \mathrm{R};\ \mathrm{M}[(\vec{x} - \vec{m}_x)\vec{v}\,\mathrm{T}] = 0. \quad (1)$$

The corresponding structural scheme for the problem under consideration is shown in Fig. 1. The distribution parameters $\vec{m}_x$, X, R in this case represent a priori information about the vectors $\vec{x}$ and $\vec{z}$. The vector $\vec{z}$ is observed and it is required to find the estimate of the vector $\vec{x}$.

To solve the problem, it is necessary to find the statistical characteristics of the vector $\vec{z} = \mathrm{H}\vec{x} + \vec{v}$ and the mutual correlation matrix L [1].

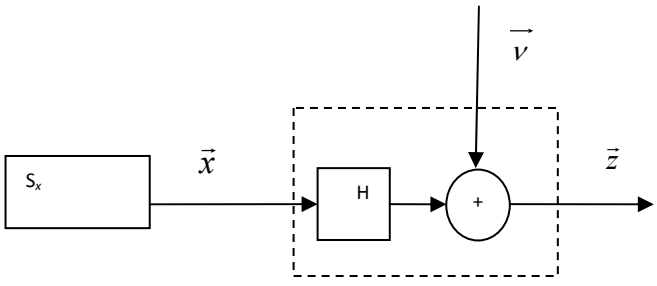

Fig. 1 - Model of the system and measurements for the case of linear dependence of the vectors $\vec{z}$ and $\vec{x}$

We obtain the mathematical expectation of the vector $\vec{z}$

$$\vec{m}_z = \mathrm{M}[\mathrm{H}\vec{x} + \vec{v}] = \mathrm{H}\vec{m}_x; \quad (2)$$

the correlation matrix of the vector $\vec{z}$

$$Z = M[(\vec{z} - \vec{m}_z)(\quad - \vec{m}_z)T] = M[H(\vec{x} - \vec{m}_x) + \vec{v}\,] \times$$

$$\times\,[H(\vec{x} - \vec{m}_x) + \vec{v}\,]T = HXHT + R; \qquad (3)$$

the mutual correlation matrix of the vectors x and $\vec{x}$ and $\vec{z}$

$$L = M[(\vec{x} - \vec{m}_x)(\vec{z} - \vec{m}_z)T] =$$

$$= M\{(\vec{x} - \vec{m}_x)[H(\vec{x} - \vec{m}_x) + \vec{v}\,]T\} = XHT. \qquad (4)$$

Since the results of the previous paragraph were obtained on the assumption that the vectors $\vec{x}$ and $\vec{z}$ have a normal distribution, in this case it is necessary to first verify that the vector $\vec{z} = H\vec{x} + \vec{v}$ also has a normal distribution.

This follows from the results proved in probability theory:

- if $\vec{x}$ is a random vector with a normal distribution, then the vector $\vec{y} = H\vec{x}$ has a normal distribution;
- the sum of two normal random vectors is a normal vector.

It follows that if the vectors $\vec{x}$ and $\vec{v}$ have a normal distribution, then the vector $\vec{z} = H\vec{x} + \vec{v}$ is also distributed by the normal.

We obtain the required solution for the estimate in the form

$$\hat{\vec{x}} = \vec{m}_x + XHT\,(HXHT + R)\text{-}1\,(\vec{z} - H\vec{m}_x); \qquad (5)$$

$$P = X - XHT\,(HXHT + R)\text{-}1\,HX. \qquad (6)$$

Let us consider the case when the parameters of the a priori distribution of the vector x are unknown.

Sometimes it is possible that the parameters $\vec{m}_x$, X of the a priori distribution density $f_{\vec{x}}(\vec{\alpha})$ of the estimated vector $\vec{x}$ are unknown. In this situation, it is impossible to use relations for solving the estimation problem. We obtain a relation for solving the estimation problem in the situation under consideration. To do this, we use the lemma on the inversion of matrices considered in application B. Applying the lemma to the expression, we find

$$P\text{-}1 = X\text{-}1 + HTR\text{-}1H. \qquad (7)$$

We transform the matrix factor for $(\vec{z} - \vec{m}_x)$ as follows:

$$XHT(HXHT + R)\text{-}1 = (PP\text{-}1)XHT(HXHT + R)\text{-}1 =$$

$$= P[HT(R\text{-}1R) + HTR\text{-}1H]XHT(HXHT + R)\text{-}1 =$$

$$= P[HT(R\text{-}1R) + HTR\text{-}1HXHT](HXHT + R)\text{-}1 =$$

$$= PHTR\text{-}1(R + HXHT)\,(HXHT + R)\text{-}1 = PHTR\text{-}1. \qquad (8)$$

The absence of a priori information about the vector $\vec{x}$ means that X-1 = 0, which implies:

$$P = (HTR\text{-}1H)\text{-}1. \qquad (9)$$

Substituting, we find

$\hat{\vec{x}} = \vec{m}_x + \text{XHT (HXHT + R)-1 } (\vec{z} - \text{H}\vec{m}_x) =$

$= \vec{m}_x + \text{(HTR-1H)-1 HTR-1 } (\vec{z} - \text{H}\vec{m}_x) -$

$- \vec{m}_x + \text{(HTR-1H)-1 HTR-1}\vec{z} - \vec{m}_x$ (10)

As a result, we obtain the known formulas for estimating and the correlation matrix of the estimation error:

$\tilde{\vec{x}} = \text{(HTR-1H)-1 HTR-1 } \vec{z}$; (11)

P = M[$\tilde{\vec{x}}\ \tilde{\vec{x}}$ T] = [HTR-1H]-1.(12)

If R = σ2I, then

$\hat{\vec{x}}$ = (HTH)-1HT$\vec{z}$; (13)

P = σ2(HTH)-1. (14)

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ЧАСТНЫЕ СЛУЧАИ ОЦЕНИВАНИЯ НОРМАЛЬНОГО ВЕКТОРА

С.С. Семенов, Д.А. Гусев, И.Ю. Воробьев
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: semenov.spark@mail.ru

Аннотация

В данной статье была предложена задача нахождения максимальной оценки, т.е. условного математического ожидания случайного вектора.

Ключевые слова: вектор, линейная зависимость, распределение векторов.

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THE DIFFERENCE BETWEEN BIT RATE AND BAUD RATE

G.E. Sotnikov, K.A. Merkushova, I.A. Mashkov
Tambov State Technical University, Tambov, Russia
e-mail: gl.sotnikov@yandex.ru

Abstract
Serial-data speed is usually stated in terms of a bit rate. However, another often-quoted measure of speed is baud rate. Though the two are not the same, similarities exist under some circumstances. This paper will make the difference clear.
Key words: bit rate, baud rate, Shannon–Hartley theorem.

Bit rate is the maximum possible transmission rate of information over a communication channel.

Bit rate characterizes the maximum possible data rate that can be achieved on the communication channel. The peculiarity of bit rate is that, on the one hand, this characteristic depends on the parameters of the physical medium, and, on the other hand, it is determined by the method of data transmission. Therefore, it is impossible to talk about the bit rate of a communication channel before a physical layer protocol is defined for it.

For example, since a physical layer protocol defining a bit rate is always defined for digital communication channels, bit rate is always known for them.

In cases where it is only necessary to choose which of the many existing protocols to use, the characteristics of the communication channel are very important. In particular, the bandwidth, the level of interference and the degree of attenuation are important, as well as the adopted method of data coding.

Bit rate of the communication line depends not only on its characteristics, such as attenuation, but also on the spectrum of transmitted signals. If significant harmonics of the signal fall into bit rate of the communication channel, then such a signal will be transmitted well by this communication line and the receiver will be able to correctly recognize the information sent through the line by the transmitter. If significant harmonics go beyond the bandwidth of the communication channel, then the signal will begin to be significantly distorted, and the receiver will make mistakes in recognizing the information.

Bit rate is measured in bits per second (bps), as well as in derived units, such as kilobits per second (Kbps), and so on. Bit rate of the communication channel and communication equipment is traditionally measured in bits per second, due to the fact that the data in the networks are transmitted sequentially, that is, bitwise, and not parallel bytes, as occurs between devices inside the computer.

The signal spectrum and bit rate depend on the selected coding method. The choice of the method of representing discrete information in the form of signals applied to a communication line is called physical or linear coding.

An application of the bit rate concept to an additive white Gaussian noise (AWGN) channel bandwidth and signal-to-noise ratio is the Shannon–Hartley theorem:

$$C = Blog_2(1 + \frac{S}{N}),$$

where C is bit rate in bps; B – bandwidth in Hz; S is signal power in watts or volt^2; N –noise power in watts or volt^2.

From this relation it follows that there is no theoretical limit of the capacity of a line with a fixed bandwidth. However, in practice such a limit exists. The bit rate increase could be done by increasing the transmitter power or reducing the noise power in the communication channel. Both these components can be changed with great difficulty. Increasing the transmitter power leads to a significant increase in its size and cost. Reducing the noise level requires the use of special cables with good protective screens, which is very expensive, also reduce noise in the transmitter and intermediate equipment, which is very difficult to achieve. In addition, the influence of the power of the useful signal and noise on bit rate is limited by the logarithmic dependence, which grows not so fast as directly proportional.

Close to the Shannon formula is another relation obtained by Nyquist, which also determines the maximum possible bit rate, but without taking into account the noise in the line:

$$C = 2Flog_2M,$$

where M is the number of distinguishable states of the information parameter.

If the signal has two distinguishable states, then bit rate is twice the bandwidth of the link. If the transmitter uses more than two stable signal states to encode the data, bit rate is increased.

In the Nyquist formula, the presence of noise is not explicitly taken into account, its influence is indirectly reflected in the choice of the number of states of the information signal. To increase bit rate, it would be necessary to increase the number of states, but in practice this is impeded by noise on the communication channel.

Baud rate refers to the number of signal or symbol changes that occur per second. A symbol is one of several voltage, frequency, or phase changes.

One of the main methods of coding is HRZ (non-return-to-zero). NRZ binary has two symbols, one for each bit 0 or 1, that represent voltage levels (1 are represented by a positive voltage, while 0 are represented by a negative voltage, with no other neutral or rest condition). In this case, the baud or symbol rate is the same as the bit rate.

However, it's possible to have more than two symbols per transmission interval, whereby each symbol represents multiple bits. With more than two symbols, data is transmitted using modulation techniques.

By using multiple symbols, multiple bits can be transmitted per symbol. For example, if the symbol rate is 4800 baud and each symbol represents two bits, this translates into an overall bit rate of 9600 bits/s.

Many different modulation schemes can implement high bit rates. For example, frequency-shift keying (FSK) typically uses two different frequencies in each symbol interval to represent binary 0 and 1. Therefore, the bit rate is equal to the baud rate. However, if each symbol represents two bits, it requires the four frequencies (4FSK). In 4FSK, the bit rate is two times the baud rate.

Phase-shift keying (PSK) is another popular example. When employing binary PSK, each symbol represents a 0 or 1. A With one bit per symbol, the baud and bit rates are the same. However, multiple bits per symbol can be easily implemented.

For instance, in quadrature PSK there are two bits per symbol. Using this arrangement and two bits per baud, the bit rate is twice the baud rate. Other forms of PSK use more bits per baud. With three bits per baud, the modulation becomes 8PSK for eight different phase shifts representing three bits. And with 16PSK, 16 phase shifts represent the four bits per symbol.

One unique form of multilevel modulation is quadrature amplitude modulation (QAM). QAM uses a mix of different amplitude levels and phase shifts to create the symbols representing multiple bits. For example, 16QAM encodes four bits per symbol. The symbols are a mix of different amplitude levels and different phase shifts.

By transmitting more than one bit per a baud, higher data rates can be transmitted in a narrower channel. Maximum possible data rate is determined by the bandwidth of the transmission channel.

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РАЗНИЦА МЕЖДУ БИТРЕЙТОМ И БОДРЕЙТОМ

Г.Е. Сотников, К.А. Меркушова, И.А. Машков
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: gl.sotnikov@yandex.ru

Аннотация

Скорость передачи данных обычно обозначается термином битрейт. Однако, существует другой частотный показатель скорости – бодрейт. Хотя эти два понятия не совпадают, при некоторых обстоятельствах существует некоторое сходство. Эта статья сделает разницу понятной.

Ключевые слова: битрейт, бодрейт, теорема Шеннона-Хартли.

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DATABASE DESIGN FOR DOCUMENT AUTOMATION SOFTWARE

D. A. Shishkov
Tambov State Technical University, Tambov, Russia
e-mail: sw.k5nc@gmail.com

Abstract
Software always should be scalable and have high performance. To meet these requirements, appropriate database design is a very crucial step in software development. This is refers to document automation software as well. First of all, there are different types of software which should be properly examined. Whole database design is dependent on it. Then, each of these types should be analyzed to draw a conclusion about how database design should be conducted.
Key words: databases, database design, data modeling, document automation software.

Introduction

Any software tool uses some kind of storage for its persistent data. Usually, it is a relational database. Aside from that, software should be scalable. That is, a database should stay fast and responsive despite increasing volume of data it stores. Database should always perform its operations quickly, like saving and retrieving data.

Thus, a database design is a first and foremost step in software development. This is the case for document automation software too. However, it should be designed properly to use it efficiently. Database design means the process of producing a detailed data model. Data modeling is the process of making a formal model from domain data with all its rules and requirements. This logical model then can be converted into a physical one, that is, into a schema for specific relational database.

OLTP and OLAP environments

The first step in data modeling is defining the environment in which a database will operate. There are two types of such environments: OLTP (Online Transaction Processing) and OLAP (Online Analytical Processing).

One of the main features of OLTP is large number of short transactions like updating or deleting specific row in one of database tables. The main emphasis for OLTP systems is put on very fast query processing and maintaining data integrity in multi-access environments. Number of transactions per second measures the effectiveness of such systems.

The main advantages of OLTP systems are reliability, fast performance in multi-access environment, data integrity and consistency.

The main disadvantage of OLTP systems is complexity and inefficiency of data aggregation operations. The reason of this is a way of designing database schema required for OLTP systems. Schema designed in such way that data are

split in separate tables interconnected by keys. In case of any aggregation query, this means large numbers of joins between multiple tables, which instantly leads to slow performance.

OLAP is the opposite of OLTP. Database in OLAP environment usually represent itself as a storage of some historical or archival data. Thus, OLAP systems are characterized by relatively low volume of transactions. On the other hand, queries for data retrieval are most of the time very complex and involve aggregations. Effectiveness of OLAP systems is response time of such queries.

Document automation software is mostly OLTP type, since it has large number of short transactions from parsed documents, and does not deal with large amounts of aggregated data.

Requirements for database design in OLAP and OLTP environments

There are two approaches in making a data model according to mentioned environments. Both of them are about so called database normalization.

In the field of relational database design, normalization is a systematic way of ensuring that a database structure is suitable for general-purpose querying and free of certain undesirable characteristics. Those characteristics are so called database anomalies that could lead to loss of data integrity.

In OLAP case, it is highly recommended to use non-normalized design. Normalization helps with data integrity at expense of query performance, while fast processing of complex queries is required. Thus, using other techniques such as dimensional modeling will improve performance drastically.

Dimensional model is a database structure that is optimized for queries. Dimensional models are built by business process area, e.g. store sales, inventory, claims, etc. Dimensional modeling always uses the concepts of facts and dimensions. These two concepts are split by separate tables in database.

Facts are typically numeric values that can be aggregated (e.g. sales amount). Fact tables store records of either specific events or some aggregated data at given point in time. For instance, total sales for a product. Aside from that, fact tables should have a foreign key to dimensional data where descriptive information is kept.

Dimensions are groups of descriptors that define the facts. Dimension tables usually have a relatively small number of records compared to fact tables, but each record may have a very large number of attributes to describe the fact data. Dimensions can define a wide variety of characteristics. For instance, it could be tables, which describe products or employees.

The benefits of denormalized schemas are the following: simpler queries, query performance, fast and simple aggregations compared to normalized design.

The main disadvantage of denormalized design is a possible loss of data integrity and presence of undesirable side effects, such as database anomalies.

OLTP applications, on the opposite, are all about maintaining data integrity. Thus, normalized design approach is highly recommended. Typically, it means following the rules of at least third normal form.

Normal forms are certain rules for organizing data. There are six normal forms. However, the higher the normal form to which a database design corresponds, the slower the performance will be. That is why it is recommended to use the third normal form. Thus, OLTP database design should follow these simple rules: data atomicity, avoidance of data duplication and repeating groups, avoidance of functional dependencies between non-prime attributes, presence of functional dependency between full primary key and all non-prime attributes.

Since document automation software is mostly OLTP environment, the mentioned rules regarding it should be applied to database design.

Conclusion

The main approaches to database design were examined in this paper. The main environments, in which a database could reside, were emphasized as well. Aside from that, all the features, differences and applications of those two types were mentioned, as well as rules of database design in each case.

Document automation software was confirmed as OLTP type, thus database design should be conducted in a normalized way, according to the third normal form.

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ПРОЕКТИРОВАНИЕ БАЗЫ ДАННЫХ ДЛЯ ПРОГРАММНОГО ОБЕСПЕЧЕНИЯ ПО АВТОМАТИЗАЦИИ ДОКУМЕНТООБОРОТА

Д. А. Шишков

Тамбовский государственный технический университет, Тамбов, Россия

e-mail: sw.k5nc@gmail.com

Аннотация

Программное обеспечение всегда должно быть высокопроизводительным и масштабируемым. Для того, чтобы соответствовать этим требованиям, правильное проектирование базы данных – важный этап в разработке программного обеспечения. К программному обеспечению по автоматизации документооборота это также относится. Прежде всего, необходимо рассмотреть разные типы, к которым программное обеспечение может принадлежать. От этого сильно зависит все дальнейшей проектирование базы данных и составление логической модели данных. Далее, необходимо тщательно проанализировать каждый из этих типов и сделать соответствующие выводы по тому, как проводить проектирование базы данных.

Ключевые слова: базы данных, проектирование баз данных, моделирование данных, автоматизация документооборота.

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IMPLEMENTATION OF THE MANDATE SECURITY POLICY THROUGH MAP WITH THE RFID-TAG ON THE BASIS OF FREQUENCY CHANNEL SEPARATION

A.M. Shuvaeva, A.V. Yakovlev
Tambov State Technical University, Tambov, Russia
e-mail: anastasi93_007@mail.ru

Abstract
Protection of information from unauthorized access at information objects is an important component of information security. One of the most important methods of protecting confidentiality is the delineation of access. Access control mechanisms are the basis for protecting resources, ensuring the solution of the task of distinguishing between the access of subjects to protected information and technical resources - objects.

Key words: access control, access control scheme, FDMA, mandatory access control, RFID-card, RFID-tag, security labels, the authenticator.

Introduction

Delineation of access is one of the main tasks of information security of the organization.

To provide mechanisms for differentiating access to information resources from a local workplace, information security tools are used to prevent unauthorized access.

The system for delineating access to information must contain four functional blocks [1]:

- block of identification and authentication of access subjects;
- the access manager;
- the unit of information cryptographic transformation when it is stored and transmitted;
- memory cleaning unit.

The system of differentiation of access of the mandatory type. Access control mechanisms are the basis for protecting resources, ensuring the solution of the task of delineating the access of subjects to protected information and technical resources-objects.

Multilevel models presuppose the formalization of the procedure for assigning access rights through the use of confidentiality labels or mandates assigned to subjects and objects of access [2].

Methods and materials

The implementation of the access control system based on the credential policy of access control. There are 2 types of safety labels:

- logical, representing an account (login and password) and assigned to them a confidentiality mark;

- Hardware, the privacy mark is inserted in the physical carrier, for example, a card with an RFID tag.

Since the hardware security label is more reliable than the logical one, it is advisable to use a hardware security label in the RFID card.

The system will implement a three-level access model:

- high-full access to objects;
- medium- limited access;
- low-minimum access to the system.

A card with an RFID tag can be implemented in such a way: a card with recorded information about the access level, which simultaneously contains 3 antennas of different lengths and 1 chip that implements frequency division technology for FDMA channels. The structure of the map is shown in Fig. 1.

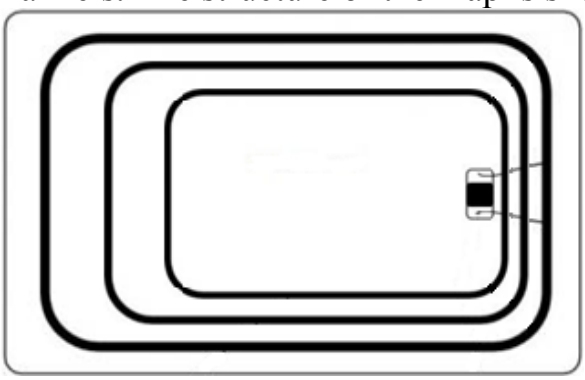

Fig. 1 – RFID-card

The FDMA method splits the entire frequency spectrum of the communication channel into sub-areas of equal / unequal width, symmetric / asymmetrical in both directions.

The card with the RFID-tag contains information about the user (his name, name, patronymic and personal identifier), his authenticator and the subject's access mark.

Results and discussion

The formation of a security label is based on frequency division of FDMA channels. FDMA (Frequency Division Multiple Access) technology manages only one parameter of an information signal - frequency. Each channel is allocated its own rather narrow band (20 ... 25 KHz) in the frequency range. Between these bands there are still additional frequency intervals - protective, reducing the mutual influence of some channels on others [3]. Based on FDMA, it is possible to synthesize a multifrequency access device to an information system using a three-level security label scale.

Let's consider in more detail the principle of device operation and the formation of a security label based on FDMA.

1) The cardholder, with the identifier and offset recorded on it, which contains 3 antennas of different length and 1 chip, brings the card to each of the multi-frequency readers.

2) The reader receives an identifier ID from the card, sets the offset as the initial value, and starts reading the sequence from a certain character, which is then converted to a hash function.

3) In the decision block, the obtained hash value is compared to the reference value. Then, as a Boolean variable, the value is passed to the access control elements, where the corresponding security label is allocated. On it, the cardholder gets access to the system (Fig. 2).

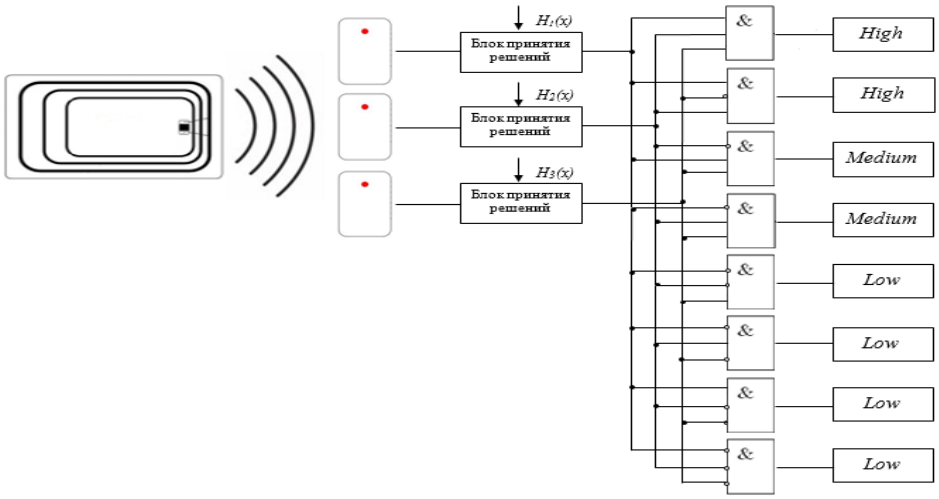

Fig. 2 – Access control scheme based on FDMA

Disadvantages of this method are limited frequency resources, which leads to an expensive organization, since there are three antennas on the RFID card that will need three readers at different frequencies, as well as three decision blocks. As a result, the circuit becomes less flexible, although it allows you to work autonomously, without connecting to a central server.

Conclusion

Thus, in the FDMA standard, the transmitted information is converted by frequency and the signal is transmitted so that it can be isolated by having a demodulator on the receiving side. At the same time, it is possible to transmit and receive multiple signals in a wide frequency band, which do not interfere with each other.

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РЕАЛИЗАЦИЯ МАНДАТНОЙ ПОЛИТИКИ БЕЗОПАСНОСТИ КАРТОЙ С RFID-МЕТКОЙ НА ОСНОВЕ ЧАСТОТНОГО РАЗДЕЛЕНИЯКАНАЛОВ

А.М. Шуваева, А.В.Яковлев
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: anastasi93_007@mail.ru

Аннотация

Защита информации от несанкционированного доступа на объектах информатизации представляет собой важную составляющую обеспечения безопасности информации. Одним из важнейших методов защиты для соблюдения конфиденциальности является разграничение доступа. Механизмы управления доступом являются основой защиты ресурсов, обеспечивая решение задачи разграничения доступа субъектов к защищаемым информационным и техническим ресурсам – объектам.

Ключевые слова: аутентификатор, мандатное управление доступом, метки безопасности разграничение доступа, схема контроля доступа, *FDMA*, *RFID*-карта, *RFID*-метка.

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ББК 262.10 + з81
Р -64

FORMALIZATION OF REQUIREMENTS TO THE INFORMATION SYSTEM OF REMOTE BANKING SECURITY

A. V. Vysotsky
Tambov State Technical University, Tambov, Russia
e-mail: gru28@mail.ru

Abstract
The article considers such concepts as remote banking services and online banking, the work of the RB system as a multi-channel queuing system with expectation and unlimited queue length is also mathematically described, and Duran's model is described in assessing the creditworthiness of a borrower.

Key words: online banking, queuing system (QS), Durand's model, creditworthiness of individuals

Online banking is a remote service for customers. The system itself can be considered as a multichannel queuing system (QS) with an unlimited queue [1].

The stream of requests with λ rate, and μ.intensity of service for each channel is received. The probabilities of conditions will get out of the formulas for multi-channel QS with a limited queue during the transition to the limit at $m \to \infty$.

Expressions for the limiting probabilities of the conditions:

$$P_0 = \left[1 + \frac{P}{1} + \frac{P^2}{2} + \ldots + \frac{P^n}{n} + \frac{P^{n+1}}{n+1}\right]$$

$$p_1 = \frac{p}{1!} * p_0; p_2 = \frac{p^2}{2!} * p_0; \ldots p_n = \frac{p^n}{n!} * p_0; p_{n+1} = \frac{p^{n+1}}{n * n!} * p_0; p_{n+2} = \frac{p^{n+2}}{n^2 * n!} * p_0; p_{n+r} = \frac{p^{n+r}}{n^r * n!} * p_0$$

As far as the denial of service in such systems is impossible, then its features of bandwidth are equal to:

$$p_{отк} = 0; Q = 1; A = \lambda * Q = \lambda;$$

the average number of requests in queue is:

$$L_{оч} = \frac{p^{n+1}}{n * n! * (1 - \frac{p}{n})^2} * p_{0;}$$

the average waiting time in the queue is:

$$T_{оч} = \frac{p^n}{n * \mu * n! * (1 - \frac{p}{n})^n} * p_0 = \frac{L_{оч}}{\lambda};$$

the average number of applications in QS is:

$$L_{ÑÌÎ} = L_{î÷} + p; T_{ÑÌÎ} = \frac{L_{ÑÌÎ}}{\lambda}..$$

The probability of the QS which is under the condition S_0, when there is no bids and no any occupied channel, is defined by the expression $p_0 = [\sum_{k=1}^{n} \frac{p^k}{k!} + \frac{p^{n+1}}{n!(n-p)}], k = 0.$

This probability determines the average percentage of the idle time of the channel maintenance. The probability of employment by services of k filings is:

$$p_k = \frac{p^k}{k!} \cdot p_0, \quad 1 \le k \le n$$

On this basis, we can determine the probability or fraction of time of employment of all channels by the service $p_n = \frac{\rho^n}{n!} \cdot p_0, \quad k = n.$

If all channels are already occupied by the service, the state probability is given by $p_{n+r} = \frac{p^{n+r}}{n * n^r} * p_0 = \left(\frac{p}{n}\right)^r, k > n$.

The probability of being in the queue is equal to the probability to find all channels are already busy by service $p_{оч} = \frac{p^{n+r}}{n*(n-p)} * p_0, k \ge n$

The average number of requests queued and waiting for service is: $L_{оч} = \frac{n}{n-\rho} \cdot p_{оч}$; The average waiting time of requests in the queue is determined by Little's formula: $T_{оч} = \frac{L_{оч}}{\text{A}}$ and in the system $T_{смо} = \frac{L_{смо}}{A}$; average number of busy channels by service is $n_1 = \lambda / \mu = p;$ the average number of free channels is $n_{св} = n - p;$ the employment rate channels service is: $K_3 = n_3 / n = p / n$

The parameter characterizes the degree of matching of the input stream, for example, customers in the bank with the intensity of the service flow. The service process is stable when p<n [2]. The creditworthiness of the borrower is expressed through his ability to perform fully and timely its obligations under the credit agreement. One of the most famous is the Durand's model. He determined the coefficients for the various factors that characterize the creditworthiness of individuals:

Gender: female (0.40), male (0)

Age: 0.1 point for each year exceeding 20 years but not more than 0.30

The period of residence in the area is 0.042 for each year, but not more than 0.42

Profession: 0.55 – for a profession with a low risk; 0 for a profession with high risk; 0.16 – other jobs

Financial indicators: bank account is 0.45; real estate is 0.35; the existence of the policy of insurance is 0.19

Work: 0.21 are the enterprises in public sector, 0 – others

Employment: 0.059 for each year of work in the enterprise

He also identified a threshold, crossing which, a person is considered as creditworthy 1.25. The Durand model allows making formalization of risk factors on the basis of linguistic variables and fuzzy expected utility for the bank.

λ1 – sex – inf = 0.0; sup = 0.40

λ2 – age – [0.1 - 0.30]

λ3 – duration of stay – [0.042 - 0.42]
λ4 – profession – [0; 0.16; 0.55]
λ5 – financial indicators [0.19; 0.35; 0.45]
λ6 – job – [0; 0.21]
λ7 – employment [0.059 – 2.95]
λ8 – threshold credit– [0– 1.25].

Experts highlighted a number of indicators to evaluate the financial condition of the borrower and his personal qualities associated with responsibility for credit commitments [3]. The indicators are grouped and summarized in the table. Each indicator has a score from 0 to 1 according to its relative importance. The estimate calculation performed by the formula:

W= $\left[\prod_1^s\left(\prod_1^n k^j\right)\right]^i$ where W is the total "weight" of the indicator.

i – is a weight of groups of indicators (for the group "Personal information" = 0,7);

j – is a weight of indicator (for the group "Personal information" of the indicator "Weight" = 1);

k – is a value score of an indicator (the indicator "Weight" of values "36-45" = 1)

n - is a number of indicators in the group (for the group "Personal information" n = 4).

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К ВОПРОСУ О ФОРМАЛИЗАЦИИ ТРЕБОВАНИЙ К ИНФОРМАЦИОННОЙ СИСТЕМЕ ДИСТАНЦИОННОГО БАНКОВСКОГО ОБЕСПЕЧЕНИЯ

А.В. Высоцкий
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: gru28@mail.ru

Аннотация

В статье рассматриваются такие понятия, как дистанционное банковское обслуживание, банкинг-онлайн, также математически описана работа системы ДБО, как многоканальной системы массового обслуживания с ожиданием и неограниченной длиной очереди и описана модель Дюрана при оценке кредитоспособности заемщика.

Ключевые слова: дистанционное банковское обслуживание, Банкинг – Онлайн, система массового обслуживания, модель Дюрана, оценка кредитоспособности.

УДК 623
ББК 0332

DETERMINUNG THERMAL CONDUCTIVITY OF NANOMODIFIED POLYPROPYLENE

E.E. Bogometova, A.V. Grishin, D.V. Trofimov, I.V. Rogov
Tambov State Technical University, Tambov, Russia
e-mail: qrishinag@gmail.com

Abstract
Methods and the means intended for determination of temperature dependences of heatphysical properties of materials are investigated.
Key words: nanotube, polypropylene, thermophysical properties.

Introduction

Over the past 20 years, nanocomposites based on dozens of polymers and carbon fillers: nanotubes (nanotubes), nanofibers, graphene particles have been obtained in various laboratories. A typical example is a nanocomposite based on polypropylene (PP) and CNT. Significant interest in such composites is caused by the desire to obtain materials that combine a low cost price and a set of properties that exceed the properties of the original polymers. The most important for composites based on large-tonnage polymers are the mechanical properties that ensure their performance in the operating conditions of products. Carbon nanofillers provide ample opportunities to regulate the properties of substances without changing their composition due to the manifestation of the dimensional effects that affect the electronic, thermal, mechanical, electrical, magnetic and other properties of the filler and affect the properties of nanomaterials [1].

Temperature dependences of the thermal conductivity of PP and composite, the group of CNTs obtained with the help of a measuring system (IS), allowing in one and a smaller volume. To determine the thermal conductivity in the measuring system, the dynamic calorimeter λ method is used.

The measuring system is constructed as a result of a significant upgrade of the heat-conductivity meter it-400.

The signals from the thermocouples are fed to the inputs of the analog-digital board, which has a software-controlled signal amplifier, which allows changing the range of the applied voltage. The adiabatic envelope realizes the software of the measuring system through the output signals of the DAC of the board

Power supply voltage of the main electric heater of the measuring system Software control of the IC in the implementation of the experiment is carried out by software in Delphi.

Thus, CNTs have a high capacity for elastic deformation, which increases the tensile strength of composites with fillers on their basis. They impart rigidity to polymers and increase the specific characteristics of the strength and stiffness of composites.

The aim of this work was to investigate the temperature dependences of the thermal conductivity of composite materials based on polypropylene filled with CNTs.

The polypropylene (PP) of grade 01030 was used. CNTs were obtained on a Co + Mo / MgO catalyst with a Co + Mo content of 0.5 mass% and a specific surface area of 1308 m^2 / g. To regulate the interaction and improve the compatibility of PP with CNT, oligooxypropylene glycol was used. Previously, the compounding of the components was carried out in a mixer using an MEF 91 ultrasonic disperser [1].

The temperature dependences of the thermal conductivity of PPs containing CNTs are obtained on a measuring system that allows one to determine the temperature dependences of the thermal conductivity of solid materials in a short-term experiment through definable programmed time intervals [2 ± 4].

The dependences of the thermal conductivity of the initial PP and the composite material on the basis of PP with the CNT filler (0.1% by mass) on the temperature are shown in Fig.

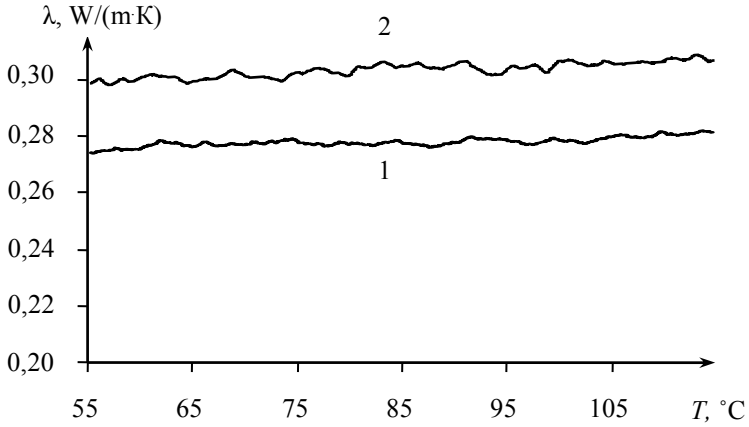

Fig.1 - Temperature dependences of thermal conductivity of PP (1) and a composite based on PP containing 0.1% by weight. CNT (2).

Conclusion

Filling the PP with carbon nanotubes slightly increases the thermal conductivity of the material throughout the temperature range studied, without actually changing the nature of the dependence. Taking into account the high thermal conductivity of the individual CNTs that make up the materials, the thermal conductivity of the composite obtained with their help increases.

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ОПРЕДЕЛЕНИЕ ТЕПЛОПРОВОДНОСТИ НАНОМОДИФИЦИРОВАННОГО ПОЛИПРОПИЛЕНА

О. Е .Богометова, А.В. Гришин, Д.В. Трофимов, И.В. Рогов
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: qrishinag@gmail.com

Аннотация
Исследованы методы и средства, предназначенные для определения температурных зависимостей теплофизических свойств материалов.

Ключевые слова: нанотрубки, полипропилен, теплофизические характеристики.

УДК 339.13 + 661.66
ББК 65.05 + 24.46

MARKETING PROGRAM OF CARBON NANOTUBES "TAUNIT" AND EQUIPMENT FOR THEIR SYNTHESIS IN THE GLOBAL MARKET

A.B. Edapina
Tambov State Technical University, Tambov, Russia
e-mail: edapinaal@gmail.com

Abstract
The paper studies the global and Russian nanotechnology markets, the development problems of nanotechnology sector of domestic production and prospects for the development of nanoindustry in Russia.
Key words: nanotechnology, nanomaterials, carbon nanotubes, marketing program.

There is no doubt the development of nanotechnology can cause a new technological revolution that will affect all areas of human activity. Nanotechnology will have an impact on all spheres of material production and consumption. Currently, one of the most promising fields of nanotechnology is the synthesis of carbon nanomaterials, including carbon nanotubes (CNTs). CNTs have a number of unique properties: good electrical conductivity and adsorption properties, ability to cold emission of electrons and accumulation of gases, diamagnetic characteristics, chemical and thermal stability, high strength in combination with high values of elastic deformation [1]. Introduction of CNTs into the composition of products increases such qualities as elasticity, strength, toughness, wear resistance and electrical conductivity.

CNT is no longer a unique material abroad with laboratory volumes of synthesis. Developed countries, the leaders of this area make up a larger part of the total volume of production and consumption of CNTs in the world, and the amount of investment in R&D is estimated at trillions of dollars [2]. Successful development of nanotechnologies in these countries is based on a long and active interaction of business, science and government structures. The domestic market of CNTs is currently in the incipient stage. Commercial offers in nanotechnology industry are almost absent. According to Research.Techart currently Russia's part in the global nanotechnology market is 0.04% [3].

The current condition of the Russian nanotechnology market is characterized by a sufficient amount of R&D in the development of nanomaterials and the actual absence of trends towards the practical application of existing developments. The backlog caused by the complexity of the transition from the scientific segment of fundamental research to the market cluster of high-tech and science-intensive production with the subsequent commercialization of the final product. All currently produced nanomaterials are used mainly for scientific researches. There are less than 20% of companies of the total number of participants which

commercializes their inventions, but the production is limited to certain orders and does not stand the competitive pressure from the world's analogue producers [4].

In the given conditions, product marketing of "NanoTechCenter" in cooperation with "Tambov Plant "Komsomolets" named after N.S. Artyomov" is extremely interesting. During the period of 2008-2014 years, the company sold CNT "Taunit" in the amount of 4.7 million rubles and three reactors of the periodic synthesis of CNM with an average cost of 200 thousand rubles. [5]. However, in general, the Russian market of nanomaterials is one of the least developed segments of nanotechnology cluster. Techart's data shows that the total sales of nanomaterials such as CNTs in Russia do not exceed 100 million rubles, and the development of a competitive production of scientific instrumentation is practically absent [3].

Despite the lack of productive interaction between science and business, as well as the underdevelopment of the venture infrastructure, Russia still has chances to be among the leading producers due to the capacity of the resource base and the strategic position. With government support, Russia can catch up with the EU and the US on the volume of nanoproducts output into the world market within 5-8 years [6].

For the successful enter into the global market and for the increase of competitiveness of domestic innovative products, in addition to government support and financing of private investors, companies need to work out a strategic plan for promoting their product, which will include the following stages:

- collecting data on potential consumers;
- setting the goals of promotion;
- determination of the target audience, topics and forms of the advertising message;
- budget planning*;*
- preparation of a promotion program;
- setting the parameters for evaluating the results of promotion [7].

The collection of data consists in obtaining information about potential consumers, their information preferences, values and motives for acquiring this product. Besides, obtaining characteristics of competing products will make you able to offer customers a product that has a number of improved properties and prices in the market of nanomaterials.

Goals of promotion can be divided into two main areas: the stimulating demand, aimed at increasing sales in the short term, and the improve of the company image.

For advertising product promotion, it is necessary to determine the target audience, to which the advertising message should be addressed and the topic of the message itself. The topic of the message should match with the goals of promotion and should be traced in all promotion activities. In addition to the topic, it is important to take into account the form of the message, since it is often the form that can consciously determine the number of demand for products.

Budget planning should be carried out according to the principle of the target method: the formulation of goals and objectives and then the calculation of costs for their solutions.

The promotion program is a set of promotion tools used by the company. In other words, the promotion program is a detailed list of activities that should be implemented as part of the promotion of products or services to the market. It is one of the most important stages of the strategic plan, which allows to assess the situation in the global market and to increase the competitiveness of the products.

Finally, it is necessary to evaluate the results, the purpose of which is to increase the volume of demand for products, increase profits and improve the properties of the produced nanoproducts.

A large research base of technological developments and a huge reserve of high-quality raw materials lead to a conclusion that Russia is able to compete with the world's leading producers of nanoproducts. To achieve results, smaller companies carrying out R&D in the field of nanotechnology and producing CNTs and equipment for their synthesis, need larger venture financing, government support and a quality promotional program of their products in the global market.

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ПРОГРАММА ПРОДВИЖЕНИЯ УГЛЕРОДНЫХ НАНОТРУБОК СЕРИИ «ТАУНИТ» И ОБОРУДОВАНИЯ ДЛЯ ИХ СИНТЕЗА НА МИРОВОМ РЫНКЕ

А.Б. Едапина
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: edapinaal@gmail.com

Аннотация

Статья посвящена оценке состояния мирового и российского рынков нанотехнологий, проблеме развития нанотехнологического сектора отечественного производства и составлению прогнозов развития наноиндустрии в России и во всем мире в целом.

Ключевые слова: нанотехнологии, наноматериалы, углеродные нанотрубки, программа продвижения.

УДК 539.2-022.532
ББК 0332

THERMALY STABLE HEAT MATERIAL BASED ON FLUOROPOLYMER COMPOSITES WITH CARBON NANOTUBES

A.M. Ermolaeva
Tambov State Technical University, Tambov, Russia
e-mail: eam201195@mail.ru

Abstract
The influence of conditions modification of PTFE carbon nanotubes (CNTS) on its chemical composition and structure is shown. Treatment of CNTS with the use of fluoride does not cause significant damage to the side walls and a pronounced increase in the degree of imperfection, but helps to increase the specific surface to 2.26 times. From the viewpoint of reinforcing effect with the introduction of ferroplast CNTS, it becomes more effective than the original.

Key words: nanomaterials, carbon nanotubes, epoxy resin, modification, functionalization, composite, fluoropolymer.

Introduction

The first fluoropolymer was in the Soviet Union on American military equipment, supplied under lend-lease from the USA in the years of the great Patriotic war in the various seals and bearings.

In March 1947, Leningrad Scientific research Institute of polymerized plastics began working on the creation of the Soviet fluoropolymers. The decision of the Central Committee of the Communist party was established in the laboratory number 1 at the same Institute, which was headed by the founder of Russian fluoropolymers Lev Chereshkevich. In parallel, the State Institute of Applied Chemistry, Leningrad was developed the process of obtaining tetrafluoroethylene. It was obtained in the pilot plant Hypha. Raw materials for the production of tetrafluoroethylene — chloroformate (freon 22) was supplied by plant No. 752 (future Kirovo-Chepetsky chemical plant named after B. P. Konstantinov). The first batch of Teflon-4 is received on the pilot plant NIIPP in the reactor polymerizate volume of 130 liters.

The topic of my thesis is devoted to the study of physical and mechanical properties of PTFE with the addition of carbon nanotubes. Research relevance in light of current trends in the industry has replaced metal products, lighter polymer materials that are not inferior to them in strength. The goal of this work is to study the impact of functionalized carbon nanotubes on the strength of the PTFE used in many industrial processes.

Fluoropolymers are widely used in engineering, due to its properties. It is known that fluoropolymers are insulators current, and PTFE film perform primary winding high-voltage wires. PTFE is used also when manufacturing a heating cable, insulation and conductive heating core, used for floor heating. Also fluoropolymers are excellent anti-friction and enough heat-resistant polymers that

allow it to be used in friction without additional lubrication. PTFE also make gaskets and washers, and the abutting parts can never "catch". Details of PTFE bonded only in the processing of surfaces with a special primer, but even in this case, the quality of the adhesion is not very high. PTFE, in particular, make hoses, hydraulic high pressure plastic tube in stainless steel braid is designed for long-term work with the discharge pressure of the hydraulic system 210 kg/cm^2. Due to the high chemical resistance of fluoropolymers made hoses for pumping aggressive liquids (concentrated alkali, acid), including hot and under high pressure.[1]

Experimental research

The study includes analysis of scientific literature and patents. On the basis of analysis and experimental data, the technology for the modification of PTFE will be developed. The developed method of introduction, distribution and stabilization of dispersions of carbon nanotubes in the binder based on PTFE will be created.

It was established experimentally required mass fraction of carbon nanotubes introduced into ftoroplast binder, providing a significant increase in physical-mechanical characteristics. Found the best time evacuating, and polymerization..

Obtained and analyzed laboratory samples nonmodifying binder and ftoroplast composite materials with improved characteristics. Physico-mechanical characteristics (relative to bending) of the binder is improved by 20-30%, the limit of compressive strength and heat resistance - up to 70% and breaking load nanomodification epoxy - 2-3 times. Specific electrical resistivity of nano-modified epoxy resins decreased to a value of 2.5 Ohm•m.

The possibility of industrial production of ftoroplastnanomodified composite materials with improved characteristics is shown and justified. Developed technology and processes that improve the physical and mechanical properties of polymer composite materials, allows providing resource and energy saving in industrial production.[2]

Acknowledgments

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ТЕРМОУСТОЙЧИВЫЙ ТЕПЛОАККУМУЛИРУЮЩИЙ МАТЕРИАЛ НА ОСНОВЕ ФТОРОПЛАСНОГО КОМПОЗИТА С УГЛЕРОДНЫМИ НАНОТРУБКАМИ

А.М. Ермолаева
Тамбовский государственный технический университет, Тамбов,
e-mail: eam201195@mail.ru

Аннотация

Исследовано влияние условий модифицирование фторопласта углеродными нанотрубками (УНТ) на его химический состав и структуру. Обработка УНТ с использованием фтора не вызывает заметных повреждений боковых стенок и выраженного увеличения степени дефектности, но способствует увеличению удельной поверхности до 2,26 раз. С точки зрения усиливающего эффекта при введении в фторирорпласт УНТ, он становится более эффективным, чем исходный.

Ключевые слова: композит, модификация, наноматериалы, углеродные нанотрубки, функционализация, фторопласт.

УДК 620.22=111
ББК 804

SUPERHARD ABRASIVE TOOLS

V.A. Ershov, A.S. Cherkasova
Tambov State Technical University, Tambov, Russia
e-mail: slavaershov47@gmail.com

Abstract
This article discusses the production of abrasive tools on a metal base from superhard materials. The chemical compositions and technology of production of abrasive tools are covered.

Key words: abrasive, material processing, powder technology, superhard materials, tools production.

Introduction

Modern heavy industry cannot be imagined without abrasive materials. Abrasives for their hardness are divided into soft, hard, super-hard and ultra-hard (lonsdaleite, fullerite). A special place in this row is occupied by super hard abrasive materials (SHMs). There are several ways of making tools with SHMs. This article discusses some of the SHMs used in the manufacture of abrasive tools, as well as the methods of obtaining an abrasive tool by powder metallurgy and the method of galvanic deposition.

Methods and materials

The first step in the process of manufacturing an abrasive tool is to determine its purpose. Next is choosing the components for the future tool. These components can be divided into a binder and abrasive filler. Consider some SHMs used as an abrasive fillers.

Natural diamond can be called the most famous abrasive. Diamonds contain minor impurities of metal oxides, which color them into different colors. The highest hardness of diamond is explained by the structure of its crystal lattice and the extremely dense arrangement of atoms in it. The mechanical and physicochemical properties of different types of diamonds differ. Depending on the shape the diamond crystals can be arranged in reducing the mechanical resistance sequence as follows: octahedron, rhombododecahedron and hexahedron. Diamond is not used in the processing of steel and cast iron, because when the temperature rises to 800 ^{o}C it begins to dissolve in iron.

At present, the technology of synthesis of artificial diamonds has been well mastered. Artificial diamonds have the same density, chemical composition, structure and hardness as natural, but contain more impurities. The process of synthesis of diamonds occurs when a large pressure is applied to the graphite-containing mass, with simultaneous heating. In this case, the hexagonal lattice of graphite changes to cubic of diamond.

For the treatment of steels, another SHM - cubic boron nitride (CBN) is used. Its hardness is close to diamond, at the same time, adhesion to steel is much lower. CBN, otherwise borazon or elbor, is synthesized from boron nitride at a temperature of 1700-1800 ° C and a pressure of 8-12 GPa.

All SHMs are produced in a form of powders or polycrystals. Depending on the grain size and the purpose, the grits are divided into 4 categories:

1) Grinding powders (grain size from 40 to 2500 μm)
2) Micropowders (grain size from 1 to 60 μm)
3) Submicro-powders (grain size from 0.1 to 1μm)
4) Nanopowders (grain size from 10-4 to 10-3 microns)

In the abrasive tool based on SHM, the working part consists of diamond grains or CBN. They are evenly distributed throughout the volume and firmly fixed in a solid or porous binder. Thus, the tool is a composite material. When selecting components, it is good to select them so that the tool works in the self-sharpening mode. The main types of abrasive tools are produced on metal, organic and ceramic bonds. The appearance and structure of the bundle, along with the properties of SHM, are the main characteristics determining the operability and effectiveness of the abrasive tool.

Metal bonds for an abrasive tool usually choose from the systems: Cu-Sn, Cu-Al-Zn; Co-Fe-Ni; Co-Fe; Co; Ni-Fe-Cu. Also, various fillers are added to the binder. Sulphides, graphite and fluorides are added to the binder as solid lubricants. To reduce plasticity, brittle additives such as diborides, oxides, etc. are introduced into the matrix of the copper-tin basis systems. The volume fraction of such additives varies from 3 to 20%.

Metal binders are designated by the index “M” and numbers, of which the first characterizes the bundle group, the second order number of the composition in this group. The first group bundle includes bonds primarily based on aluminum. The second group is universal bonds based on the copper-tin system. The third group is binders, used for manufacturing tools by rolling and vacuum technology. The fourth group consists of binders, produced by the method of electroplating with a single-layer arrangement of SHMs. The fifth group is binders for lapping, debugging. Sixth group include binders for a tool for processing stone, rocks.

Particles of SHMs in a binder can be fixed by various methods. The main for the industry at the moment is the method of powder metallurgy and electrochemical deposition.

The essence of the first method consists in pressing a mixture of metal powders and various fillers and then sintering the billet at a temperature less than the melting temperature of the most fusible component. As a result, a strong and precise product with a uniform distribution of the grain size of the STM is obtained.

Electrochemical deposition is based on the theory of electrolytic dissociation. Diamond-galvanic coating (DGC) is formed in the process of electrochemical deposition of metal with simultaneous trapping of sediment in contact with the

cathode of diamond grains. The method of securing diamond grains with electrochemical deposited metal allows producing diamond tools of almost any profile and dimensions.

Conclusion

This article illustrates the main base points of production of abrasive tools from SHMs on metal bonds. It should be noted that this area is of considerable interest for scientific research.

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СВЕРХТВЕРДЫЕ АБРАЗИВНЫЕ ИНСТРУМЕНТЫ

В. А. Ершов, А.С.Черкасова
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: slavaershov47@gmail.com

Аннотация

Данная статья посвящена вопросам производства абразивного инструмента на металлической связке из сверхтвердых материалов. Освещаются химические составы и технология производства абразивного инструмента.

Ключевые слова: абразив, инструмент, обработка, порошковая технология, производство, сверхтвердые материалы.

УДК 539.2-022.532
ББК 24.58

IMPROVING MECHANICAL PROPERTIES OF BFE-170 EPOXY RESIN BY ADDING FLUORINATED CARBON NANOTUBES

I. A. Zaytsev, A. N. Blohin, A. K. Sukhorukov
Tambov State Technical University, Tambov, Russia
e-mail: i.zayczew@rambler.ru

Abstract

The effect of fluorination conditions for carbon nanotubes (CNTs) on their chemical composition and structure has been researched. The CNT treatment using fluorine does not cause noticeable damages to side of walls and a pronounced increase in the degree of defectiveness, but contributes to an increase of up to 2.26 times in the specific surface area. From the viewpoint of a reinforcing effect, when introduced into a polymer matrix based on a Bisphenol-F-type epoxy resin, the fluorinated CNTs are noticeably more effective than the initial ones. At the fluorinated CNT concentration of 0.1 wt.% in the composite, the tensile strength, Young's modulus at stretching, flexural strength and Young's modulus at bending increase by 50, 74, 60 and 66 %, respectively, whereas the thermal stability and electrical conductivity of the composite practically do not change.

Key words: nanomaterials, carbon nanotubes, epoxy resin, modification, functionalization, composite.

Introduction

Recently, carbon nanomaterials, especially single-walled and multi-walled carbon nanotubes (CNTs), have been widely used as fillers to improve the properties of polymer composites [1]. In many cases, the tendency of CNTs to agglomerate, low polarity of their surface, and low adhesion to polymer matrices do not allow for achieving the necessary efficiency indicators [2-12]. To enhance the affinity of the fillers to polymers and solvents, various methods of plasma and chemical and mechanical processing are used. One of the most promising ways of functionalizing the CNT surface is direct fluorination using treatment with fluorine gas at elevated temperature [13-17].

In this regard, the purpose of the present work was to study the effect of fluorination conditions on the chemical composition and structural characteristics of CNTs and the strength characteristics of composites based on a Bisphenol-F-type resin modified with initial and fluorinated CNTs.

Experimental research

During fluorination, the CNT specific surface area increases (Table 1). The greatest increase, 2.26-fold, was recorded for the sample treated at 150°C. Increasing the fluorination temperature to 250 or introducing the oxygen into the fluorinating mixture gives a lesser effect. The increase in the specific surface area during the fluorination can positively affect the strengthening effect of the CNTs when incorporating them into the epoxy composition.

Thus, the samples fluorinated at 150 °C have the same degree of fluorination as the CNTs fluorinated at 250, but have a higher specific surface area and fewer

defects. Based on the data obtained, it can be assumed that the reinforcing effect of the CNTs fluorinated at 150 °C will be maximum, and further on, to strengthen epoxy composites, these CNTs were used.

Table 1. The fluorination effect on the specific surface area of the "Taunit-M" CNTs. The pressure of the fluorinating mixture is 0.7 atm, and the fluorination time is 2 h.

Sample	**Fluorination mixture**	**Fluorination temperature, °C**	**Specific surface area, m^2/g**
Initial CNTs	-	-	105
Fluorinated CNTs	F_2	250	166
Fluorinated CNT	$80\%F_2+20\%O_2$	150	180
Fluorinated CNT	F_2	150	238

Both the initial and fluorinated CNTs were firstly dispersed directly in the epoxy resin, due to shear flows in a thin gap between rotating rolls, and then sonicated in a thin layer.

The dispersion composition of the obtained materials was studied on a Nicomp 308ZLS instrument by the dynamic light scattering method, which makes it possible to estimate the effective particle size of the disperse phase, which would be a true size if these particles were spherical.

Since both the CNTs and the agglomerates formed by them are not spherical, the results of the measurements allow for evaluating only relative changes in the disperse composition of the suspensions analyzed.

As seen from the analysis of the particle effective size distribution diagram (Fig. 1), the suspension containing the initial CNTs is polydisperse. The average effective size of the smallest agglomerates was found to be 418 nm. The second peak shows an effective particle size of about 7μm, and the number of large agglomerates slightly dominates over the number of smaller ones.

The suspension containing the fluorinated CNTs is monodisperse, and the average effective agglomerate size was found to be about 900 nm, and larger agglomerates cannot be observed. Thus, the CNT fluorination contributes to a better dispersion of these in the epoxy binder.

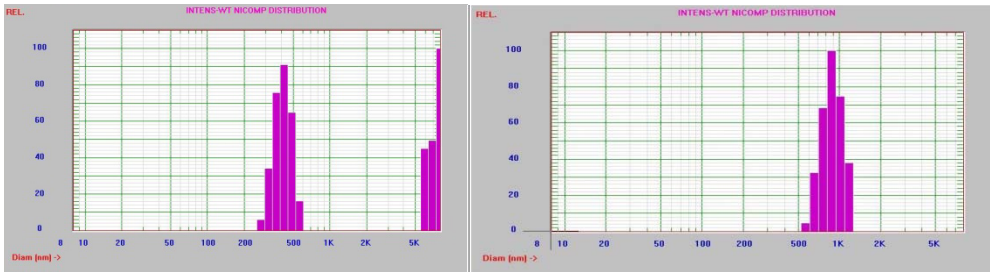

Fig. 1 - Effective size distribution of the initial (a) and fluorinated (b) CNTs in the BFE-170 epoxy monomer dissolved in isopropyl alcohol. CNT concentration is - 0.1 wt.%.

The use of the CNTs leads to a significant increase in the mechanical characteristics of the epoxy composites (Bisphenol-F-type resin and L-19 polyaminoamide-based hardener) based on the data presented in Table 2.

The fluorinated CNTs provide better effect compared with the initial ones. The greatest effect is achieved with 0.1 wt.% of the fluorinated CNTs in the composite: the tensile strength increases by 50 %, the Young's modulus at stretching increases by 74%, the flexural strength increases by 60%, and the Young's modulus at bending increases by 66%. Only in one of the above-mentioned papers [16], the same increase in the tensile strength as in the experiments described herein, is reported; however, the amount of multi-walled amino-functionalized nanotubes introduced into the epoxy composition is 1%. In our experiments, the same effect was achieved at the fluorinated CNT concentration of 0.1 %, i.e. 10 times less than in [16].

Table 2. Mechanical properties of the epoxy composites

Concentration of CNTs introduced into the composite, wt.%	**Tensile strength, MPa**	**Young's modulus, MPa**	**Breakig elongation, %**	**Flexuralst rength, MPa**	**Young'smo dulus, MPa**
0 (unfilled composite)	18.2±1.09	849±51	4.3±0.22	32±1.60	933±47
0.01 % of initial CNTs	20±1.1	1077±44	4.2±0.2	42±1.7	1100±55
0.1 % of initial CNTs	24±1.2	1137±46	4.9±0.2	45±1.8	1251±50
0.5 % of initial CNTs	23±1.1	1245±50	4±0.16	43±1.7	1290±52
Concentration of CNTs introduced into the composite, wt.%	**Tensile strength, MPa**	**Young's modulus, MPa**	**Breakig elongation, %**	**Flexuralst rength, MPa**	**Young'smo dulus, MPa**
0.01% of fluorinated CNTs	22±0.88	1352±54	4±0.15	45±1.75	1187±48
0.1% of fluorinated CNTs	27±1.05	1479±56	3.5±0.14	51±2.0	1550±59
0.5% of fluorinated CNTs	25±1.0	1588±65	3.2±0.13	48±1.8	1611±61

The results on the measurement of the electrical resistivity of the composites are given in Table 3. In the percentage region of up to 0.5 wt. %, the CNTs cause to a decrease in the resistivity of the epoxy bisphenol matrix from 274 to 6 MOhm*m. The introduction of the fluorinated CNTs does not lead to an improvement in the electrical conductivity of the epoxy bisphenol matrix, and the composite remains insulator.

Table 3. The effect of the CNT additive on the resistivity of the epoxy composite.

	Initial CNTs			FluorinatedCNTs		
Concentration of CNTs introduced into the epoxy matrix	0.01%	0.1%	0.5%	0.01%	0.1%	0.5%
Resistivity	274 MOhm*m	19 MOhm*m	6 MOhm*m	1.4 GOhm*m	1.4 GOhm*m	1.4 GOhm*m

Conclusion

Both the initial and fluorinated CNTs can be effectively used for hardening epoxy resin composites when their concentration in those materials is about 0.1 wt.%. The tensile and flexural strength and Young's modulus are significantly improved. The fluorinated CNTs are more effective as fillers compared with the initial ones.

This was confirmed by mechanical tests and electron microscopy analyses. Owing to the increase in the CNT specific surface area during the fluorination and formation of polar functional groups, the adhesion between the matrix (epoxy resin) and the filler is increased, thereby contributing to the improvement in the mechanical properties of the composites.

In this regard, the CNTs treated with fluorine at 150 °C are the most efficient. An increase in the fluorination temperature reduces the strengthening effect of the CNTs, which may be due to damages of their surface

The achieved tensile strength and flexural strength of the epoxy composites based on the "Bisphenol-F"-type epoxy resin reinforced with the fluorinated CNTs significantly exceeds the available literature data for similar materials when the CNT concentration is less than 5 wt.%. The fluorinated CNTs used as fillers did not degrade the thermal stability of the composites and did not affect the dielectric properties.

Acknowledgments

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УЛУЧШЕНИЕ МЕХАНИЧЕСКИХ СВОЙСТВ ЭПОКСИДНОЙ СМОЛЫ BFE-170 ЗА СЧЕТ ВВЕДЕНИЕ ФТОРИРОВАННЫХ УГЛЕРОДНЫХ НАНОТРУБОК

И. А. Зайцев, А. Н. Блохин, А. К. Сухоруков
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: i.zayczew@rambler.ru

Аннотация

Исследовано влияние условий фторирования углеродных нанотрубок (УНТ) на их химический состав и структуру. Обработка УНТ с использованием фтора не вызывает заметных повреждений боковых стенок и выраженного увеличения степени дефектности, но способствует увеличению удельной поверхности до 2,26 раз. С точки зрения усиливающего эффекта при введении в полимерную матрицу на основе эпоксидной смолы типа бисфенола-F фторированные УНТ более эффективны, чем исходные. При концентрации фторированных УНТ в композите 0,1 мас.% прочность на растяжение, модуль Юнга при растяжении, прочность на изгиб и модуль Юнга при изгибе увеличиваются соответственно на 50, 74, 60 и 66%, тогда как термическая стабильность и электропроводность композита практически не меняются.

Ключевые слова: композит, модификация, наноматериалы, углеродные нанотрубки, функционализация, эпоксидная смола.

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ББК 24.58

SORPTION BY CARBON NANOSTRUCTURES

T.S. Kuznetsova, T.V. Pasko
Tambov State Technical University, Tambov, Russia
e-mail: kuznetsova-t-s@yandex.ru

Abstract
Liquid-phase sorption is a very promising method of purification of toxic organic pollutants due to high efficiency and economic attractiveness. At present, much attention is paid to obtaining new sorption materials, consisting of nanometric elements.
Key words: active carbon, nanotechnology, nanotubes, sorption.

Nanotechnology has firmly established itself in modern life. No wonder they are included in the list of critical technologies of the Russian Federation. Investigation of the process of adsorption of gaseous substances by carbon nanostructures is an urgent task facing scientists.

Particular attention is paid to carbon nanotubes (CNTs) and complexes produced on the basis of graphite nanofibres (GNV). To date, the general patterns of the course of the reactions of sorption of gases have been established. At the same time, discussions are held regarding the thermodynamic conditions for the onset of physical and chemical sorption, whether the internal cavity of the nanostructures is important, how to determine the values of the heat of sorption, the limiting estimates of the capacitive characteristics, how to increase the stability of composites, and so on.

Therefore, the development of technology and hardware design of liquid-phase sorption of toxic organic pollutants with complex graphene material is a necessary and important step for the mass introduction of the practical application of sorption materials created using graphene.

All the controversial issues in this area are a consequence of two unsolved problems: improving the methods of synthesis and purification of samples, and the lack of reliable theoretical methods for calculating the sorption characteristics of nanostructured materials.

Many properties of materials in a gaseous medium, one way or another, are determined by surface phenomena arising at the interface of the two phases. As a rule, the thickness of the near-surface layers is several tens of nanometers, for laboratory samples of the usual size this is not essential. However, taking into account the specific surface area of carbon nanofibers (CNFs) or nanotubes (CNTs), the size effects significantly influence the character of the undergoing processes. Molecular processes occurring at the interphase interface are most often subjected to the methods of statistical mechanics. That is why the coordinated theoretical and experimental investigation of the processes of heat and mass transfer in nanoscale structures is topical.

Among all the methods of obtaining the nanostructures, the most popular were the two. The first is the evaporation of graphite followed by the condensation of the product when the vapor is cooled, called the arc method. The second one is based on the thermal decomposition of carbon-vapor gases (chemical vapor deposition), accompanied by gas-phase chemical deposition (GFP) of crystalline nanocarbon on metal catalysts. This method is also known as a CVD process.

The discovery of carbon nanotubes is a significant achievement of modern science. These are fundamental studies that contribute to the rapid progress of applied technologies.

Nanotubes are structurally located between graphite and fullerenes, but have other excellent properties. They are an independent material that has unique physical and mechanical characteristics. For example, nanotubes have unique sorption characteristics. This is due to their structure. They all consist of layer surfaces. Nanotubes have an abnormally high specific surface area. This feature is the basis for electrochemical and sorption characteristics. The distance between the graphite layers is sufficiently large in comparison with the dimensions of the atoms. Some other substances can be accommodated here. Thus, the nanotube is, as it were, transformed into a container for storing liquid, solid and gaseous substances. The specific surface area of nanostructured carbon materials is quite large. It is 600-800 m2 / g.

The study of carbon nanostructures is very promising for solving applied problems. If you fill the tube with metal, we get miniature wires for nanoelectronic devices. If we fill the tube with gas, we get a device for storing gases. This is useful for creating environmentally friendly modes of transport or creating filters. The main task is the purification of gaseous and liquid substances from harmful or toxic impurities.

Carbon adsorbents are also called active carbons. They are unique and ideal sorption materials because of their physical and chemical properties. Such qualities help to solve various applied tasks in questions of ensuring chemical and biological safety of a person, environment and infrastructure. These adsorbents are highly porous carbon materials. This means that they have a developed internal surface in the range of 1000-2000 m2 / g.Itis achieved due to the structural features: macro-, meso- and micropores.

In a porous structure, micropores and mesopores absorb any types of organic microimpurities due to surface interaction forces, called adsorption forces. Micropores of carbon adsorbents have a size of less than 0.6-0.7 nm, but they include larger pores - supermicropores, whose size is 0.7-1.6 nm. In the volume of such micropores, absorption takes place due to van der Waals forces of nonspecific interaction. Thus, the main absorption of impurities from the medium to be purified occurs. From this description it can be seen that carbon adsorbents are a classic example of nanomaterials. The formation of a specific, slit-shaped nanostructure of microporesis carried out within the technological process of

obtaining active coals by using a special raw material and certain modes of its heat treatment. For example, at the stage of drying, carbonization and activation.

An example is the comparison of activated carbon (AG-3) and carbon nanomaterial "Taunit" produced by NanoTechCenter LLC in Tambov. "Taunit" has a much higher capacity. According to the results obtained in the laboratory, the sorption capacity of "Taunit" is 2 to 4 times higher than the sorption capacity of active coal under various conditions. This makes it possible to consider it as a highly effective sorbent in the relevant fields of application.

Carbon adsorbents can be used in chemical, petrochemical and other industries.

The following promising fields of application of sorbents on carbon nanostructures are considered in the literature:

- solvent recovery;
- Sanitary cleaning of waste gases, incl. desulfurization;
- NPP gas cleaning systems;
- trapping of gasoline vapors released by vehicles;
- destruction of chemical weapons;
- cleaning of air entering residential and working premises (air conditioning);
- Purification of drinking water;
- decontamination of sewage;
- processing of liquid radioactive waste;
- protection of soils from xenobiotics, incl. pesticides;
- remediation of soils;
- zones of sanitary protection of water sources;
- means of individual and collective protection of filtering type;
- production of chemical farm drugs, vitamins, antibiotics.

Thus, sorption on carbon nanostructures is very promising. Therefore, the development of technology and instrumental design of liquid-phase sorption of toxic organic pollutants with complex nanostructured material is a necessary and important step for the mass introduction of the practical application of sorption materials.

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СОРБЦИЯ НА УГЛЕРОДНЫХ НАНОСТРУКТУРАХ

Кузнецова Т.С., Пасько Т.В.
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: kuznetsova-t-s@yandex.ru

Аннотация

Жидкофазная сорбция является весьма перспективным методом очистки токсичных органических загрязнителей благодаря высокой результативности и экономической привлекательности. В настоящее время большое внимание уделяется получению новых сорбционных материалов, состоящих из нанометрических элементов.

Ключевые слова: активный уголь, нанотехнологии, нанотрубки, сорбция.

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ББК 24.58

CARBON NANOMATERIALS FOR EXTRACTION OF CU(II) IONS FROM WASTEWATER

D.A. Kurnosov, E.S. Mkrtchyan, A.V. Babkin, I.V. Burakova, A.E. Burakov, E.A. Neskoromnaya
Tambov State Technical University, Tambov, Russia
e-mail: ozikimoziki@mail.ru

Abstract
The present paper contains comprehensive studies on the adsorption properties of graphene oxide (GO), coconut activated carbon (AC) and "Taunit-M" carbon nanotubes (CNTs). Cu(II) ions served as extracted component. Measurements of the Cu(II) content in water were performed using electrothermal atomization atomic absorption spectrometry. The obtained experimental data indicate high adsorption capacity of the GO along with the CNTs and the AC. Kinetic parameters of the adsorption process on the graphene oxide were calculated using standard models (pseudo-first- and pseudo-second-order, external and intraparticle diffusion, and Elovich). The presented results demonstrate the prospects of using the GO in selective extraction of heavy and rare-earth metal ions from aqueous media.
Key words: Sorption, Graphene oxide, Kinetic study, Copper.

Introduction

Along with carbon nanotubes (CNTs) and CNT-based materials, graphene oxide and its modifications have become widespread. Like any carbon nanomaterial, graphene possesses a number of unique physical and chemical properties, to which its two-dimensional structure and the corresponding thermal, electro-conductivity (zero width of the forbidden band) and optical characteristics, as well as high specific surface, may be related. The latter opens great prospects for using graphene oxide (GO) in selective extraction of harmful impurities of different chemical nature from gaseous and aquatic media. CNTs and GO are currently some of the most promising materials in the field of extraction of heavy metal ions from aqueous solutions [1].

Table 1. The Cu(II) adsorption on different materials

Adsorbent	Adsorption capacity (mg/g)	$C_{init.}$ (mg/L)	Adsorption time (min)
Activated carbon (chemical activation)[2]	7	40	210
Activated carbon[2]	11.5	40	200
Activated carbon from hazelnut husks [3]	6.65	200	60
CNT sheets [4]	6	100	70
CNT sheets (oxidized) [4]	14	100	70
As-produced CNTs [5]	8.92	50	1440

In the present work, the adsorption of Cu(II) ions from aquatic media using carbon nanostructures such as CNTs and GO, along with conventional materials such coconut activated carbon (AC) was studied.

Table 1 gives comparative results reported in literature for the Cu(II) adsorption on both the nanostructured and commercially available adsorbents. From this table, it can be seen that the CNTs exhibit the adsorption characteristics similar to those of the commercial materials, but the adsorption time in their case is reduced by 2-3 times.

Materials

Nanocarbon materials – "Taunit-M" CNTs and GO as nanoplatelet aggregates obtained via thermal oxidation of pyrolytic graphite (both – NanoTechCenter Ltd., Tambov, Russia) – were used as adsorbent samples for testing. The diameter of the CNTs is 15-20 nm, the orientation of graphene layers is cylindrical. The main characteristics of AC (AQUACARB 207C, Chemviron Carbon, UK) used as reference materials are as follows: surface area - 1150... 1350 m^2/g, adsorption capacity regarding methylene blue - 230...270 mg/g, and bulk density - 0.47...0.51 g/cm^3.

Research methods

To determine the adsorption kinetic parameters, experiments were carried out with 0.02 g of the CNTs, 0.1 g of the GO, and 1.0 g of the AC. The volume of aqueous solutions was 30 mL at the initial concentration of $Cu(NO_3)_2 \cdot 3H_2O$ (Laverna Ltd., Moscow, Russia) equal to 100 mg/L. Each solution and adsorbent were equilibrated by agitating on an end-over-end rotator (Multi Bio RS-24, Biosan, Riga, Latvia) at 120 rpm for 1 h, and then centrifuged on a centrifuge (5810 R, Eppendorf, Hamburg, Germany). The Cu(II) equilibrium concentration was determined by electrothermal atomization atomic absorption spectrometry on an MGA-915MD instrument (Atompribor Ltd., Saint Petersburg, Russia).

Result and discussion

To identify characteristic features of the Cu(II) adsorption process, kinetic studies aimed at determining the time required to achieve equilibrium in the systems under study were performed.

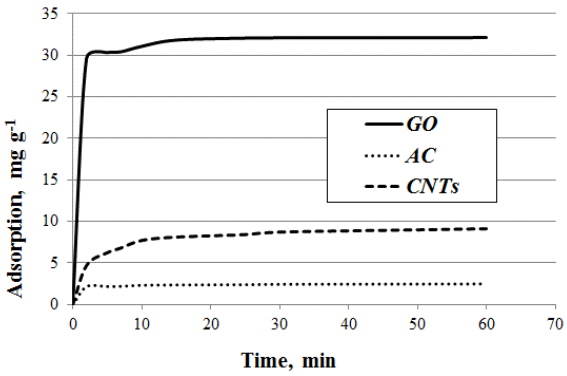

Fig. 1 - Kinetic curves constructed for the Cu(II) adsorption on the GO.

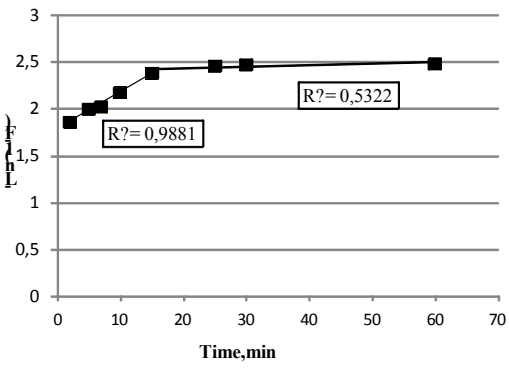

Fig. 2 - External diffusion curve constructed for the Cu(II) adsorption on the GO.

As can be seen in Fig. 1, for the GO, at the initial stage, the adsorption rate is sufficiently high, and about 90 % of the adsorbate is extracted during the first 5-10

min. It can be clearly observed that the Cu(II) maximum adsorption capacity of the GO is superior to that of the other materials studied. To describe kinetic mechanisms of the adsorption, the well-known mathematical models - pseudo-first- and pseudo-second-order, external and intraparticle diffusion, and Elovich model – were implemented herein.

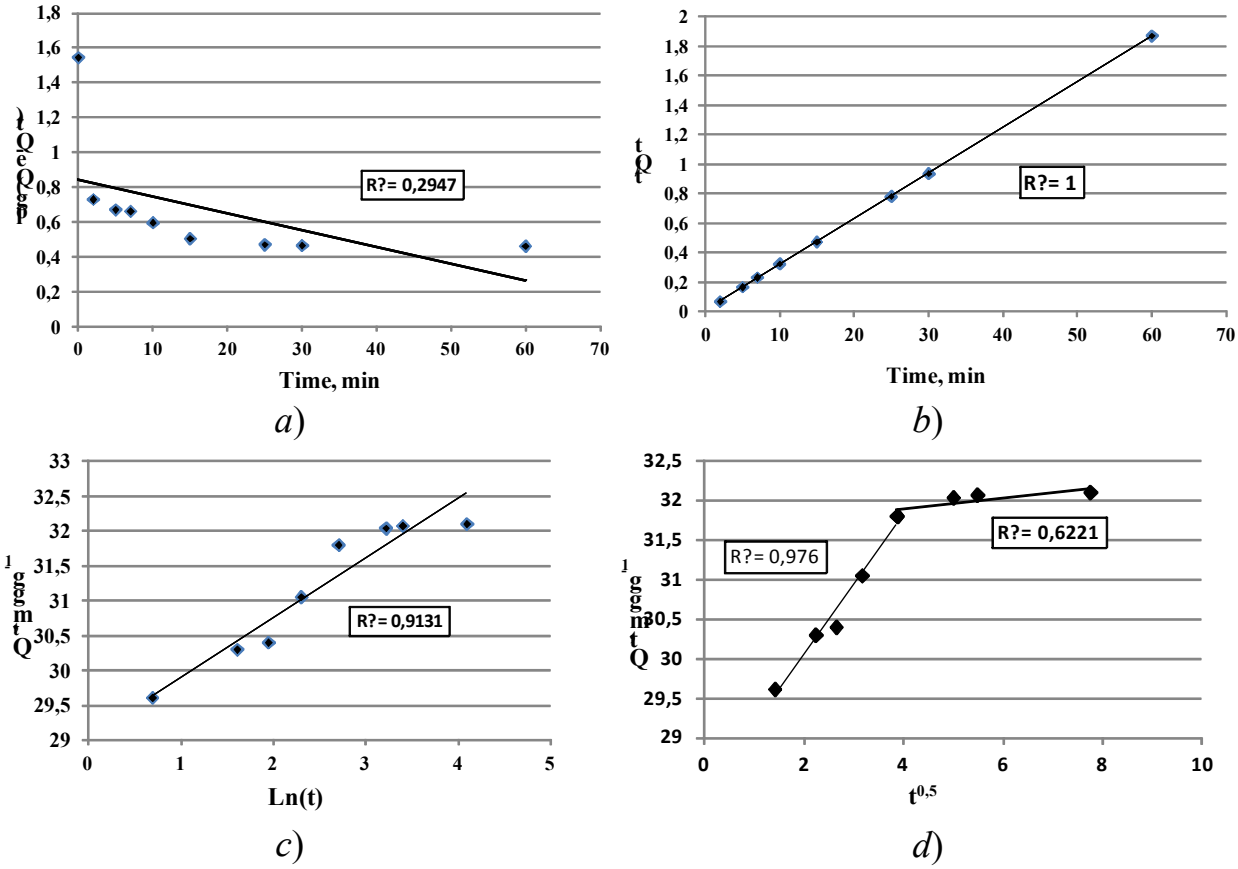

Fig. 3 - Kinetic models of the Cu(II) adsorption on the GO – a) pseudo-first order; b) pseudo-second order; c) Elovich; and d) intraparticle diffusion.

Fig. 2 (a and b) demonstrates chemical interactions during the adsorption process (where F is the fraction attainment at equilibrium, $F = \frac{Q_t}{Q_e}$; Q_e – Cu(II) amount adsorbed onto the adsorbent surface at equilibrium; Q_t – Cu(II) amount adsorbed onto the adsorbent surface at time t). It can be seen that the results of the experimental data are mostly fitted to the pseudo-second-order model, thereby indicating that the rate of chemical bond formation is limited by the interaction of the adsorbate ions with each other. The adsorption process is of the complex nature, and it is affected by both the structure of the adsorption material and the features of its chemical interaction with the extracted component.

Conclusions

Within the framework of the present paper, the kinetic mechanisms of the Cu(II) adsorption from aqueous solutions using the nanostructured and conventional materials were studied. The results of the comparative kinetic tests demonstrate a 10-fold superiority of the GO over the commercially available coconut activated carbon regarding the Cu(II) maximum adsorption capacity.

Acknowledgements

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УГЛЕРОДНЫЕ НАНОМАТЕРИАЛЫ ДЛЯ УДАЛЕНИЯ ИОНОВ CU(II) ИЗ СТОЧНЫХ ВОД

Д.А. Курносов, Э.С. Мкртчян, А.В. Бабкин, И.В. Буракова, А.Е. Бураков, Е.А. Нескоромная
Тамбовский Государственный Технический Университет
e-mail: ozikimoziki@mail.ru

Аннотация

Настоящая статья содержит всесторонние исследования адсорбционных свойств оксида графена (ОГ), кокосового активированного угля (АУ) и углеродных нанотрубок «Taunit-M» (УНТ). В качестве удаляемого компонента служили ионы Cu (II). Измерения содержания Cu (II) в воде проводились с использованием атомно-абсорбционной спектрометрии с электротермической атомизацией. Полученные экспериментальные данные указывали на высокую адсорбционную способность ГО наряду с УНТ и АС. Кинетические параметры процесса адсорбции на оксиде графена рассчитывались с использованием стандартных моделей (псевдо-первого и псевдо-второго порядка, внешней и внутричастичной диффузии и модели Эловича). Представленные результаты демонстрируют перспективы использования ГО при селективной экстракции ионов тяжелых и редкоземельных металлов из водных сред.

Ключевые слова: сорбция, оксид графена, кинетическое исследование, медь.

УДК 544.032.2
ББК 24.58

ELECTRICAL IRON – SILICON CARBIDE MATERIAL

M.V. Makarchuk, I.L. Koroleva, A.D. Loskutova
Tambov State Technical University, Tambov, Russia
e-mail: korolevanpal@yandex.ru

Abstract
The electrophysical properties of the iron-silicon carbide composite material are studied. The technology of obtaining the iron-silicon carbide composite material is proposed.
Key words: composite material; electrical conductivity; temperature dependence of resistivity.

One important feature of powder metallurgy is the possibility of obtaining composite materials of any chemical composition, the components of which have different properties [1]. Properties of a composite can differ from the properties of components.

The paper presents the results of a study of iron - silicon carbide composite material. The ratio of the powders was determined with a share of the total. The samples contain 20% of silicon carbide powder and 80% by volume of iron powder. The total mass of powder for each sample is 8 grams. The mass of powders of each component is calculated from the values of volume and density. The powders were sifted through a sieve (cell size is 315 μm). Calculated amount of silicon carbide and iron for three servings were weighed. Further components are thoroughly mixed. Samples were prepared by pressing. One mold was used for all products, the parameters of which are shown in figure 1.

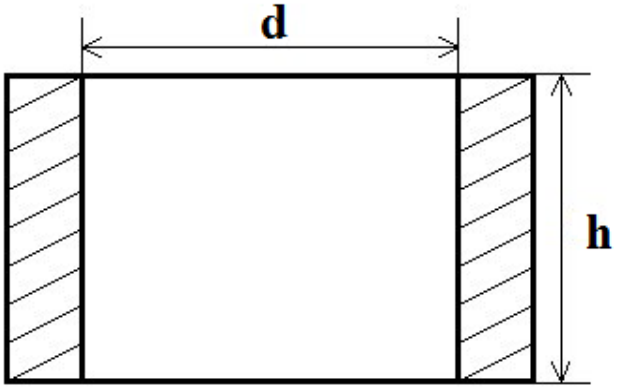

Fig. 1 - Press form: d – inside diameter, 25 mm; h – the height of 20 mm

Unlike iron, silicon carbide is almost not pressed. This is due to its high hardness. Pressure chats iron compacted and locked together the tastes carbide wolf. The load of 16 tons was applied in compression. This process is shown in figure 2.

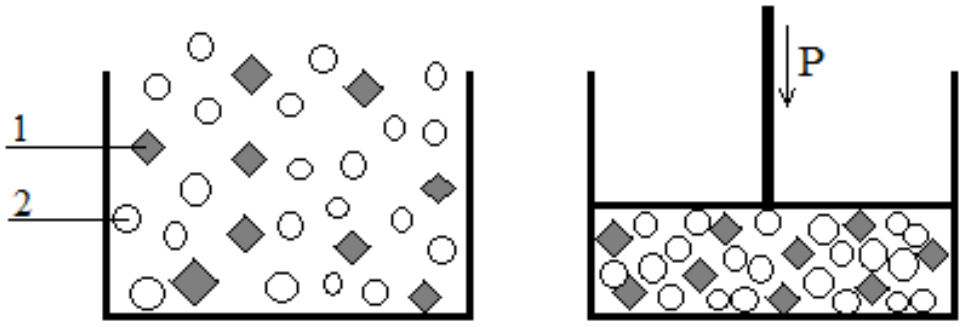

Fig. 2 - The pressing process, where 1 – tungsten carbide, 2 – iron, P – applied pressure

Pressed samples were subjected to sintering at a temperature of 1100 °C. The sintering temperature of slightly is more than 0.7 of the melting temperature of iron. Study of the temperature dependence of the electrical conductivity of the composite is carried out on six samples. The resistance of samples measured at temperatures of 20 – 120 °C. This is the completed pressing and sintering of powders of tungsten carbide and iron. The electrophysical properties of the samples depending on temperature were investigated [2]. Structural studies were carried out by the method of Moiré [3].

The effect of the response of the conductive properties for the temperature change can be expressed not only in classical semiconductors with nonlinear characteristics. Materials with changing temperature coefficient of resistance (TCR) can be created from composites. Existing composite oxide semiconductors have a negative TCR with high sensitivity. But a significant disadvantage of such composites is their aging in service. Aging affects to all materials, but the oxide semiconductors to a large extent. We need to find more sustainable chemical compositions. The stability of the microstructure of the material will have less aging and change of properties in time.

Empirically pressing force is chosen depending on the ductility of the powder particles. The more solid fraction is the reinforcement in compression, and more plastic – binder phase to provide continuous charge transfer throughout the structure. Sintered samples were made of the same size, chemical composition and under identical conditions. The electromagnetic fields of the test material were observed by the method of Moiré [1] to confirm their conductive properties. All samples were withdrawn temperature dependence of the resistivity. The result showed a negative TCR. The variation in resistivity at the same temperatures was not more than 15%. This variation can be explained by uneven contact resistance and nonuniformity of chemical composition. TCS of test material (Fig. 3) is negative as that of the semiconductor, but the temperature dependence is close to the linear.

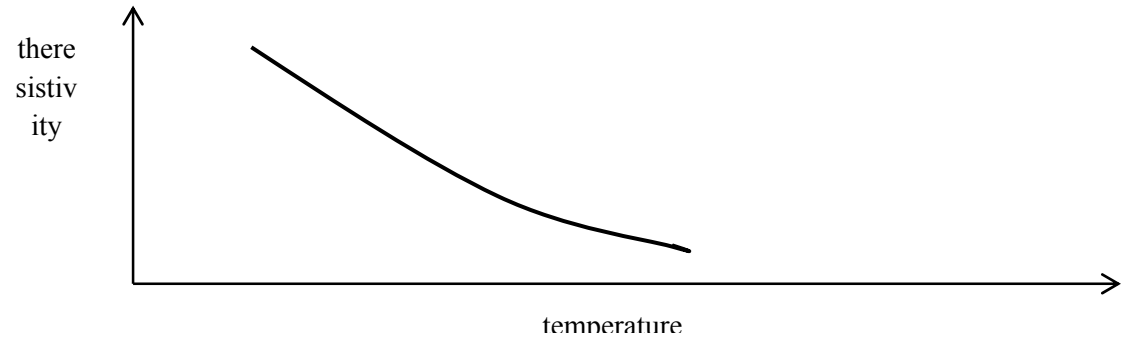

Fig. 3 - Schematic representation of the temperature dependence of the resistivity

Fig. 3 does not indicate the resistance values and temperature. At high temperatures the resistance drop is slowing down and will continue to grow. Across the borders of the phases of the charge transfer resonance is conducted [4].

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ЭЛЕКТРОТЕХНИЧЕСКИЙ МАТЕРИАЛ ЖЕЛЕЗО – КАРБИД КРЕМНИЯ

М.В. Макарчук, И.Л. Королева, А.Д. Лоскутова
Тамбовский Государственный Технический Университет
e-mail: korolevanpal@yandex.ru

Аннотация

Исследованы электрофизические свойства композитного материала железо – карбид кремния, которые определяются величиной удельной проводимости, изменяющейся в зависимости от внешних факторов. Предложена технология получения композитного материала железо – карбид кремния.

Ключевые слова: композитный материал; температурная зависимость удельного. сопротивления; электропроводность.

УДК 66.03, 66.06
ББК 24.58

NANOMODIFIERS AND BUILDING MATERIALS

E.I. Malyutina, Z.A. Mihaleva
Tambov State Technical University, Tambov, Russia
e-mail: 6740778liza@mail.ru

Abstract

The paper presents an analysis of the strategies for the implementation of nanotechnology in building materials, advantages and disadvantages of developing a strategy. New nanomodification, which enhances the performance of systems properties and high-strength lightweight concrete are described. It is shown that the proposed technology provides a lightweight concrete with considerable Nye advantages compared to global peers.

Nanotechnology in building materials implemented midst by two strategies:

1) introducing nanoscale modifiers (primary nanomaterials) into the synthesized material;

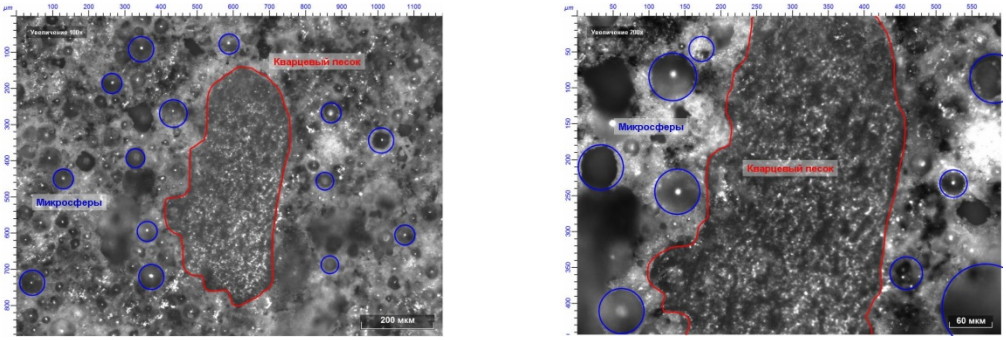
2) synthesis of nanoscale systems in the material during its manufacture.

The first strategy currently is actively developing, which proposes the introduction of carrier medium nanoscale modifiers of different nature. As the carrier medium can be used as a medium for involving modifiers into the subsequent structure of material formation and substances. Nanoscale objects widely use carbon nanomodifiers: fullerenes, nanotubes, australone's etc. Domestic and foreign experience shows some advances in the implementation of this stratumology, for example, nanomodified aerate concrete, polymer composition materials for various purposes, etc. For building materials based on polymers, in this case, the increase in strength reaches 1.5-3 times. For building materials mineral binders increase the mechanical properties of indicators does not exceed 20-50%. In addition, there are also unresolved problems of uniform distribution of carbon in the medium of nanomodifiers, toxicologists-call impact on human health, surfactants and others. The second strategy for building materials is actively developing overseas. Examples of its implementation are: nanostructured composites based on interpenetrating polymer networks; hybrid nanocomposites based on matrix; polymer nanocomposites with very low permeability and high resistance to aggressive media and others.

Key words: nanostructured, nanotechnology, interpenetrating polymer.

The essence of the modification

An example of application of the developed Nano modifier chemise is semi-high strength lightweight concrete with a specific strength of at least 30 MPa at an average density of not more than 1500 kg / m3. Designed lightweight concrete contains INH-binder, the mineral part modified filler (glass or alum inosilicate microspheres) water. International and national experience shows that acceptable strength values up to 60 MPa are achieved at an average density of not less than 1800 kg / m3 [3-6]. Application of microspheres treated, reduces the average density of the material and to increase the strength up to 25%. This forms the structure of the material with evenly distributed microspheres, to provide uniform distribution stress (Fig. 1).



a –100$^{\times}$; b – 200$^{\times}$

Additional factors that provide increased strength, are: - the physic-chemical factor, showing up in increasing the strength at the interface between the phases "cement stone - microsphere" because of the appearance of a new phase provided goethite FeOOH; - geometrical factor, expressed as follows. Solid microspheres casing provides a closed porosity, while maintaining high OPERATION properties of concrete. Moreover, close to ideal sphere shape of Tell-fill, contributes to the high fracture toughness of concrete. Development of crack-stepping is at greater than the critical load due to the uniform distribution of the stresses acting on the correct shape of the particle. [1]

Diagnostics results

Compositions obtained Nano-modified high-strength lightweight concrete with high compressive strength Rszh = 40.0 ... 65.0 MPa at an average density of 1300 ... 1500 kg / m3, which allow expanding on being-domain application of lightweight concrete. Such concretes allow almost 2-fold to reduce the load on the structural elements of the building, store and load-bearing characteristics to improve thermal properties. Economic prerequisites introducing concrete is suggested, are: - reduction in design weight, provides increased height (or reducing materials consumption), as well as saving on insulating papers; - reducing the consumption of concrete and rebar due to the use of concrete with strength. [2-4]

Conclusion

These positive properties Nano modified highly durable lightweight concrete provide economic impact of not less than 30-40%. [6] Compositions of high light concrete substantially diswidening range of applications and allows lightweight concrete used at build of multi-storey and high-rise buildings, residential and public-governmental buildings, the construction of road and rail bridges, interchanges, etc., and also produce large-span products (girders, beams, etc.).

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НАНАМОДИФИКАТОРЫ И НАНОМОДИФИЦИРОВАННЫЕ СТРОИТЕЛЬНЫЕ МАТЕРИАЛЫ

Е.И. Малютина, З.А. Михалева
Тамбовский государственный технический университет, Тамбов, Россия.
e-mail: 6740778liza@mail.ru

Аннотация

В работе представлен анализ стратегий реализации нано технологии в строительном материаловедении. Показаны преимущества и недостатки разрабатываемых стратегий. Предложен новый нано модификатор, применение которого обеспечивает повышение эксплуатационных свойств ячеистых систем и высокопрочных легких бетонов. Показано, что предлагаемая технология позволяет получить легкие бетоны, имеющие значительные преимущества по сравнению с мировыми аналогами.

Нано технология в строительном материаловедении реализуются посредством двух стратегий:

1) введение в материал синтезированных нано размерных модификаторов (первичных нано материалов);
2) синтез нано размерных систем в материале в процессе его изготовления.

В настоящее время активно развивается первая стратегия, которая предполагает введение в среду-носитель нано размерных модификаторов различной природы. В качестве среды носителя могут применяться как среды, участвующие в последующем структурообразовании материала, так и вещества, являющиеся модификаторами. Из нано размерных объектов широко применяются углеродные нано модификаторы: фуллерены, нано трубки, астралины и пр. Отечественный и зарубежный опыт свидетельствует о некоторых успехах реализации этой стратегии, например, нано модифицированный легкий бетон, полимерные композиционные материалы различного назначения и др. Значимые достижения установлены для строительных материалов на основе полимеров, в этом случае повышение прочности достигает 1,5-3 раз. Для строительных материалов на минеральных вяжущих повышение показателей механических свойств не превышает 20-50%. Для таких материалов характерен широкий разброс в показателях прочности: от – 60 до +160 %. Кроме того, имеются также не решенные проблемы однородного распределения углеродных нано модификаторов в среде-носителе, токсикологическое влияние на здоровье человека, ПАВ и др.

Ключевые слова: нано структуры, нано технологии, полимеры.

УДК 66.03, 66.06
ББК 24.58

KINETIC OF ORGANIC DYES ADSORPTION THROUGH MESOPOROUS CARBON

E.S. Mkrtchyan, D.A. Kurnosov, A.V. Babkin, I.V. Burakova, A.E. Burakov, E.A. Neskoromnaya
Tambov State Technical University, Tambov, Russia
e-mail: elina.mkrtchyan@yandex.ru

Abstract
In the present work, the kinetic parameters of methyl orange adsorption on the nanocomposite obtained were studied. As a result, the adsorption equilibrium and the adsorption capacity of the material were found.

Key words: mesoporous carbon; liquid-phase adsorption; organic dyes; kinetic models; adsorption isotherms

Introduction

Finding a suitable adsorbent for purification of aqueous solutions from various types of contamination plays an important role in the modern world. Conventional systems mostly employ activated carbon, zeolites and polymers as adsorbing materials due to their ease of use. However, to date, these materials not always seem to be efficient enough to remove both organic and inorganic contaminants. The decrease in the applicability of the traditional sorbents has been affected by anthropogenic factors. The chemical industry grows significantly every year, resulting in new high activity chemicals and reagents. Thus, in addition to the production and storage of these substances, it is necessary to dispose of them properly. In this regard, at the moment, there is a need for novel sorbents during their recovery. Many of these pollutants pose a serious threat to human health. Consequently, finding the optimal adsorbent is a very urgent problem today [4].

For several decades, scientists have intensively conducted various studies on certain parameters of the CNTs, since this material presents a wide range of properties (chemical activity, electrical conductivity, optical and mechanical properties, high thermal conductivity, chemical and thermal stability) [1,6]. Besides, the CNTs possess adsorption and antimicrobial properties. There is a large number of examples of the use of CNTs in their native form and their modifications directly for the sorption of aqueous solutions. Thus, they have found wide potential applications in different industrial areas [1,4,6].

Considering the aforementioned, the aim of the present work was to assess the adsorption capacity of a mesoporous carbon (MPC) material for organic molecules by the example of methyl orange (MO) – a known acid-base indicator and synthetic organic dye from the group of azo compounds ($C_{14}H_{14}N_3O_3SNa$).

Kinetic study

To determine the kinetic parameters of the MO adsorption on the obtained nanocomposite, experiments were carried out with 0.03 g of the adsorbent and 30 mL of 1.500 mg L-1 MO solutions (reagent grade, Laverna Story Engineering Ltd.). The mixtures were equilibrated by end-over-end shaking at 100 rpm and room temperature on a Multi Bio RS-24 programmable rotator (Biosan, Riga, Latvia), and then filtered. MO concentrations were determined after 5, 7, 10, 15, 30, 45 and 60 min of adsorption.

The adsorption kinetics depends on many factors. To describe the adsorption rate, it is necessary to take into account the limiting step for the process. As for any heterogeneous chemical reaction, the adsorption reaction can take place in the diffusion region, when the delivery of the adsorbate to the sorbent surface is the limiting step for the adsorption, and in the kinetic region, when the chemisorption rate is the limiting stage for the process [3].

Furthermore, kinetic studies of the MO adsorption on the MCP material were carried out (Fig. 1). As a result, it was found that adsorption equilibrium is reached within 10 min, and the adsorption capacity of the material is 827.5 mg g-1.

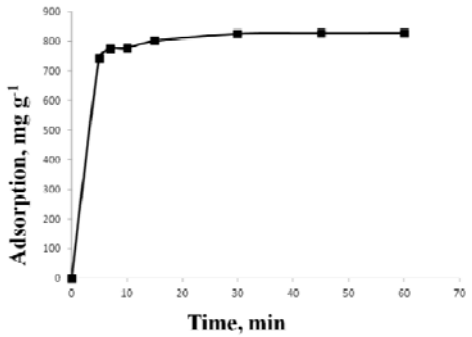


Fig. 1 - Kinetics of the MO adsorption on the MPC adsorbent.

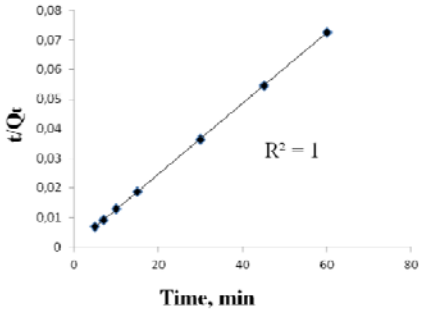
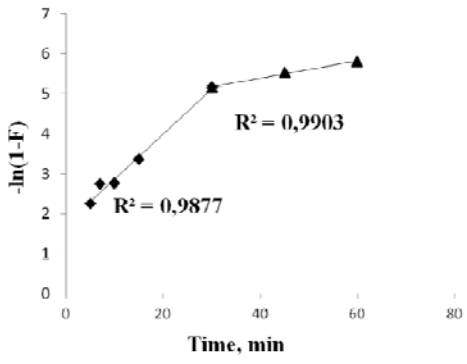
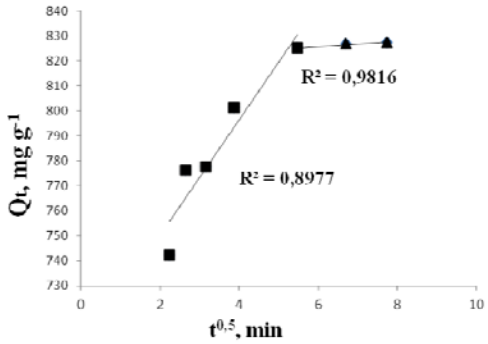


Fig. 2 - Pseudo-second order kinetics of the MO adsorption on the MPC adsorbent.

Various models such as pseudo-first- and pseudo-second-order, Elovich model, intraparticle and external diffusion were used to study the adsorption kinetics and describe the process.



a



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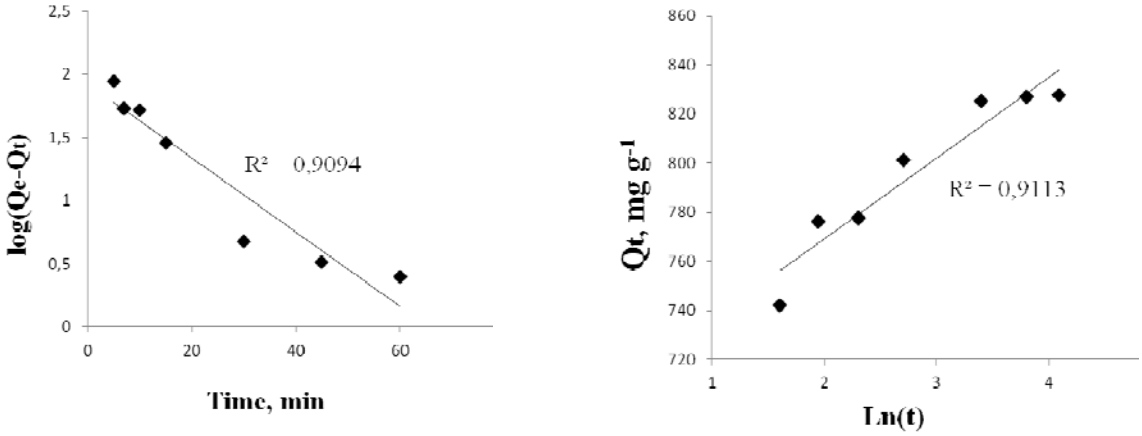

c ***d***

Fig. 3 - Modeling the kinetics of the MO adsorption on the MPC adsorbent (models: a – external diffusion, b –internal diffusion, c –pseudo-second order, and d – Elovich)

The kinetic data constructed in the coordinate plane of the pseudo-first-order model showed that the dye adsorption is not described by this model (Fig. 3c). Thus, there are no "adsorbate-adsorbent" interactions through chemical bonding.

The t/Q_t vs.t dependences (Fig. 3) and Eq. (1) allow calculation of the k_2 and Q_e parameters. Besides, the pseudo-second-order equation makes it possible to describe the experimental data, that is why the chemical exchange reaction limits the adsorption.

Fig. 3a presents the *–ln(1–F) vs. t* plot consisting of two linear parts. The kinetics of the MO adsorption on the MPC material is controlled by diffusion of the liquid film surrounding the adsorbent surface over the entire time interval. Fig. 3b confirms the occurrence of internal diffusion with a stronger binding force at the second adsorption stage. For each stage, the adsorption rate constants (Table 1) were determined.

Table 1. Kinetic parameters of the MO adsorption on the MPC material

Experimental adsorption, mg g^{-1}	**Pseudo-first order**			**Intraparticle diffusion**					
	Q_e, mg g^{-1}	k_2, g mg^{-1}min^{-1}	R^2	**Stage 1**			**Stage 2**		
				k_p, mg g^{-1}min$^{-0.5}$	c,mg g^{-1}	R^2	k_p, mg g^{-1}min$^{-0.5}$	c, mg g^{-1}	R^2
827.51	833.33	0.002	1	1.012	819.8	0.898	23.081	704.2	0.982

As can be seen from Table 1, the most intensive adsorption of the MO molecules occurs during the diffusion process in a finite period of time. The obtained estimates are well correlated with data reported in the literature, where

the kinetics of the MO adsorption on carbon nanomaterials was also found to be accompanied by diffusion and chemical transformations [7].

Conclusion

The kinetic characteristics of the MO adsorption on the novel material – MPC – were studied, and the main parameters of this adsorbent were determined. The kinetic studies showed that the time to reach equilibrium is 10 min. The maximum adsorption capacity of the material used was found to be 827.5 mg g-1.

Thus, the proposed sorbent, demonstrating a high adsorption capacity with a short time to achieve equilibrium, is promising in the processes of removing organic pollutants, in particular, a group of azo dyes.

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КИНЕТИКА АДСОРБЦИИ ОРГАНИЧЕСКИХ КРАСИТЕЛЕЙ НА МЕЗОПОРИСТОМ УГЛЕРОДЕ

Э.С. Мкртчян, Д.А. Курносов, А.В. Бабкин, И.В. Буракова, А.Е. Бураков, Е.А. Нескоромная
Тамбовский Государственный Технический Университет, Тамбов, Россия
e-mail: elina.mkrtchyan@yandex.ru

Аннотация

В настоящей работе изучены кинетические параметры адсорбции метил-оранжевого на нанокомпозите. В результате было найдено адсорбционное равновесие и адсорбционная способность материала.

Ключевые слова: мезопористый углерод, жидкофазная адсорбция, органические красители, кинетические модели, изотермы адсорбции.

УДК 620.3=111
ББКЛ 719

METHOD FOR PRODUCING FILMS FROM FERROMAGNETIC MATERIALS

Yu.Yu. Sablin, S. P. Korendyasev
Tambov State Technical University, Tambov, Russia
e-mail: shem.arleyto@bk.ru

Abstract
The method of producing films of ferromagnetic materials by magnetron sputtering using as a target material powder of magnetically-hard materials is considered.
Key words: magnetron sputtering cathode unit, powder magnets, ferromagnetic film.

The development of computer technology, communication systems and control contributed to stimulating research in the field of formation of thin film structures of metal, dielectric, semiconductor, and as in our case - magnetic materials.

Depending on the type of functional purpose as well as the required physical and mechanical properties of the formed coating, evaporation of the target can be obtained by different methods (laser, diode, magnetron, and other direct current or using a high-frequency discharge) and condensation of atoms on a substrate.

Methods of forming of highly coercive magnetic film made of ion-plasma magnetron sputtering are considered in this work. The main advantages of this method [1] of the formation of thin-film structures are: an easy process control, high performance, low power consumption, the formation of films of the same structure and chemical composition as the target.

Cathode unit is used to form films by means of classic magnetron ion-plasma sputtering (Fig. 1 a). The design represents the target of the evaporated material (2) located above the system of permanent magnets or electromagnets (3), creating a complex system of power lines to increase the lifetime of ions and electrons in under cothode region, cooled refractory base, acting as a cathode (4) and anode installation for the deposition of thin films (1).

Under the influence of the accelerating potential arising between stimulating additional electrode (5) and the cathode of the ionization of argon atoms introduced in pocketnow region, the acceleration and bombardment of a target surface take place. Excited atoms (6) of pulverized target material get energy and 12-15 eV and are deposited on the substrate having the electric potential of the opposite sign.

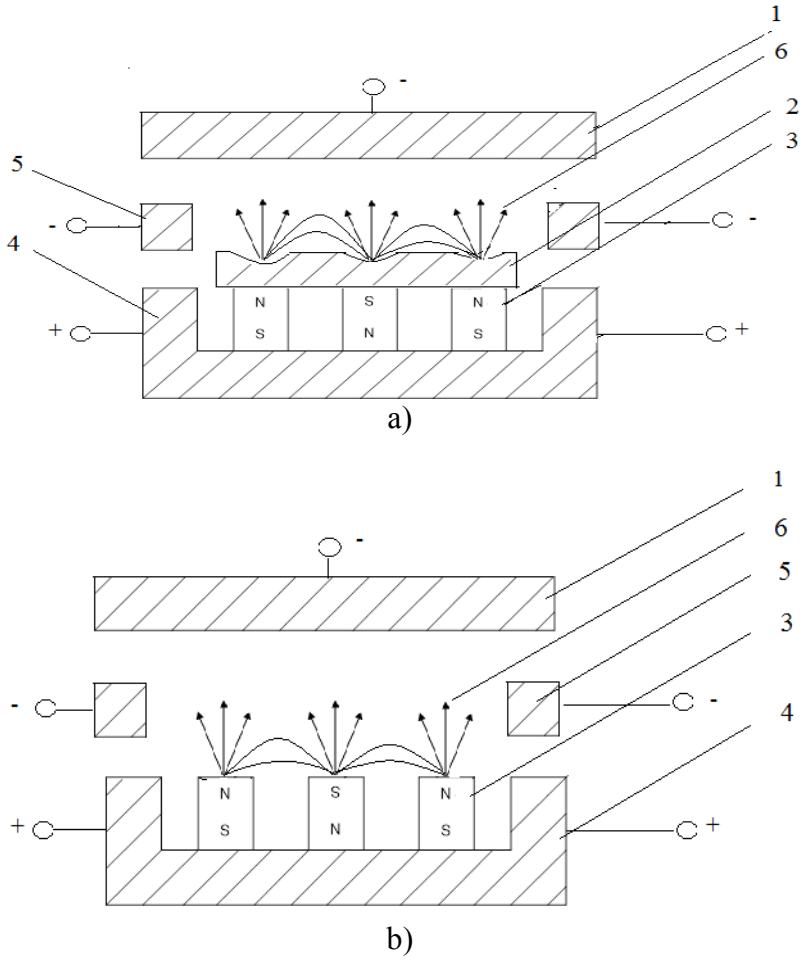

Fig. 1- a) The classic design of the magnetron cathode unit; b) The original design of the magnetron cathode unit:1 – anode installation for deposition of thin films; 2 – the target of the evaporated material; 3 – the system of permanent magnets; 4 – cathode of a cooled refractory base; 5 – additional stimulating electrode; 6 – stimulating atoms.

To improve properties of the formed films of hard-magnetic materials and optimize the design of the magnetron, we propose an original design of the cathode unit (Figure 1b), which is supposed that the evaporated ferromagnetic material performs the role of a magnetron system, which allows forming a coating of hard-magnetic material of the required thickness and chemical uniformity.

As noted earlier, the formation of a thin film structure by the magnetron sputtering technique is the evaporation of the target under the action occurring between the anode and cathode of the electric charge, by means of bombardment of its surface with charged particles [2]. Thus, a closed magnetic field localizes charge near the surface of the target. Electrons migrate from the cathode under the action of ion bombardment, entering to the region of crossed electric and magnetic fields turn out to be in the closed region. Ionization efficiency is increased, which leads to the increased ion concentration at the surface of the target, to the increase of the intensity of the bombardment and to the increase of the spraying speed. This

process significantly improves the properties and accelerates the process of forming of a thin-film coating.

Most of the structures of the cathode unit are based on the use as sources of magnetic fields, electromagnets, which increase the manufacturing complexity and the energy consumption during evaporation. However, this structural solution, has another feature which consists in the fact that under the evaporation of the cathode from the ferromagnetic materials (such as ferrites), which are in the magnetized condition, the heating take place, which adversely affects the magnetic properties of evaporated material. Therefore, the application of the permanent magnets of the AlNiCo type, with a high value of Curie temperature as a cathode material, can greatly facilitate the design of the magnetron.

As can be seen from the figure (Figure 1b), the use of highly coercive materials can form a magnetic field of high tension in the region of existence of the excited electric charge, is beneficial to the process of forming a film structure.

In addition, the position of hard-magnetic material in the area of high evaporation (under the cathode region) in staggered order allows for the evaporation process that is a ferromagnetic material inserts, not the base target. This structural solution allows you to create a ferromagnetic film with high uniformity of chemical composition.

An important fact at creating the structure of ferromagnetic films is the high degree of homogeneity and magnetic field strength. It is known, that for the formation of the optimal structure of material the value of a field of 500 – 600 Oe is required, which can be achieved by using inserts in the cathode target of a metal-ceramic permanent AlNiCo magnets, having magnetic parameters at the level of the cast counterparts [3]. During evaporation of the ceramic-metal magnetic hard targets there is not a decline in the intensity of the magnetic flux or reduction of its size.

Thus, the use of the evaporator in the design, the targetë of which is a magnetic system, allows us to simplify significantly the design without losing the quality of produced coating.

The use of this original design forms the magnetic film structure consisting of grains of a smaller size. In addition, the formation of the film structure is the orientation of highly coercive ferromagnetic particles. This has an influence on the crystal anisotropy and improves the magnetic properties.

Using the proposed design of the cathode-target for magnetron sputtering allow obtaining a thin ferromagnetic film while maintaining the structure of the AlNiCo material. This will allow extending the area of application of permanent magnets.

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ТЕХНОЛОГИЯ ПОЛУЧЕНИЯ ТОНКИХ ФЕРРОМАГНИТНЫХ ПЛЕНОК

Ю.Ю. Саблин, С.П. Корендясев
Тамбовский государственный технический университет
e-mail: e-mail: shem.arleyto@bk.ru

Аннотация

Рассмотрена технология получения пленок ферромагнитных материалов методом магнетронного распыления с использованием в качестве материала мишени порошковых магнитно-твердых материалов.

Ключевые слова: магнетронное распыление, катодный блок, порошковые магниты, ферромагнитная пленка.

УДК 378
ББК 74.48

THE COGNITIVE DISSONANCE IN THE INTERPRETATION OF THE CONCEPT “SMART HOME”

O.N. Apraksina, N.Yu. Borodulina, E.A. Gulyaeva, M.N. Makeeva
Tambov State Technical University, Tambov, Russia
e-mail: Apraksina-Olga@rambler.ru

Abstract
The article identifies the cognitive dissonance in the formation of smart home concept under actualization of such characteristic as suitability of smart home for disabled people. The authors provide the linguistic analysis of the concept of “smart home” and its characteristics using the Russian National Corpus and conclude on the importance of linguistic monitoring to overcome the cognitive dissonance.

Key words: professional communication; concept smart home; cognitive dissonance; linguistic analysis; linguistic monitoring.

The concept of cognitive dissonance was introduced into linguistics from social psychology by Leon Festinger. He is the author of the theory of cognitive dissonance. Cognitive dissonance appears when a person who explores the world operates under two interrelated cognitive elements that contradict each other. According to the scientist it is possible to move from dissonance to consonance by reducing the importance of dissonant elements or to change one of them to obtain consistency [1].

The vocabulary of business terms characterizes cognitive dissonance as "a state characterized by a clash of conflicting knowledge, beliefs, personal attitude about some object or phenomenon in the individual's mind. A person tends to overcome cognitive dissonance by changing one of the conflicting knowledge and establishing a correspondence between knowledge and behavioral settings "[2]. From the point of view of pragmalinguistics, the recognition of cognitive dissonance in the process of communication, including professional communication, and the search for means of solving the dissonance, should indicate a high degree of responsibility of communicants for the outcome of communication.

Let us focus on the aspects of the professional communication in the sphere of the construction related to the design of a "smart home" for disables people. This type of communication has specific characteristics. It is closely connected with the fact that this type of communication involves different kinds of communicants. Firstly, we should mention the experts in the field of industrial and civil construction, architects, and designers. In other words we mean the people who create the product of the professional activity. Secondly, we should take into account the possible users of this product. They can be customers, often not related

to the category of people with high income. We talk about disables people with an injury of musculoskeletal system, with visual and hearing impairment, elderly people, temporarily disabled, etc. The purpose is to help all these people feel the real members of the society. To provide disabled people with equal opportunities along with healthy people to participate in the society it is necessary to create conditions for overcoming the limitations that have arisen in their lives. This is the main idea that the developers of the “smart home” project should keep in their minds.

It should be noticed that the concept of “smart house” appeared long before its verbal form. Americans got the idea of "smart house" in the middle of the last century. Even then, Americans dreamed of making their home more comfortable. And in the early 1970s the term "Smart Home" appeared. It was a project that required huge investments.

Nowadays the “smart house” system means a set of technical devices. It is controlled by a single unit to maintain specified parameters and provide maximum comfort to the inhabitants of the house. The software controls security, energy saving and comfort in a “smart house” [3].

Further in the article the cognitive dissonance arising in the interpretation of the concept of “smart house” and the significant element of this concept – the great importance of “smart house” for disabled people - is illustrated. The examples obtained by the method of continuous sampling are taken from the the Russian National Corpus (RNC) [4].

The lexical unit (LU) “smart house”, verbalizing the corresponding concept, has 31 references in the main corpus of RNC and 47 occurrences in the newspaper corpus. In all examples we are talking about innovations, the house of the future, the dream house, the use of high technologies and, high costs, providing increased comfort and protection (LU, objectifying these conceptual characteristics, *highlighted by the authors*):

The City of Dream includes apartments, terraced houses and villas with fully equipped rooms and kitchens, broadband Internet and “smart house” system;

Eco-friendly, “smart house” together with a windmill, special walls, and windows, and with all the stuff *will cost such money as none of us earns*;

“Smart home” in which all electronic household appliances and engineering systems are integrated into a home network and controlled from a single remote, is already reality. It will make our life even more *comfortable and pleasant* in the future;

Specialists say that the “smart house” is able *to protect itself*, water the garden, and activate the lighting and music, which will sound even from the roadside stones.

Only one example shows such a characteristic as the designation of "smart home" for disables people:

The robot is called “Companionable”; it connects to the “smart house” system. It can talk, listen, recharge itself, and remind its owner to take medicine.

In another example, we are talking about the need for social programs to design a “smart home”. Suppose that this program is intended for low-income segments of the population, including people with disabilities:

Strict requirements will be prescribe for social housing. We will massively introduce the technology “smart house”.

The lexical unit “disabled people” has 6 references in the main corpus and 71 references in the newspaper corpus of the RNC.

Some examples identify the impossibility of free movement around the city, shopping, visiting cinemas, museums, public transportation, etc. And only in one case there is a hint of building a “smart house”:

The building is equipped with video control, elevators, which people with disabilities can also use.

If you type the word “invalid” in the search, you will get 1211 references in the main corpus of the RNC and 1679 references in the newspaper corpus. There are many housing problems, but there is still no interrelation with the concept of “smart house”. Only in one case there is the permission to use high-tech devices, to which "smart House" can be related to:

The fact is that Dunyashev as a disabled person with the second group of disability refers to the category of citizens who can benefit from medical services, including high-tech according to the order of the Ministry of Health in 2005.

In our opinion, the conducted linguistic analysis indicates the presence of cognitive dissonance (a contradiction between the two cognitive elements of the “smart house” concept). Fortunately, today this problem has been solving in practice by taking appropriate orders at various levels, as well as the appearance of specific projects. They clearly indicate the conceptual characteristics in the development of the concept of “smart home” related to the provision of comfort and safety for disabled people, in particular taking into account the needs of wheelchair users:

To let the wheelchair move freely from one room to another, the doorways have a width of 100 cm, and the doors are installed sliding with a “pocket”. The problem of the maximum space with a minimum of furniture was solved by taking into account the space minimum - the diameter of the wheelchair turn of 1500 mm [5].

Specific projects are created for people with visual or hearing problems:

Various devices can improve the quality of disabled persons' life depending on the characteristics of the disease. For people with poor eyes or problems with the musculoskeletal system there is an excellent solution of remote controlling of a number of basic devices (lighting devices, heating system, etc.), in particular - a voice monitoring system. If a person has problems with hearing, designing a system of alerts about the danger you should prefer noticeable and understandable visual alerts [6]. At each stage of designing such a system, it is necessary to take into account all the dangerous situations that may arise, carefully think over ways how to avoid them or minimize potential harm [6].

Further linguistic monitoring will help to understand the importance of the anthropocentric principle as the highest value significance of the developed professional communication. A person is in the center of such communication. And in our case a special person - *Homo invalidus* will take the central place. The analysis of the LUs involved in the professional communication of civil engineers and Homo invalidus, including the design and construction of a “smart home” for disabled people, will help to overcome the cognitive dissonance between the interconnected knowledge and attitudes regarding the understanding of the “smart house” concept in its new interpretation with the reference to the needs of people with disabilities.

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КОГНИТИВНЫЙДИССОНАНС В ИНТЕРПРЕТАЦИИ КОНЦЕПТА «УМНЫЙ ДОМ»

О. Н. Апраксина, Н. Ю. Бородулина, Е. А. Гуляева, М. Н. Макеева
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: Apraksina-Olga@rambler.ru

Аннотация

Проанализирован когнитивный диссонанс в формировании концепта «умный дом» при современной актуализации такой характеристики, как предназначение «умного дома» для людей с ограниченными возможностями. Проведен лингвистический анализ концепта «умный дом» и его характеристик на материале Национального корпуса русского языка. Сделан вывод о значении лингвистического мониторинга для преодоления когнитивного диссонанса.

Ключевые слова: когнитивный диссонанс; концепт «умный дом»; лингвистический анализ; лингвистический мониторинг; профессиональная коммуникация.

УДК 372.881.111.1
ББК81.2

INTERACTIVE TEACHING TOOLS IN A FL CLASSROOM

N.A. Gunina, G.N. Chebotareva
Tambov State Technical University, Tambov Russia
e-mail: natalya_gunina@mail.ru

Abstract
Interaction is understood as a process manifested in interpersonal and intrapersonal activities. The nature of interaction determines the essence of communicative teaching. Different types of interaction result in diverse interactive techniques to be used in foreign language teaching.
Key words: interactive teaching; interaction; foreign language learning.

Introduction

Recently, the communicative approach has become a "must" in a FL classroom. This trend is in line with the shift from the teacher-centered approach to the student-centered learning, and has brought about new teaching strategies and techniques. The basis of communicative teaching is interaction, which is crucial for development communication skills, especially in a foreign language.

In this paper, we explore the nature of interaction and some interactive techniques used in FL teaching.

Interaction as a the basis of language learning

As stated by Rod Ellis, the term "interaction" is "used to refer to the interpersonal activity that arises during face-to-face communication. However, it can also refer to the intrapersonal activity involved in mental processing" [1, p. 3]. Interpersonal and intrapersonal interactions are closely connected in terms of use and acquisition of language. That is, intrapersonal interaction is required in order to interact interpersonally while interpersonal interaction serves to trigger intrapersonal operations, including those that are involved in language acquisition.

One of the theories that addresses interpersonal and intrapersonal interaction is the interaction hypothesis, which states that the development of language proficiency is promoted by face-to-face interaction and communication [2]. The interaction hypothesis claims that comprehensible input is important for language learning. In language learning, input is the language data, which the learner is exposed to.

Interaction is the key to second language learning. The interactionist view of language learning is that language acquisition is the result of an interaction between the learner's mental abilities and the linguistic environment. Michael Long in his 1996 paper *"The role of the linguistic environment in second language acquisition"* focused on three aspects of verbal interaction - input, production and feedback. Input is the language offered to the learner by the teacher other learners, production (output) is the language spoken by the language learners themselves

and feedback is the response given by the conversational partners to the production of the learner [3].

In pedagogy, three types of interaction are distinguished: learner-content interaction, learner- teacher interaction and learner-learner interaction.

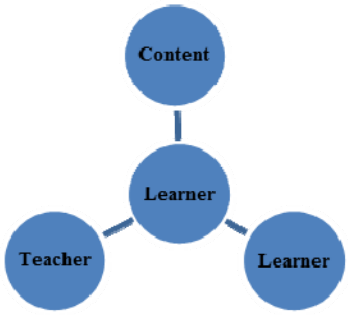

Fig. 1 Types of interaction in language learning.

1. Learner-Content Interaction

The first type of interaction is interaction between the learner and the content or subject of study. The results of such interaction include changes in the learner's understanding, the learner's perspective, or the cognitive structures of the learner's mind.

2. Learner- Teacher Interaction

The second type of interaction is regarded essential both form the educators and learners' perspective. In this interaction, teachers attempt to stimulate or at least maintain the student's interest in what is to be taught, to motivate students to learn, to enhance and maintain the learner's interest.

3. Learner-Learner Interaction

Learner-learner interaction occurs between one learner and other learners, one-to-one or in a group setting, in real-time or offline, in the presence of an instructor or without it. The learner-learner interaction among members of a class or other group is sometimes an extremely valuable resource for learning, and is sometimes even essential as it helps to acquire skills of group interaction.

Interactive teaching tools

It is noteworthy that the role of a teacher has changed and involves encouraging learners' participation by using questions to stimulate discussion and emphasizing the value of answers. A teacher is no longer an instructor, but a facilitator who give students an opportunity to gain hands-on experience.

Interactive teaching is impossible without special techniques and tools that help teachers to facilitate interferon in the classroom.

Depending on the types of interaction, the interactive techniques can be divided into instructor action and student action. The latter can be classified into individual, pairs and groups.

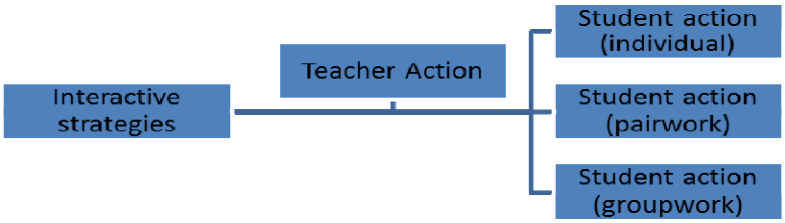

Fig. 2 Classification of interactive strategies depending on the type of interaction

Some examples of interactive activities include brainstorming, think-pair-share, discussions, buzz sessions, icebreakers and many others.

Interactive techniques have a lot of advantages. Firstly, they add energy to the classroom by making students more engaged. Secondly, when students work in pairs or in groups they feel more confident, especially when they have to deal with quite challenging topics. They can rely on their peers, and in mixed groups weaker students can feed off the stronger students. Less confident students can model their answers on those who have no difficulty producing the language. Thirdly, teachers can observe and monitor all students at a time and assist those who find the assignment challenging. And, finally, interactive teaching increases the amount of student talking time (STT) and reduces teacher talking time (TTT), giving student more opportunities to socialize with each other and practice the target language.

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МЕТОДЫ И ТЕХНОЛОГИИ ИНТЕРАКТИВНОГО ОБУЧЕНИЯ ИНОСТРАННОМУ ЯЗЫКУ

Н.А. Гунина, Г.Н. Чеботарева
Тамбовский государственный технический университет, Тамбов Россия
e-mail: natalya_gunina@mail.ru

Аннотация

Рассмотрены интерактивные технологии обучения иностранному языку с точки зрения различных видов взаимодействия в процессе обучения. Интерактивность понимается как процесс, в котором происходит взаимодействие обучающегося с содержанием обучения и с участниками обучения – учителем и другими обучающимися. Выбор технологии интерактивного обучения обусловлен типом взаимодействия.

Ключевые слова: интерактивное обучение; интерактивность; изучение иностранных языков.

УДК 378
ББК 74.48

TRANSLATION SERVICES IN THE UNITED NATIONS ORGANIZATION

A.N. Jumber
Lomonosov Moscow State University, Moscow, Russia
e-mail: cisbd@mail.ru

Abstract

The United Nations Organization has been very active for seventy three years and, on the whole, and has been successfully fulfilling its main mission - ensuring international peace and security. All the work of the UN system is based, inter alia, on continuous and harmonious support by several services, which provide for interpretation and translation of written documents and oral statements into the six official languages of the organization: English, Arabic, Spanish, Chinese, Russian, and French. Since July 1, 1975, most important UN documents have also been translated into German at the request and at the expense of Austria, Germany, Luxembourg, and Switzerland. Highly professional translation helps to overcome cross-cultural barriers imminent to professional communication in international organization of 193 member nations. The purpose of this article is to investigate how these activities are organized and promote the opportunities offered by the UN services among talented translation professionals.

Key words: official languages, translation services, translators, overcoming cross-cultural barriers, United Nations Organization.

The United Nations officially exists since October 24, 1945. By this day the UN Charter adopted unanimously by 50 founding states at a conference in San Francisco in June 1945, has been ratified by Britain, China, the Soviet Union, the United States, France and most other states.

The predecessor of the United Nations was the League of Nations, an organization conceived during the First World War and established in 1919 in accordance with the Treaty of Versailles for the development of cooperation between peoples and for the maintenance of peace and security. The League of Nations ceased its activities in 1946. The official and working languages of the League of Nations were: French, English, and Spanish (since 1920). The League also seriously considered adoption of Esperanto as a working language.

Currently, operational management of the smooth operation of the General Assembly, the Security Council, and other important organs and organizations of the UN system is coordinated by the UN Secretary-General Antonio Guterres.

Fot language support of the work of the system of United Nations, the Secretary-General relies on the support of Under-Secretary-General for General Assembly and Conference Management, Ms. Catherine Pollard, who has held this post since 2015. Previously, Ms. Pollard served as the Assistant Secretary-General for General Assembly and Conference Management since September 2014. The official UN portal underlines that "Mrs. Pollard has an undeniable valuable

experience in the field of conference management, finance, human resources and general administrative management. For 26 years of work at the UN, she has acquired a strong knowledge of the culture of the UN, organizational and operational structures, global initiatives and reforms implemented in accordance with the priorities and strategies of the Secretary-General. At all senior positions she held, she helped to make real improvements in management practices [1].

Interpretation Service

At any session taking place within the system of the UN, official oral statements are made in one of six official languages of the Organization - English, Arabic, Spanish, Chinese, Russian and French and simultaneously - that is instantly translated into other languages.

How Do Interpreters Work at the United Nations?

Interpreters and translators services are employeed and directed by the Department for General Assembly and Conference Management (DGACM) - the largest in the United Nations Secretariat. With over 1,000 staff at United Nations Headquarters in New York and almost 2,000 worldwide, including conference management staff at the UN offices at Geneva (620), Vienna (174) and Nairobi (65) [2].

Conference interpretation can be performed in three ways: simultaneously, consecutively and by whispering (chuchotage).

In **simultaneous mode**, the interpreters sit in sound-proof booths where the speaker is heard through headphones and they deliver a running interpretation transmitted through a microphone to participants in the meeting who wear earphones. They need to have information and the documentation concerning served session. In this respect new computer technologies have been very useful. Earlier they had to hold a bale of documents and help materials at hand. Glossaries and a selection of the help materials, as a matter of fact representing dictionaries and terminological directories in all official languages, are accessible in an on-line mode. As language of the international diplomacy undergoes changes and covers all new areas, these materials are continuously updated.The oral translators working in the UN, should be capable to distinguish and understand a myriad of topics and to find instantly in the other language the necessary words or word-combinations

Consecutive mode consists of the interpreter sitting at the conference table, taking notes and delivering the statement in another language.

Whispering (chuchotage), used in certain working environments such as field missions, press conferences, and high-level bilateral private meetings, consists of the interpreter simultaneously whispering the interpretation directly to a very limited audience with or without mobile equipment.

The United Nations relies mainly on simultaneous interpretation because its work generally involves large multiple-language meetings. Conferences and meetings of the United Nations bodies may be conducted in as many as all 6 official languages. Consequently there are six corresponding language sections

(booths) in the Interpretation Service. Normally, only these languages may be used at United Nations meetings. If a Member State wishes to use a non-United Nations language, it must make the necessary arrangements for that language to be interpreted into one of the official languages.

Interpreters are identified by the language they work into, which at the United Nations is always their mother tongue. Thus an English (booth) interpreter interprets from other official languages into English. English is referred to as this interpreter's "active" or "target" language, while the two or more other languages from which he/she interprets are referred to as "passive," or "source" languages. Because certain language combinations at the level required for interpreting work are very rare, this structure is not applied to the Arabic and Chinese, where interpreters work both into and out of their mother tongues.

For properly organising translation into six languages it is required to create a group of 14 translators: three translators in Arabic and Chinese cabins as these translators translate both from these languages, and into these languages, and two translators in English, Spanish, Russian and French cabins. The service provides continuous oral translation at the sessions for long hours. The translation goes on as long as the speakers are allowed to take the floor by the President of the session notwithstanding late hours or general fatigue. Resilience matters.

Oral translators work in the closed cabins which allow them to see and hear officials and participants of session which they serve..

The program of training in the field of oral translation

Within the framework of the initiative on attracting of the linguists, developed by DGACM, the Service of oral translation has started active imlementation of the program, allowing for the use of experience and knowledge of experienced interpreters and translators already working at the UN for training and preparation of already cetrtified linguists from the partner universities. This program admitting various combinations of languages, has been carried out in English, Arabic, Spanish, Russian and French languages and is at an initial stage of realization.

Service of written translation

After employees of the Service of the editorial control and terminological support finish the work, documents are ready for translation which is the following stage in a technological chain of document circulation. All official documents of the UN, reports presented on sessions and the messages cerculating among top management of the organisation are translated. Some official documents are translated also to German language. Services of English, Spanish, Russian and French written translation make summary records about sessions of intergovernmental bodies which contain the information on a course of session, including the statements made and the decisions adopted.

All written translators of the UN should be perfectly fluent in their native language and perfectly know at least other two official languages. Though

documents are translated, as a rule, for immediate use, they then are long stored, becoming the important archival materials.

Service of written translation of the UN uses many modern technologies, such as terminological databases, the electronic storehouses of documents allowing a full text search, programs for creation of parallel texts in two languages, programs of management of translation databases and programs of recognition of speech, as well as machine translation. However translation at a level which is meeting the requirements of the UN, still is inherently a human intellectual process.

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СЛУЖБЫ ПЕРЕВОДА В ОРГАНИЗАЦИИ ОБЪЕДИНЕННЫХ НАЦИЙ

Дж. Н.Асатиани
МГУ имени М.В. Ломоносова, Москва,Россия
e-mail: cisbd@mail.ru

Аннотация

Универсальная, межправительственная, международная Организация Объединенных Наций вот уже семьдесят третий год весьма активно и, в целом, успешно осуществляет свою главную миссию – обеспечение международного мира и безопасности. Вся работа системы ООН опирается, среди прочего, и на непрерывное слаженное сопровождение службами перевода письменных документов и устных заявлений на шесть официальных языков организации: английский, арабский, испанский, китайский, русский и французский. Важнейшие документы с 1 июля 1975 года переводятся также на немецкий язык по просьбе и за счет Австрии, Германии, Люксембурга и Швейцарии. Целью данной статьи является изучение специфики организации этой работы и попытка привлечения к ней внимания талантливых переводчиков и преподавателей.

Ключевые слова: Организация Объединенных Наций, официальные языки, службы перевода, переводчики.

УДК 378
ББК 74.48

SPORTS MARKETING: ESSENCE AND STRATEGIES

T.C. Kapiya, D.S. Shindyapin
Tambov State Technical University, Tambov, Russia
e-mail. tkaps123@gmail.com

Abstract
The article examines the main features of sports marketing. It shows problems solved by sports marketing as well as the methods used.
Key words: sports marketing, sports, market, sports industry, brand.

In today's world, peoples' interests in sports have drastically increased and more people are participating in sports like never before. The sports industry consists of the following market segments: professional, health, children's and mass sports. The sports market consists of:

- Market for sporting goods;
- Market for sports personnel;
- Market for sports services;
- Market of sports sponsorship.

Each sport is surrounded by a multitude of individuals pursuing different goals. In the sports world, sports clubs want to work win and earn more money, viewers want to attend competitions, manufacturers of sports goods want to build up sales, sponsors want to promote their brands, TV channels want to broadcast high-rating matches.

The actions by these actors to achieve their goals, all belong to the category of "Sports marketing".

Sport marketing is a complex activity for developing, promoting and selling all kinds of sports products. The object of sports marketing is a sports product: a sporting event; sports goods or services; information regarding the sporting event; individuals (athlete, trainer, manager); sports facility; television, licensing, transfer right.

Sport marketing uses a variety of tools:

1. Advertising boards in sports arenas;
2. Advertising inserts during TV shows, advertising on the radio;
3. Adverts in sports newspapers, magazines, booklets, programs, on entrance tickets, etc.
4. Participation and filming of sportsmen in advertising programs, films, video clips;
5. Positive feedback and recommendations from popular athletes and trainers about the production of the firm-sponsor;
6. Images of popular sportsmen and sports symbols on goods or their packaging.

7. Performance of athletes in clothes or with inventory with identification signs of the sponsor, etc.

Since the main feature of the sport is the unpredictability of the results, the task of sports marketers is to cultivate it and correct filing.

Sport marketing, on one hand, solves marketing questions on production, personnel, price, sales and communication policy, and on the other hand, it has a number of features. Including sports activities which are non-commercial, these are not financed by spectators, but rather at the expense of the country's budget, various funds, sponsors, etc.

Sport marketing is used in a number of different ways:

- Attracting the viewers (impress, interest)and the fans;
- Engagement and involvement of sponsors, fostering commitment in their clubs
- Creating associative links between the brand of a professional club and brand manufacturer;
- Creating news feeds;
- Making profit for the sponsor, profit for the club and control spectator impressions;
- Interacting with cultural organizations.

Other excellent tools of sports marketing, besides traditional sponsorship (financial, technical, information) and advertising are: celebrity marketing, event marketing and licensing. The use of celebrities takes play when starting a new product, renaming of a brand or creating a different image for the brand. Event marketing involves the use of various sports activities for brand promotion. Owners of rights to sports brands have an excellent possibility to receive additional income from the sale of licenses of their brands.

In the center of mass sports marketing, there lies mass sporting events and health promotion (marketing objectives here are the promotion of a healthy lifestyle and various forms physical activity. Mass sports includes, the fitness industry (aerobics, body building etc.), the healthy industry (dietology, nutrition etc.), cosmetology, cyclotourism, sports tourism, rehabilitation therapy services industry, etc., and these industries bringing in a huge amount of profit to the sporting industry.

Thus, sport marketing is aimed at developing, promoting and the sale of products popular with the market through sports and at the same time is a means of developing the sport itself.

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СПОРТИВНЫЙ МАРКЕТИНГ: СУЩНОСТЬ И СТРАТЕГИИ

Капия Т.К., Шиндяпин Д.С

Тамбовский государственный технический университет, Тамбов
e-mail. tkaps123@gmail.com

Аннотация

В данной статье рассмотрены особенности спортивного маркетинга. Перечислены задачи, решаемые спортивным маркетингом, а также используемые инструменты.

Ключевые слова: спортивный маркетинг, спорт, рынок, индустрия спорта, бренд.

УДК 378
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SHAPING LEARNERS' IDENTITY THROUGH PROJECT WORK: "CITY STARS" FOR GRADE 5

E.E. Kriventsova, Yu.V. Akinshina
School № 1315 with Intensive Study of English, Moscow, RF
e-mail: iamokay@mail.ru

Abstract

The paper describes the experience of using project work in teaching young learners as a way of shaping their identity as citizens of the Russian Federation. The "City Stars" learning The specifics of using project-based learning in ESL classroom is discussed. The types of projects have been identified; the requirements to their practical implementation have been formulated. The experience of using the method of project-based learning has been described.

Key words: project-based learning; ESL; creativity; communicative competence.

Introduction

Project-based learning (PBL) or learning through projects is a teaching tool that is increasingly becoming popular in various disciplines. When it comes to learning and teaching a foreign language it is a great way of motivating learners as it inspires them to do what they really like doing and escape dong things which they hate.

PBL has a number of advantages over other less creative methods. The potential of this method has been widely explored [1, 2, 3] and it definitely helps learners to develop various skills, namely, the intellectual skills, physical/motor and ICT skills, social skills and learner independence skills. This is possible because learners work individually and in groups, they discuss and share ideas with each other, they search for relevant information and subject it to critical analysis and synthesis. In this article, we will explore the possibility of shaping learners' identity using the materials from City Stars textbook for grade 5.

City Stars as an innovative learning resource

City Stars is a multi-level textbook, which consists of a textbook and online platform for teachers, learners and their parents. Teachers have access to the necessary teaching resources, including methodological materials, work programs and calendar-thematic planning, webinars and video lectures on current topics, handouts, assignments for interim control, and much more. Learners can make used of audio courses, materials for creating personal portfolio, various additional resources, and unique *My Moscow Extra* with case studies in an interactive format. Parents can get acquainted with the content of the textbook, and help their children to manage their learning of English.

The unique feature of *City Stars* is the content of the textbook which covers various aspects of the history and culture of Moscow. For many years, school learners had an opportunity to study the history of their home country and city only

in the classes of History, whereas in the English classes they focused mainly on the English-speaking countries. However, the requirements of Federal Educational Standards for secondary schools stress the importance of developing learners' transferrable skills and achieving the learning outcomes.

The interface of the online platform is user-friendly and easy to use. It consists of different tabs that navigate learners, teachers and parents through the website.

Fig. 1 shows the layout of the tabs and user possibilities.

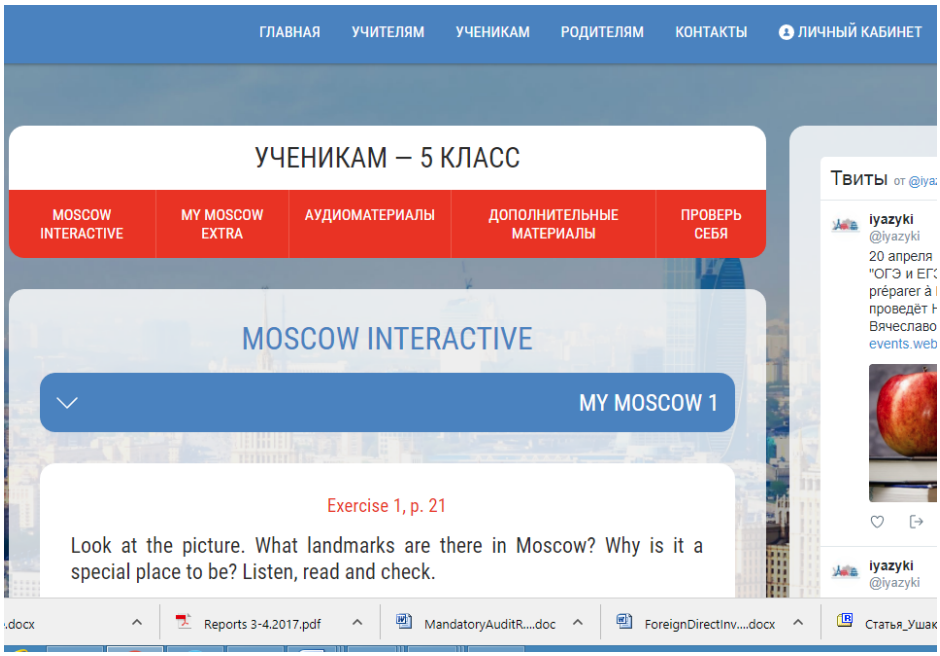

Fig.1 – Screenshot of City Stars online platform for grade 5.

As can be seen from Fig. 1, users can create a personal account and make use of the resources to their advantage. By selecting the right tab in the upper line, you can have access to student's, teacher's or parent's webpage. Depending on the user status – teacher, student, or parent – the content varies. Take for instance, the student's webpage. It consists of *Moscow Interactive, My Moscow extra, Audio resources, Supplementary materials* and *Self-check*. Each tab has a wide range of activities and assignments.

Learners' civil identity

At different stages of education learners go through various stages of shaping their identity. In the primary school, the civil identity of a child is formed and the foundations of the individual as a subject of cognitive activity are laid. In the secondary (middle) school, the social competence of the individual is added through the system of interpersonal relations. In high school, the environmental culture is developed. *City Stars* focuses on the students' Russian identity formation, development of friendly relations with all peers, caring attitude to the surrounding world, cognitive interests. These and other areas of development of the personality of students are increasingly being realized in the middle and high

schools. It familiarizes learners with the history of their homeland and the capital city.

City Stars and PBL

The content of the textbook is well suited for different types of projects:

Research projects

Such projects require a well-designed structure, defined goals, rationale for the research subject for all participants, reference to sources of information, methods, results.

Creative projects

Creative projects usually do not have a detailed structure but they require the presentation of the project results in the appropriate manner.

An example of a combination of research and creative projects is the assignment from the *City Stars for grade 5* online platform (Fig. 2).

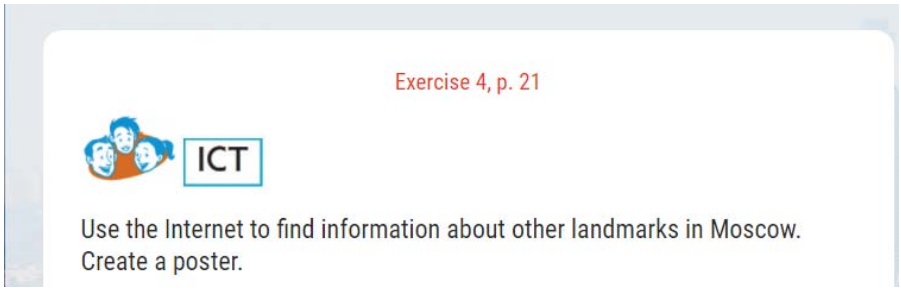

Fig. 2 – A combination of research and creative projects from the City Stars online platform

Role playing projects

In such projects, the structure is planned, but it remains open until the end of the project. Participants take on certain roles because of the nature and content of the project, nature of the problem being addressed.

Information projects

This type of project was originally aimed at gathering information on any object, phenomenon. The participants collect project information, analyze, synthesize and present the facts to a wider audience. Such projects require a well-designed structure, the possibility of systemic adjustments in the course of the project.

This is an example of the assignment for the information project from the *City Stars* online platform (Fig.3).

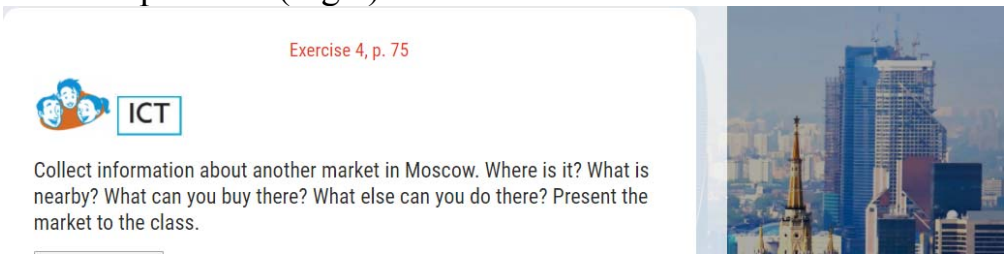

Fig. 3 – An information projects from the City Stars online platform

Interdisciplinary projects

This type of project vary in size, they can be small projects involving two or three subjects, as well as quite big ones aimed at solving a rather complex issue that is relevant to all project participants. Such projects require coordinated work of several creative groups with clearly.

Conclusion

PBL can be used in ESL classroom when teaching young learners. It gives students opportunities to have an in-depth learning of the topic and build up their socio-cultural awareness. It develops their communication skills and teaches them to work independently and in teams, to select materials and present the findings of their work. The biggest advantage is that learners create a product which is feasible – a poster, a report, an article, a wall display, a booklet, a guidebook, a video-story, etc. It is important that children have something to show at the end of the project. Besides, it is something that makes it special, unique and personal. This is really important for learners.

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ФОРМИРОВАНИЕ НАЦИОНАЛЬНОЙ ИДЕНТИЧНОСТИ ОБУЧАЮЩИХСЯ В УСЛОВИЯХ ПРОЕКТНОЙ РАБОТЫ НА ПРИМЕРЕ УМК «CITY STARS» ДЛЯ 5 КЛАССА

Е.Э. Кривенцова, Ю.В. Акиншина

ГБОУ «Школа № 1315 с углубленным изучением английского языка», Москва, Россия

e-mail:: iamokay@mail.ru

Аннотация

В статье описывается опыт формирования национальной идентичности с использованием проектной методики при обучении английскому языку школьников 5 класса. Обсуждаются особенности использования проектной методики на примере УМК City Stars. Приведены примеры разных типов проектов и сформулированы требования их практической реализации.

Ключевые слова: проектное обучение; урок английского языка; креативность; коммуникативная компетентность.

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ББК 74.48

WORD FORMATION COMPETENCE IN THE SYSTEM OF COMPETENCE-BASED APPROACH TO EDUCATION IN DIFFERENT COUNTRIES

L.Yu. Korolyova
Tambov State Technical University, Tambov, Russia
e-mail: lyu-korolyova@yandex.ru

Abstract
A competence-based approach to education in different countries is considered. The classification and analysis of competences in higher educational institutions of Russia, the EU countries, Latin America, Africa, the USA is given. Special attention is paid to competences peculiar for the study of foreign languages. The word formation competence as an integral part of developed language skills is focused on.

Key words: competence-based approach, education, foreign languages, higher educational institution, word formation competence.

Introduction

The system of education in general and higher education in particular is changing all the time to meet the requirements of the society. At the present moment this system is based on the development of competences which play a significant role in the education of young people. The word 'competence' is defined as "a combination of particular knowledge, abilities and skills which a person must have together with the practical work experience" [3].

Classification of competences in different countries

In the Russian Federation, there is a number of state educational standards in which particular competences are specified according to those courses which students have chosen. The competences that must be developed in higher educational institutions are classified as general cultural competences, general professional competences and professional competences. The first type characterizes general skills and abilities which form the cultural level of a person. The second type refers to general knowledge, skills and abilities needed in the specific professional field and other areas related to it. They include:

- a social competence (an ability to take responsibility, to brainstorm ideas and make decisions appropriate for all members of the team a person is working in, to have tolerance to different ethnic cultures and religions, to combine personal interests with needs of the enterprise);
- a cognitive competence (readiness to improve one's educational level, a need to realize personal potential, an ability to acquire new knowledge by self-education, self-development);
- a communicative competence (the knowledge of the ways which help to communicate in different languages orally or in the written form, including

computer programming);

– a socio-information competence (the knowledge of information technologies and a critical attitude to social information presented by mass media);

– cross-cultural competences;

- a special competence (readiness to evaluate professional acts independently) [1].

The third type covers specific professional skills.

It should be noted that in the EU countries eight key competences are distinguished and considered to be the most important ones for "personal fulfillment and development, active citizenship, social inclusion and employment" [6; p. 7]. They are as follows:

– "communication in the mother tongue;

– communication in foreign languages;

– mathematical competence and basic competence in science and technology;

– digital competence;

– learning to learn;

– social and civic competences;

– sense of initiative and entrepreneurship;

– cultural awareness and expression" [6; p.7].

Furthermore, in the EU countries, Latin America, Africa and the USA the term 'generic competences' is used. The classification of generic competences includes:

– "instrumental competences (cognitive abilities to understand and manipulate ideas and thoughts; methodological capacities to manipulate the environment: organising time and strategies of learning, making decisions or solving problems; technological skills related to use of technological devices, computing and information management skills; linguistic skills such as oral and written communication or knowledge of a second language);

– interpersonal competences (individual abilities relating to the capacity to express one's own feelings, critical and self-critical abilities; social skills relating to interpersonal skills or team-work or the expression of social or ethical commitment);

– systemic competences (skills and abilities that suppose a combination of understanding, sensibility and knowledge that allows one to see how the parts of a whole relate and come together)" [2; p.55].

Thus, it is evident that in Russia and the EU countries, Latin America, Africa, the USA a competence-based system of education covers the same areas differing only in terms of their definition and explanation. Although the further classification can single out the aspects which are not included into the scope of competences that must be developed in this or that region due to various reasons.

Word formation competence

Besides the competences mentioned above, the educational process implies the development of competences typical for particular courses. From our point of view, studying of foreign languages based on the competence approach to education is of great interest as it can combine general competences as well as language competences.

In Linguistics the term 'competence' is defined as "the knowledge that enables one to speak and understand a language" [4]. This knowledge can be obtained as a result of hard work during which a student must develop several competences as parts of a language competence including "a linguistic or grammatical competence, a discourse competence, a socio-linguistic or socio-cultural competence and a textual competence" [7]. All of them are needed for the successful communication in a foreign language that implies the use of skills and abilities in four types of the communication activity, i.e. reading, writing, listening and speaking.

A linguistic competence also has some constituents one of which is a word formation competence. The development of this competence allows a student to succeed in oral and written communication and shows the readiness of the former to produce an intelligible speech. If the competence is developed, the main requirement for mastering a foreign language is met.

The process of setting rules for the word formation derivation is an important and long-term period of the longitudinal speech development and the rules themselves are an independent component of a man's language ability [8].

Word formation is the process of making new words on the base of old ones adding morphemes. "Most English vocabulary arises by making new lexemes out of old ones — either by adding an affix to previously existing forms, altering their word class, or combining them to produce compounds" [5].

In Russian schools students taking the Unified National Exam in a Foreign Language must show their knowledge of word formation rules doing one of the assignments. Most international exams also have the same tasks.

As for higher educational institutions this competence is not paid proper attention to and it is not usually tested at exams although language teachers do focus on word formation models at classes of foreign languages.

It should be noted that the development of the word formation competence from the beginning of the learning process will be helpful for the further studying of foreign languages and students' adaptation to modern requirements as people's vocabulary is being enriched all the time due to the word formation first of all.

Conclusion

So, a competence-based approach to education must enable teachers to focus on the development of the most significant skills and abilities which students will be able to use in their professional field. The study of foreign languages as an integral part of the curriculum must also cover several competences among which a word formation competence is of great importance.

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СЛОВООБРАЗОВАТЕЛЬНАЯ КОМПЕТЕНЦИЯ В СИСТЕМЕ КОМПЕТЕНТОСТНОГО ПОДХОДА К ОБРАЗОВАНИЮ В РАЗЛИЧНЫХ СТРАНАХ

Л.Ю. Королева
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: lyu-korolyova@yandex.ru

Аннотация
Рассмотрен компетентностный подход к образованию в различных странах. Приведена классификация и дан анализ компетенций в высших учебных заведениях России, странах Евросоюза, Латинской Америки, Африки, США. Особое внимание уделяется компетенциям, необходимым для успешного изучения иностранных языков, в частности, словообразовательной компетенции как неотъемлемой части сформированных языковых навыков.

Ключевые слова: высшее учебное заведение, иностранный языки, компетентностный подход, образование, словообразовательная компетенция.

УДК 378
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CLIL AS A MODERN TEACHING TECHNOLOGY

T. V. Mordovina
Tambov State Technical University, Tambov, Russia
e-mail: tvmordovina76@mail.ru

Abstract
The article discusses the prospects for the application of the Content and Language Integrated Learning in a non-linguistic university as a way of increasing the effectiveness of teaching a foreign language. A definition of the CLIL approach in teaching a foreign language is given and four training stages on this technology are described.
Key words: Content and Language Integrated Learning (CLIL), training on CLIL technology, the 4 "Cs" Framework.

Content and Language Integrated Learning (CLIL) is becoming increasingly popular in the teaching of a foreign language in a modern higher school. We believe that the growing interest in this method is due, first of all, to serious changes in the methodology of teaching certain subjects, including a foreign language, in connection with the introduction of a competence-oriented model of education.

The technology of content and language integrated learning (CLIL) is a direct descendant of the technology of language integration (SPRINT: SPR-spraesk - the language (Swedish) and integrated (English)). The studied language becomes a mean of mastering the methods of activity and information of other disciplines. With the help of the studied language, the content of other disciplines is revealed; the language itself is developed in parallel, in the context of activities that are not related to the language study [1; 2].

Content and Language Integrated Learning (CLIL) is a competence-based teaching approach that created in 1994 by David Marsh. He wrote: "To learn a language and subject simultaneously provides an extra means of educational delivery which offers a range of benefits relating to both learning of the language, and also learning of the non-language subject matter. In addition, there are social, psychological and economic benefits that suit political policies and goals. Thus there is a need to consider CLIL in terms of language policy, planning, and politics [3].

It is an approach for learning content through an additional language (foreign or second), thus teaching both the subject and the language. CLIL encourages the use of curricula which promote the right interpersonal skills, cultural sensitivity and communication and language abilities which are in demand by today's employers. [4]

This kind of approach has been identified as very important by the European Commission because: "It can provide effective opportunities for pupils to use their

new language skills now, rather than learn them now for use later. It opens doors on languages for a broader range of learners, nurturing self-confidence in young learners and those who have not responded well to formal language instruction in general education. It provides exposure to the language without requiring extra time in the curriculum, which can be of particular interest in vocational settings." [5]

This technology is based on the synergy of integrated learning and language learning, interdisciplinary and intercultural approaches, the principle of taking into account the native language, the principle of communicative orientation of the learning process as a whole, the principle of differentiation and integration in the learning process.

Training on this technology takes place through several stages:

1. Preparation for the use of the language in the process of communication; the appropriation of the necessary speech material, the drill of speech structures, lexical and grammatical units on the topic, the use of role games, communicative tasks, situations that simulate real communication in order to improve the level of the language fluency within the necessary topic.

2. Language inclusion in the process of studying a particular topic of the discipline being mastered.

3. Further language inclusion in the development of the disciplines of the professional cycle (fragmentarily, within the framework of the topic). Creation of conditions for the formation and development of integrative thinking of students at all levels of the educational space, discursive abilities and abilities: students master information, methods of processing it at a more complex level, knowledge, skills and experience of the subject in the dynamics of learning and using a foreign language.

4. Reflection, including on the basis of self-control results.

Taking into account the possibility of using a wide variety of methods of work, starting from discussion pyramids, blitz games and ending with game design, as well as various forms of work and teaching aids, training programs, the potential of this technology is great. The problem situation in the context of the subject under study, the conditions for the need to use the language for solving a wide variety of pedagogical tasks, and the analysis of situations require the productive educational activity of students. The effectiveness of technology largely depends on how much the "C" framework (the 4 "Cs" framework) is taken into account at the planning stage of the lesson. The mechanism primarily focuses on *content* (subject, interdisciplinary approach), then on the relationship of content and *communication*, *cognition*, and *culture* (cultural self-determination through the learned language and awareness of the value of another professional culture).

In the countries of central Europe, this technology has been used for several years and is considered quite effective, since it helps to develop discursive abilities and skills; students master information processing techniques at a more complex

level. An important role is played by the practical orientation of training in technology.

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ПРЕДМЕТНО-ЯЗЫКОВОЕ ИНТЕГРИРОВАННОЕ ОБУЧЕНИЕ КАК СОВРЕМЕННАЯ ТЕХНОЛОГИЯ ОБУЧЕНИЯ

Т.В. Мордовина
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: tvmordovina76@mail.ru

Аннотация

В статье рассматриваются перспективы применения предметно-языкового интегрированного обучения в неязыковом вузе как способ повышения эффективности преподавания иностранного языка. Приводится определение CLIL и описано четыре этапа обучения по данной технологии.

Ключевые слова: предметно-языковое интегрированное обучение (CLIL), механизм четырех «С».

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GENERAL PROPERTY OF SPOUSES: HISTORICAL ANALYSIS AND CONTEMPORARY SITUATION

D.A. Sychova
Tambov State Technical University, Tambov, Russia
e-mail: Dasha7362@mail.ru

Abstract
In this article current problems of legal regulation of common property of spouses are considered. The analysis of foreign practice is given and the system used in the Russian Federation is investigated. The author gives suggestions on the modernization of the system of common property of spouses in Russia.
Key words: common property of spouses, property, deferred property system, system of completely separate property.

One of the pressing problems of the Russian law system today remains the problem of regulation of common property of spouses. It consists in the fact that in our system the regime of joint ownership of spouses for common property is still in effect. In the opinion of R.S. Bevzenko, in the current situation the problem of justification of joint property of spouses is more than controversial [1, p. 124].

Legal regulation of the regime of common property of spouses in the Russian Federation is carried out by Articles 33 and 34 of the Family Code of the Russian Federation (hereinafter – FC). Article 33 of the Family Code of the Russian Federation establishes that the legal regime of spouses' property is a mode of their joint ownership. Paragraph 2 of Article 34 of the Family Code defined the common property of the spouses, it refers to: income of each of the spouses from work, business activities and results of intellectual activity; received a pension of, allowances and other cash benefits, with no special purpose; acquired from the general revenues of the spouses movable and immovable property, securities, shares, deposits, share capital made to the credit institutions or other commercial organizations, and any other property acquired by the spouses during the marriage, regardless of the name of which of the spouses it was acquired either in the name of whom or by whom of the spouses money was contributed; any other acquired by the spouses during the marriage property [2].

In the legal science, there are four main approaches to solving property issues in the family.

The first approach retains ownership of his property for each of the spouses, that is, to the property of one spouse belongs all that is earned before marriage and all that sold on its income during the marriage. However, the court can recognize that in connection with the significant non-material contribution of one of the spouses to the farm, property should be redistributed. In one famous case White v. White considered the issue of property division. The parties during the marriage

created a successful agricultural business on two farms with a total value of 4.6 million pounds, and then decided to dissolve the marriage. Wife appealed to the court for additional remedies for the purpose of equitable distribution of assets. She asked to divide the business so that she and her husband were able to independently pursue business activities.

The trial court found the following: ordered the husband to pay his wife 800 thousand pounds to buy a house, and the whole business has left her husband.

By decision of the House of Lords Pamela White, 2/5 of the assets of the spouses were awarded [3].

The second approach to legal doctrine - namely, a system of deferred property. This legal regime assumes that premarital property is the separate property of each of the spouses; an income received during the marriage by each of the spouses, and the property acquired by them is also a separate property. But in case of divorce, the court compares the increase in the property of one and the other spouse and aligns them. As a result of this alignment, the situation is as follows: the spouse who has earned more must pay the earned less than his share. This model allows you to take into account the non-property contribution of one of the spouses to family life. Under the non-property contribution R.S. Bevzenko understands various household chores: raising children, cooking and cleaning etc. [1, p. 124]. The significance of non-property contribution of spouses was mentioned in the above-mentioned case of White vs. White.

The third approach presupposes the ownership of property received before marriage, the gift or inherited property. Income received during the marriage and property acquired for this income becomes joint property of spouses, the free disposal of which one of the spouses without the consent of the other is not allowed. The system has found its application in the Russian Federation, it causes a painful blow on turnover, due to the fact that the acquirer of the property does not know and cannot know that the transferor is not the sole owner of the property.

Finally, a system that applies only to the Netherlands is a system of full joint ownership. It assumes that both premarital and acquired property in marriage becomes common. But with the existence of such a system, it is in Holland that the largest percentage of couples entering into marriage agreements that change the ownership regime from the general to the separate. According to the electronic resource old.gazeta.zn.ua 23% of marriages in the Netherlands are concluded with the application of a marriage contract [4].

To ensure maximum independence of the spouses in the Russian Federation, there is also the possibility of concluding marriage contracts. It is only spouses or persons entering into a marriage.

Often, in a marriage agreement, spouses take into account only the material side of family life, forgetting about the intangible contribution. From the wording of Article 40 of the Family Code of the Russian Federation, it follows that only the property rights and duties of spouses are taken into account when concluding a marriage contract. This position of the legislator, in our view, violates the principle

of fair division of property of spouses in divorce, and therefore, the inclusion of "intangible contribution of spouses" or at least the possibility of proving this contribution in court, following the example of procedures, existing in foreign countries.

In addition, in our view, a system of common property of the spouses must be changed; it is possible, through the synthesis of the above systems, to structure a different from the European system of regulation of the common property of the spouses. In our opinion, it can be ironed as follows: in the presence of a completely separate property of spouses, both before marriage and acquired during marriage, in the event of divorce, the court equates the increase in the property of one and the other spouse and aligns them. According to the results of this alignment - the spouse who earned more should pay make less, but there is a registration and intangible contribution of spouses in family well-being, since such a system, the spouse is clearly earned less will receive their share with the principle of equitable division of property.

The transition to this system will allow achieving accounting for the intangible contribution to family life and ensuring the protection of the interests of third parties entering into transactions with spouses.

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ОБЩЕЕ ИМУЩЕСТВО СУПРУГОВ: ИСТОРИЧЕСКИЙ АНАЛИЗ И СОВРЕМЕННОЕ ПОЛОЖЕНИЕ

Д.А. Сычёва
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: Dasha7362@mail.ru

Аннотация

В данной статье рассматриваются актуальные проблемы правового регулирования общего имущества супругов. Приводится анализ зарубежной практики и исследуется система, применяемая в Российской Федерации. Автором даны предложения по модернизации системы общего имущества супругов в России.

Ключевые слова: общее имущество супругов, собственность, система отложенной собственности, система полностью раздельной собственности.

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IMAGE BUILDING IN THE FITNESS INDUSTRY

A. O. Shildiaeva
Tambov State Technical University, Tambov, Russia
e-mail: alena.shildiaeva@yandex.ru

Abstract
The fitness industry has been developing in the Russian market for more than 20 years. Due to the fact that the number of consumers and competitors has been growing significantly over the past decade, there is an urgent need to create a unique image of fitness clubs. PR plays the most important role in creating a positive image of fitness services. Sport marketing creates a strong link between the product and the consumers' healthy lifestyle.
Key words: brand, image, fitness-industry, PR, promotion.

The fitness industry has been developing and holding a leading position on the market for over 20 years, and every year the number of its fans is increasing. For Russia, the development of fitness areas is relatively new. In the 1990-s, a new class of wealthy people who believe that health and a presentable appearance are worth the money, appeared in Russia. Advertising of fitness clubs plays an important role.

The founder of the market of fitness services in Russia is World Class, which started its operations in 1993, with the opening of the first club in the city of Moscow where the basic standards of the Russian "fitness" were laid down.

The value of a trademark or brand for the company cannot be overestimated, because the brand is not only a quality product, but also something from the realm of the abstract. Over the last few decades the marketing phenomenon has managed to enter the Toolkit of Russian business. The brand can be considered an indicator of the market leadership, because the brand is not just a name. This is the name that is impossible to forget.

The terminological dictionary of marketing gives the following definition of branding: "it is the area of marketing communications, dealing with the development of corporate identity, its elements, forming a unique brand that distinguishes it from its competitors" [2].

It is not only advertising of the product, but everything that can be attributed to the functional properties: lower price, higher quality, some innovation, and certain emotional and social components.

It is believed that emotional components to achieve inner peace from the acquisition and use of the goods through the purchase of things. For example, going to a prestigious sports club, a person satisfies, above all, his need for self-realization, and then for sport.

People are willing to pay several times more for branded products rather than for conventional ones.

The main task in the promotion of a brand is finding the most effective way to the "heart" of the consumer. This is determined by the preferences, perceptions of the brand and associations that may result from it. Today, the marketing policy implies adherence to the tastes and needs of a particular consumer. Advertising is bocoming more targeted.

Fitness centers are primarily commercial entities and their primary goal is to profit through the sale of goods and services. It results in the fact that any PR project of these companies results from direct advertising targeted at the final consumer of goods and services.

The promotion of the institution at the expense of prestige is a privilege of the elite sports clubs intended for a certain segment of the market. Health care, beautiful appearance are the components their own image.

An important component of promotional activities of fitness clubs is an advertising campaign, designed for a specific user. These are direct advertising services. It is designed mainly to maintain sales and attract new customers. Usually such promotions are held during any discount programs or during seasonal downturns.

Major sales are done for the periods from January to April and from September to November. Client statistics should be run weekly to keep old customers, which is much cheaper than attracting new ones.

The creation of the department working with corporate clients is another important marketing step. The corporate contract is a contract for 5 or more employees of the same company. By purchasing a corporate package, the company receives significant discounts, plus an individual approach to your company depending on the chosen program.

The main aspect of competition today is a set of services. The evaluation of the success of a project in fitness today depends on many factors, which include location, range and quality of services, level of staff training.

Advertising in the sphere of fitness services can be divided into two major blocks. The first is the promotion of the brand and image of the institution.

The main actions aimed at maintaining the image of a company include:

- Conference of trainers and fitness professionals under the name of companies. Major market players can afford to create a convention under their own brand. For smaller clubs it is a great option, they can appear in the eyes of their clients and competitors through participation in the conventions, lectures and master classes.

- Educational academies, school of fitness with the license for educational activity in the sphere of fitness services. This kind of activity helps promote the brand of the club in the emerging market of fitness services in Russia.

- Consulting services is another way to promote your business.

The second part of the advertising activities of the fitness clubs are advertising companies focused on the individual consumer. Usually such

promotions are held during any discount programs or during the summer period, which is considered the “off-peak season” in the fitness centers.

In addition to various unique offers for the price reduction this could include:

- round-the-clock operation of some clubs to attract customers who work shifts;
- monthly payment for club membership, which is quite attractive for the customers.
- different types of membership: individual, family, corporate.
- expanding the number of services and introduction of new fitness programs.
- children’s programs.

These are the main aspects of promotional activities on the market of fitness services.

Today online marketing is gaining in popularity. The formation of public opinion is especially relevant today, because the majority of both potential and existing clients of fitness clubs get information from Internet sources. Forums, blogs and official social media help fitness clubs to communicate online and offline with their customers.

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СОЗДАНИЕ ИМИДЖА В ФИТНЕС ИНДУСТРИИ

А. О. Шильдяева
Тамбовский государственный технический университет, Тамбов, Россия
e-mail: alena.shildiaeva@yandex.ru

Аннотация

Фитнес-индустрия на Российском рынке существует более 20 лет и особо актуальна в наше время. В связи с тем, что количество потребителей и конкурентов с каждым годом значительно возрастает, возникает острая необходимость в создании уникального имиджа и образа фитнес-клубов. Для создания позитивного образа фитнес-услуг самым эффективным инструментом является PR.

Спортивный маркетинг создает ассоциативные связи между продуктом и тем, что потребители любят, а именно здоровый образ жизни.

Ключевые слова: Бренд, имидж, PR, продвижение, фитнес-индустрия.

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EVALUATING THE CORRELATION BETWEEN THE NET INCOME AND MARKETING COSTS OF PJSC "SBERBANK OF RUSSIA"

M.A. Yushina, A.A. Butenko
Tambov State Technical University, Tambov, Russia
e-mail: marya.yushina@gmail.com

Abstract
The article examines the nature of marketing and focuses on the dependence of net income of banks on their marketing expenses. Currently, the Russian market is experiencing a fierce competition, which, in particular, affects the banking sector. As October 1, 2016 in Russia there were 600 commercial banks, each of them continues to expand their services, and uses a variety of marketing tools, thereby attracting potential customers. At the moment, the question of evaluation of the effectiveness of advertising investments for banks is becoming more and more important. The article aims to explore the effectiveness of marketing strategies implemented by the PJSC "Sberbank of Russia".
Keywords: bank marketing; efficiency of the bank marketing; marketing costs

Each commercial bank plans its marketing budget, in which it includes the costs of market research and activities, such as advertising, special offers, commercial events. Forming a marketing budget is one of the goals of a commercial bank. One of the most widely used methods is the method of determining the budget as a percentage of the expected income. Along with it, the method of determining the budget by the residual principle and the method of comparison with the costs of the leading competitor are applied. In Russia, the leading bank is the Public Joint-Stock Company (PJSC) "Sberbank of Russia", an international financial group, the oldest and largest bank in Russia and one of the largest banks in Europe. Every year, the banking competition is exacerbated, as a result of which banks increasingly use marketing as a method of promoting their services, annually increasing advertising costs. So in 2000, expenses of this kind amounted to 3.640 million rubles, in 2008 they reached 18.209 million rubles. In 2016, the total expenditure of Russian banks on marketing and advertising amounted to 31.3 billion rubles.

Planning advertising costs is an integral part of the marketing budget. The average value of marketing expenses in Russia is 3% of revenues. The economic effectiveness of banking marketing is assessed by the degree of its impact on the financial performance of banks in the short term. It reflects the change in the level of sales of the promoted service, as well as what additional income the bank received, and what impact advertising costs had on the cost of banking services. A marketing event is effective if the achieved economic effect is greater than the money spent on it. Examine the relationship of funds spent on marketing, and financial indicators, using the example of PJSC "Sberbank of Russia" (table 1).

Table 1 — Financial performance

Index	2008	2009	2010	2011	2012	2013	2014	2015	2016
Marketing expenses (billion rubles)	3.4	2.2	2.8	5.1	9.6	10.2	9.6	7.3	8.7
Net income (billion rubles)	97.7	24.4	181.6	315.9	347.9	362.0	290.3	222.9	517

The dynamics of these indicators has the following form (Fig. 1):

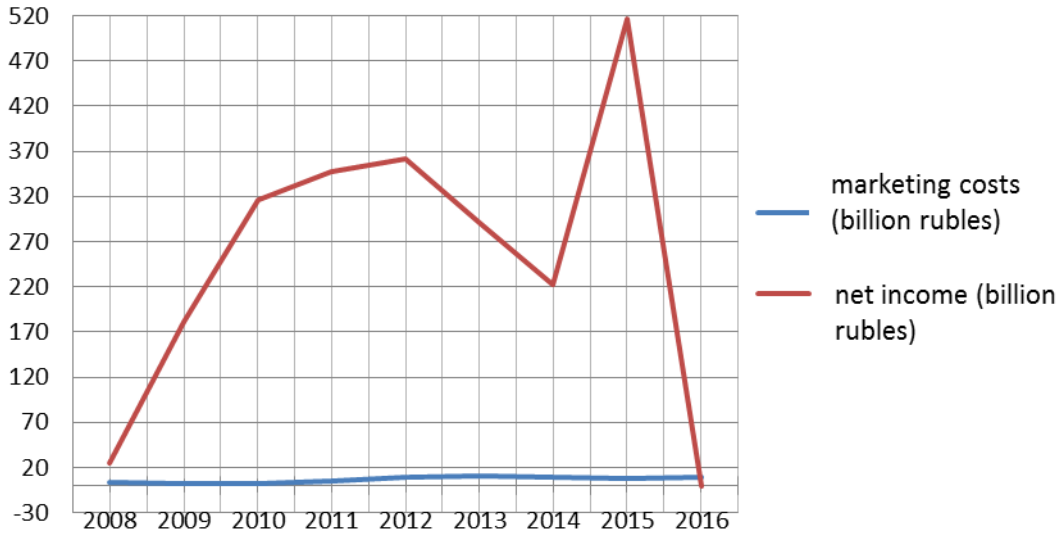

Fig. 1 - Dynamics of marketing costs and net income for the period from 2008 to 2016

To determine the intensity of changes in net income and marketing expenses of PJSC "Sberbank of Russia", we calculate the chain growth rates and the growth of both indicators (Table 2).

Table 2 - Chain growth rates and growth in marketing and net income expenses of PJSC "Sberbank of Russia"

Index (%)	2008	2009	2010	2011	2012	2013	2014	2015	2016
The growth rate of marketing costs	—	64.7	127.3	182.1	188.2	106.3	94.1	76.0	119.2
Net income growth rate	—	25.0	744.3	174.0	110.1	104.1	80.2	76.8	231.9

The growth rate of marketing expenses	—	-35.3	27.3	82.1	88.2	6.3	-5.9	-24.0	19.2
The growth rate of net income	—	-75.0	644.2	74.0	10.1	4.1	-19.8	-23.2	131.9

The graph of the dynamics of the values of the indicators in question has the following form (Figure 2):

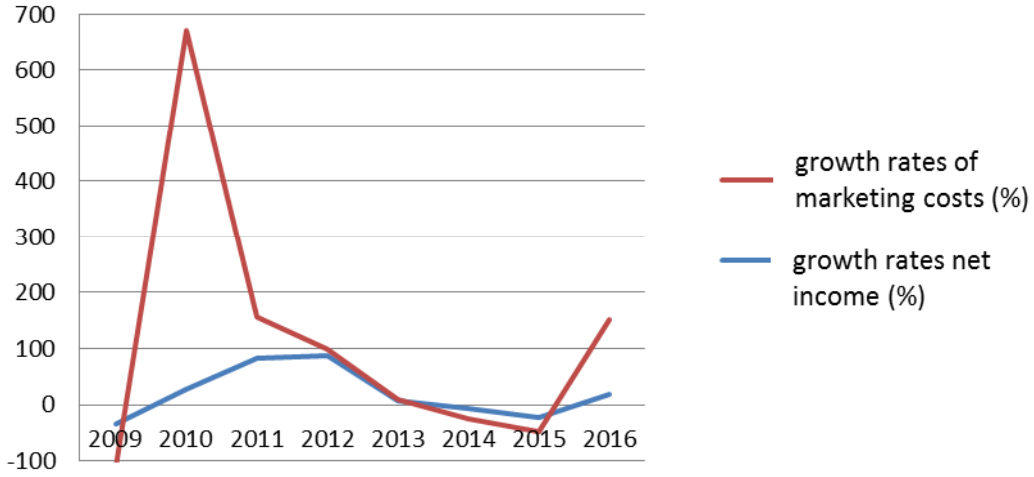

Fig. 2 - Dynamics of growth rates of marketing costs growth rate and net income for the period from 2008 to 2016

It can be seen from the graph that the greatest intensity of changes in the levels of a number of dynamics of growth rates of net income was observed in 2016 (131.9%). Starting from 2010 and up to 2015 inclusive, there is a decrease in the rate of growth and growth in the net income of PJSC "Sberbank of Russia". The increase in the growth rate of marketing expenses falls on 2016. Similarly, like net income, after 2012 there is a reduction in spending on marketing activities and the advertising budget, in general. On the basis of the data obtained, it can be concluded that there is a correlation between the costs of marketing and net income.

In order to evaluate the relationship between advertising costs (independent variable x) and net income of commercial banks (dependent variable y) and prove its presence, we will use the correlation-regression analysis method. The regression equation, reflecting the general trend in the behavior of the variables under consideration, will have the following form: $y = 36.6124x + 22.5808$. To calculate the tightness of the connection, it is necessary to calculate the parameters of the regression equation:

1 Selective means.

$x - \frac{58.9}{9} - 6.544$ –on average, PJSC “Sberbank of Russia” spent 6.544 billion rubles on marketing activities for the period from 2008 to 2016 (1)

$'y = \frac{2359.7}{9} = 262.189$- on average, the income of PJSC “Sberbank of Russia” was 266.189 billion rubles for the period from 2008 to 2016 (2)

$$x'y = \frac{18\,449.62}{9} = 2049.958 \quad (3)$$

2 Selective variances.

$$s^2(x) - \frac{467.59}{9} - 6.544^2 - 9.12 \quad (4)$$

$$s^2(y) = \frac{706237.93}{9} - 262.189^2 = 19727.87 \quad (5)$$

The calculated tightness ratio is a selective linear pair correlation coefficient, equal to 0.787.

Thus, the relationship between the sign of Y income) and factor X (marketing costs) is direct and close.

As a result of the first half of 2016, there was a significant reduction in the volume of advertising budgets by most banks. This is explained by the fact that the banking market experienced a protracted systemic crisis characterized by a high key interest rate (11% per annum), which automatically reduced the base of potential borrowers; they cannot afford to be credited at high interest rates (about 30% per annum for consumer loans under pre-crisis 18-20% per annum).

We will extrapolate the value of the marketing expenditure indicator for 2017 using the average annual absolute growth. We calculate the average annual absolute growth of marketing expenses of PJSC "Sberbank of Russia":

$$\Delta \text{net income} = \frac{8.7-3.4}{8} = 0.66 \text{ million rubles} \quad (6)$$

Thus, the estimated marketing expenses in 2017 and 2018, respectively, will be:

8.7+ 0.66 = 9.36 million rubles (7)

8.7+ 0.66*2 = 10.2million rubles. (8)

Using the method of scientific forecasting, we conclude that the expenses of PJSC “Sberbank of Russia” for marketing activities will increase in 2018.

Thus, using the example of PJSC “Sberbank of Russia”, we have proved that there is a direct link between the financial performance of the company, in particular, the net income and the money spent by the organization on marketing activities.

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ОЦЕНКА ЗАВИСИМОСТИ ЧИСТОЙ ПРИБЫЛИ ПАО «СБЕРБАНК РОССИИ» ОТ ЗАТРАТ НА МАРКЕТИНГОВЫЕ МЕРОПРИЯТИЯ

М.А. Юшина, А.А. Бутенко
Тамбовский государственный технический университет, Тамбов
e-mail: marya.yushina@gmail.com

Аннотация

В статье анализируется сущность банковского маркетинга и выявляется зависимость чистой прибыли банков от их затрат на маркетинговые мероприятия. В настоящее время на российском рынке ведется жесткая конкурентная борьба, которая, в частности, затрагивает и банковскую сферу. По состоянию на 01 октября 2016 года в России действуют 600 коммерческих банков, каждый из которых не перестает ежегодно расширять виды предоставляемых ими услуг и использовать различные маркетинговые инструменты, тем самым привлекая потенциальных потребителей. На данный момент вопрос оценки эффективности рекламных вложений приобретает для банков все большую актуальность. Сколько денег потратить на рекламу? Как достичь максимального эффекта? Как оценить эффективность проведения рекламной кампании? Цель статьи - ответить на эти вопросы.

Ключевые слова: банковский маркетинг; эффективность банковского маркетинга; маркетинговые затраты

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392000, г. Тамбов, ул. Советская, д. 106, к. 14.
Телефон (4752) 63-81-08, 63-81-33.
E-mail: izdatelstvo@admin.tstu.ru