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ФАН ВА ТАЪЛИМ**

**ҚАРАҚАЛПАҚСТАНДА
ИЛИМ ҲӘМ ТӘЛИМ**

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DYNAMICS OF SPECIMEN QUALITY AND POPULATION CYCLES OF *MERIONES TAMARISCINUS* IN THE LOWER AMUDARYA

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Summary: *The article presents the results of research on the dynamics of species quality and population cycles of Meriones tamariscinus in the lower reaches of the Amudarya. The ecosystems of intrazonal territories are the most sensitive to changes in the natural environment and easily pass from one state to another. Individuals of the most numerous generations born at the beginning of the population growth age and die off en masse, and their quantitative replacement does not occur due to a decrease in growth.*

Key words: *the lower reaches of the Amudarya, population dynamics, ecosystem, generations, monophasic growth of individuals.*

INTRODUCTION. At present, the study of the processes developing at the population level and based on the mechanisms ensuring the adaptive regulation of the population size under changing conditions is one of the main tasks of modern ecology. Its relevance, on the one hand, is dictated by the demands of practical epidemiology and biocenology and is a key point in the development of the principles of rational nature management, and on the other hand, is determined by the needs of the theory of evolution [3, 5].

The study of the bioecological features of the populations of indicator rodent species under the intensive influence of anthropogenic factors in intrazonal territories is very important theoretically and practically [3].

The Amudarya valley and delta is a vast alluvial plain located in the lower reaches of the river from the Tuyamuyun gorge to the Aral Sea. It is bounded by the Aral Sea in the north, by the Ustyurt chink in the west, by the Zaunguz Karakum and Sarykamysh hollow in the south, and by the Kyzylkum desert in the east. By the complex of physical and geographical conditions the lower reaches of the Amudarya differ significantly from the surrounding sandy and gypsum deserts. Under the influence of centuries of human economic activity, the natural undulating relief of the Amudarya lower reaches has turned into a fine-terraced surface, crossed in different directions by wide main canals and collectors [2, 8].

Soils of the Amudarya valley are desert-takyr, sandy and desert-meadow, developed on ancient alluvium, and in deltas and on the Aral Sea coast - swamp, swamp-meadow and solonchak, on elevations and in remnants of Tertiary there are sandstones and clays. Small areas are occupied by gray-brown soils [2, 8]. The climate in the lower reaches of the Amudarya can be characterized as sharply continental and dry. Deterioration of the hydrological regime and land development led not only to a reduction of the areas occupied by tugai forests and reed beds (the area of tugai forests decreased by more than 3 times, reeds by 8-10 times), but also to the replacement of hydrophytes by xerophytes and halophytes. Reed, cattail, false reedgrass and water-logged species grow on flooded areas. In the floodplains of the lower reaches of the Amudarya river, turangelose loosestrife associations, shrubs and semi-shrubs prevail [2].

Ecosystems of intrazonal territories are the most sensitive to changes in the natural environment and easily transition from one state to another. In the early 1990s, the transition to a market economy caused a sharp and significant reduction in livestock population, which led to the rapid development of restoration succession and the formation of anthropogenic transformation of landscapes in the lower reaches of the Amudarya. In this connection, the study of reactions of small

mammals - the habitat-forming component of arid ecosystems - to the process of vegetation restoration is of particular interest.

We analyzed the population dynamics of *Meriones tamariscinus* from 2018 to 2022. *Meriones tamariscinus* is the greenest sandfly species, preferring areas with dense soils and saltwort, sagebrush, and shrub communities. Observations showed that the biotopic confinement and abundance of individuals of the gerbil at the beginning of the period increased following the recovery of vegetation cover and overgrowth of sandy massifs [1, 12]. During further stages of restoration succession, habitats suitable for this species began to shrink and fragment. In the period from 2018-2019, apparently due to unfavorable natural and climatic conditions, the population number sharply decreased and remained at a low level until 2021, after which the Grebench Sandpiper began to occur in low numbers in the records.

For many species of small mammals adapted to the specific conditions of arid climate, including the gerbil (*Meriones tamariscinus*), seasonality of reproduction is typical: one reproductive period (March - September), during which females bring several litters (from 1 to 3). In the course of our studies, we found that *Meriones tamariscinus* is characterized by two variants of ontogenesis: monophasic growth for young animals maturing in the year of birth, and biphasic growth for overwintered animals maturing the year after their birth. The second jump of biphasic growth occurs in spring and is also associated with the sexual maturation of the arrivals [4, 5].

To compare the growth patterns of immature (0) and mature (1) segregates, a 2-parameter Michaelis-Menten type equation was used:

$$y = a \times x / (b + x),$$

where a is an estimate of the population mean upper asymptote, b is a "constant" numerically equal to the abscissa value (age) at which the ordinate reaches half of its maximum value.

The following parameter estimates were obtained with a 95% confidence interval:

For body length (mm):

$$Y(0) = 93,2[94,5-96,2] \times x / (0,7[0,6-0,9] + x);$$

$$Y(1) = 101,2[96,1-101,6] \times x / (0,2[0,02-0,4] + x)$$

for body weight (g):

$$Y(0) = 27,2[21,8-23,1] \times x / (2,5[2,2-3,0] + x);$$

$$Y(1) = 23,6[25,4-28,3] \times x / (1,2[0,4-1,9] + x)$$

Since the confidence intervals do not overlap, we can conclude that maturing fledglings are not only characterized by higher asymptotes, but also reach their half value about 0,5-1 weeks earlier. These results are in good agreement with the ideas about the signaling role of photoperiodicity in the growth and development processes of small mammals in arid climates.

Dependence of reproduction rate on population density is established in many species of mammals. With its increase, the size of broods, the proportion of breeding females, and the embryonic mortality rate increase [13, 14]. The effect of different population densities on reproductive potential can affect both directly and indirectly. The stress factor caused by high population density leads to inhibition of reproduction, disrupts parental behavior, which leads to the death of broods [13, 14].

At higher densities, due to the reduction of free territory and territorial behavior, it is more difficult for the young to disperse, and they are more likely to remain near their mother dens. Over time, as a result of their reproduction, the number of related individuals living nearby increases. Note that after several generations, population differentiation by hereditary traits in different parts of spatial groupings and formation of genetic lines takes place. Reproduction rates decrease not only due to stress situations, but also due to inbred depression [9, 10].

At the same time, high population density, acting as a factor determining the temporal differentiation of the gene pool into genetic lines in different parts of spatial groupings, creates the

conditions necessary for obtaining the effect of reproductive heterosis in the descendants of parents belonging to different lines [8, 11].

With a significant decrease in population density, migration activity increases and the probability of mating of unrelated individuals that previously lived far apart increases. Their offspring are heterozygous and usually bear the manifestations of reproductive heterosis, which manifests itself only under certain conditions [6, 7]. These include not only low population density, but also an unformed spatial-ethological structure. This is confirmed by the fact that during the population decline, when the population density decreases, but its spatial structure is still preserved, the fecundity of the offspring born in such conditions does not increase, which determines the inertia of reduced reproduction in further generations of the population [3, 5, 10]. Different population densities regulate its reproduction not only by a physiological mechanism based on stress effects, but also by genetic mechanisms common to all species based on the effects of different mating types which become predominant under conditions of high or low population densities in turn. They are non-specific intrapopulation mechanisms because all species periodically find themselves in a state where, as a result of natural or anthropogenic influences, the spatial-ethological structure is destroyed and the population size is so small as to temporarily prevent its recovery, or in a state of increased population density and structuredness. In the first case, the number of especially prolific progeny increases, and in the second case, it decreases.

The reasons for the ups and downs of small mammal populations are explained by genetic effects caused by the change in the predominant mating types: related and unrelated, such as inbred depression and heterosis [1, 3]. An abundance cycle is understood as such changes when its temporary increase ends with the return to the initial values [1, 3].

It is known that heterosis manifests itself in an increase in body size, in the increased reproductive potential of females, and in changes in other traits [3, 4, 10].

Large sizes and high survival rate of individuals of different mammal species born at the beginning of the population upsurge [10] may indicate that heterosis may be the cause. A temporary increase in the birth rate during the phase of population growth can also be explained by this phenomenon.

In the conditions of unformed spatial-ethological structure and low population density, which are usually observed at the beginning of the population growth, mass migrations of individuals take place and their descendants show reproductive heterosis.

The level of reproductive potential of females is maintained during their life, so high increases are preserved until the most fertile generations die out from old age. It is known that heterosis is manifested only in individuals of the first generation, and it fades in individuals of subsequent generations. Therefore, the decrease in the growth rate at the end of the phase of population growth occurs automatically with the change of generations [6, 7, 13].

CONCLUSION. As a result of intensive reproduction and increased survival of offspring, the population is rejuvenated, so the mortality due to aging decreases temporarily. It increases later in the phase of population peak, when changes in the age structure occur.

Individuals of the most numerous generations born at the beginning of the population surge age and die off en masse, and their quantitative replacement does not occur due to a decrease in growth rates. Therefore, the decline in the population after its peak is inevitable and does not depend on enemies, diseases, or bad physiological condition of individuals, which only accelerate it. When the value of growth returns to its previous values and the population that was excessively formed during the increase phase dies out from old age, the initial number is restored and the cycle is completed.

Changes in reproduction indices, body size, survival rate of individuals born at different phases of the cycle testify to regular transformations of the qualitative state of the population during the population cycle, which confirms the hypothesis expressed by I.A. Shilov [12] that it is more correct to speak not about population dynamics but about population cycles.

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Rezyume: Maqolada Amudaryoning quyi oqimida *Meriones tamariscinus* populyatsiyalari va individlari sifati dinamikasini o'rganish natijalari keltirilgan. Intrazonal hududlarning ekotizimlari tabiiy muhitning o'zgarishiga eng sezgir bo'lib, bir holatdan ikkinchisiga osongina o'tadi. Ko'p sonli avlodlar sonining ko'payishi boshida tug'ilganlar qariydi va ommaviy ravishda nobud bo'ladi va ularning miqdoriy almashinuvi o'sishning pasayishi tufayli sodir bo'lmaydi.

Резюме: В статье приведены результаты исследований динамика качества особей и популяционные циклы *Meriones tamariscinus* в низовьях Амударьи. Экосистемы интразональных территорий являются наиболее чувствительны к изменениям природной среды и легко переходят из одного состояния в другое. Особи самых многочисленных поколений, рожденные в начале подъема численности, стареют и в массе отмирают, а их количественного замещения не происходит из-за снижения приростов.

Kalit so'zlar: Amudaryoning quyi oqimi, populyatsiya dinamikasi, ekotizim, avlodlar, individlarning bir fazali o'sishi.

Ключевые слова: низовья Амударьи, динамика численности, экосистема, генерации, монофазный рост особей.

2-LOCAL INNER DERIVATIONS OF FINITE-DIMENSIONAL PHILIFORM NON-LIE LEIBNIZ ALGEBRAS

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Summary: In this article, we consider 2-local inner derivations of finite-dimensional filiform non-Lie algebras of Leibniz.

Key words: Leibniz algebra, derivation, inner derivation, 2-local inner derivation.

1. Introductions

In 1997, P.Šemrl [10] initiated the study of so-called 2-local derivations and 2-local automorphisms on algebras. Namely, he described such maps on the algebra $B(H)$ of all bounded linear operators on an infinite dimensional separable Hilbert space H . Afterwards 2-local derivations have been investigated by many authors on different algebras and many results have been obtained (see [1-4, 7, 8, 10]). Note that the definition of local inner derivations on standard operator algebras was introduced by L.Molnár in [9]. A.Ayupov and F.Arzikulov proved in [6] that every 2-local inner derivation on a Lie ring of skew-symmetric matrices over a commutative ring is an inner derivation.

2. Preliminaries

First, let us recall the definition Leibniz algebras.

Definition 2.1. An algebra L over a field F is called a Leibniz algebra if for any $x, y, z \in L$ the Leibniz identity

$$[x, [y, z]] = [[x, y], z] - [[x, z], y],$$

is hold, where $[,]$ is multiplication in L .

For an arbitrary Leibniz algebra L , we define the sequence:

$$L^1 = L, L^{k+1} = [L^k, L^1], k \geq 1.$$

A Leibniz algebra L of dimension n is called filiform, if $\dim L^i = n - i, 2n - 1$.

Theorem 2.1 [5]. In any n -dimensional complex filiform Leibniz algebra, there is a basis $\{e_1, e_2, \dots, e_n\}$ such that its multiplication in this basis has one of the following forms:

$F^1(\alpha_4, \dots, \alpha_n, \theta):$

$$[e_1, e_1] = e_3, \quad [e_i, e_1] = e_{i+1}, \quad 2 \leq i \leq n-1,$$

$$[e_1, e_2] = \alpha_4 e_4 + \alpha_5 e_5 + \dots + \alpha_{n-1} e_{n-1} + \theta e_n,$$

$$[e_j, e_2] = \alpha_4 e_{j+2} + \alpha_5 e_{j+3} + \dots + \alpha_{n+2-j} e_n, \quad 2 \leq j \leq n-2,$$

$$[e_j, e_2] = \alpha_4 e_{j+2} + \alpha_5 e_{j+3} + \dots + \alpha_{n+2-j} e_n, \quad 2 \leq j \leq n-2.$$

$F^2(\beta_4, \dots, \beta_n, \gamma):$

$$[e_1, e_1] = e_3, \quad [e_i, e_1] = e_{i+1}, \quad 3 \leq i \leq n-1,$$

$$[e_2, e_3] = \beta_4 e_4 + \beta_5 e_5 + \dots + \beta_n e_n, \quad [e_2, e_2] = \gamma e_n,$$

$$[e_j, e_2] = \beta_4 e_{j+2} + \beta_5 e_{j+3} + \dots + \beta_{n+2-j} e_n, \quad 3 \leq j \leq n-2.$$

Definition 2.2. The linear operator $D: L \rightarrow L$ is called the *derivation* of the Leibniz algebra L if $D[x, y] = [D(x), y] + [x, D(y)]$ for all $x, y \in L$ (Leibniz's rule).

Definition 2.3. For every element $a \in L$, the right multiplication of $R_a(x) = [x, a], x \in L$ is called an *inner derivation*.

Definition 2.4. A $\Delta: L \rightarrow L$ mapping is called a 2-local inner derivation of a Leibniz algebra, if for every pair $x, y \in L$, there exists an inner derivation (depending on x, y) such that $\Delta(x) = R_{x,y}(x)$ and $\Delta(y) = R_{x,y}(y)$.

3. Main results

In this section, we consider 2-local inner derivations of filiform non-Lie Leibniz algebras. Now we present the main results.

Theorem 3.1. Each 2-local inner derivation on algebra $F^1(\alpha_n, \theta)$ is inner derivation.

Proof. Let the operator Δ be a 2-local inner derivation on $F^1(\alpha_4, \dots, \alpha_n, \theta)$. Consider the 2-local inner derivation

$$\nabla = \Delta - R_a \quad (3.1)$$

such that $\nabla(e_1) = \nabla(e_2) = 0$.

Take an arbitrary element $x = x_1 e_1 + \dots + x_n e_n \in F^1(\alpha_n, \theta)$. There is an inner derivation $R_{b_{e_2, x}}$ such that

$$\nabla(e_2) = [e_2, b_{e_2, x}], \quad \nabla(x) = [x, b_{e_2, x}]. \quad (3.2)$$

Consider the following cases:

Case 1. Let $\alpha_k \neq 0$ for some $k \in \{4, \dots, n\}$. Then it follows from (3.2) that

$$0 = \nabla(e_2) = [e_2, b] = b_1 e_3 + b_2 \sum_{k=4}^{n-1} \alpha_k e_k,$$

hence we get $b_1 = b_2 = 0$ and therefore $[x, b_{e_2, x}] = 0$. Consequently $\nabla(x) = 0$.

Case 2. Let $\alpha_4 = \dots = \alpha_n = 0$. Take an arbitrary element $x \in F^1(\alpha_n, \theta)$. There is an inner derivation $R_{c_{e_1, x}}$ such that

$$\nabla(e_1) = [e_1, c_{e_1, x}], \quad \nabla(x) = [x, c_{e_1, x}].$$

From these equalities follows

$$0 = \nabla(e_1) = [e_1, c] = c_1 e_3 + c_2 \theta e_n,$$

and therefore $c_1 = c_2 \theta = 0$. Then

$$\nabla(x) = [x, c] = c_2 \theta x_1 e_n = 0.$$

From (3.1) we have $\Delta \equiv R_a$. The proof is complete.

Theorem 3.2. Each 2-local inner derivation on algebra $F^2(\beta_4, \dots, \beta_n, \gamma)$ is inner derivation.

Proof. Let the operator Δ be a 2-local inner derivation on $F^2(\beta_4, \dots, \beta_n, \gamma)$. Consider the 2-local inner derivation

$$\nabla = \Delta - R_a \quad (3.3)$$

such that

$$\nabla(e_1 + e_2 + e_3) = 0, \quad (3.4)$$

and

$$\nabla(e_1 + e_2 - e_3) = 0.$$

Take an arbitrary element $x = x_1 e_1 + \dots + x_n e_n \in F^1(\alpha_n, \theta)$. There is inner derivation $R_{b_{e_2, x}}$ such that

$$\nabla(e_1 + e_2 + e_3) = [e_1 + e_2 + e_3, b_{e_1+e_2+e_3, x}], \quad \nabla(x) = [x, b_{e_1+e_2+e_3, x}]. \quad (3.5)$$

Then we have $0 = \nabla(e_1 + e_2 + e_3)|_3 = b_1$, i.e. $b_1 = 0$. Now consider the following cases:

Case 1. Let $\beta_4 \neq 0$. From the equality (3.4) we obtain the following equalities

$$0 = \nabla(e_1 + e_2 + e_3)|_4 = b_3\beta_4 + b_1,$$

$$0 = \nabla(e_1 + e_2 + e_3)|_5 = b_3\beta_5 + b_2\beta_4.$$

Therefore $b_2 = b_3 = 0$.

Case 2. Let $\beta_4 = \dots = \beta_{k-1} = 0$, $\beta_k \neq 0$ for some $k \in \{5, \dots, n-2\}$. From (3.4) we have that $0 = \nabla(e_1 + e_2 + e_3)|_k = b_3\beta_k$,

$$0 = \nabla(e_1 + e_2 + e_3)|_{k+1} = b_3\beta_{k+1} + b_2\beta_k.$$

Consequently $b_2 = b_3 = 0$.

Case 3. Let $\beta_4 = \dots = \beta_{n-2} = 0$, $\beta_{n-1} \neq 0$. From (3.4) we get following

$$0 = \nabla(e_1 + e_2 + e_3)|_{n-1} = b_3\beta_{n-1},$$

$$0 = \nabla(e_1 + e_2 + e_3)|_n = b_2(\gamma + \beta_{n-1}) + b_3\beta_n.$$

Consequently $b_3 = 0$. If $\gamma \neq -\beta_{n-1}$ then $b_2 = 0$. Otherwise, if $\gamma = -\beta_{n-1}$ in these four cases instead of $e_1 + e_2 + e_3$ take the element $e_1 + e_2 - e_3$ and get result of third case $b_2 = 0$.

Case 4. Let $\beta_4 = \dots = \beta_{n-1} = 0$. From (3.4) we get

$$0 = \nabla(e_1 + e_2 + e_3) = b_1e_3 + (b_2\gamma + b_3\beta_n)e_n.$$

and $b_1 = b_2\gamma + b_3\beta_n = 0$.

In all cases found values of b_1, b_2, b_3 are substituted in (3.5) and we get $\nabla(x) = 0$. From (3.3) we have $\Delta \equiv R_a$. The proof is complete.

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Rezyume: Mazkur maqolada chekli o' lchamli Li bo' limgan filiform Leybnits algebralarining 2-local ichki differensiallashlari urganilgan.

Резюме: В этой статье изучены 2-локальные внутренние дифференцирования конечномерных не левых алгебр Лейбница.

Kalit so'zlar: Libnits algebrasi, differensiallash, ichki differensiallash, 2-lokal ichki differensiallash.

Ключевые слова: Алгебра Лейбница, дифференцирование, внутреннее дифференцирование, 2-локальное внутреннее дифференцирование.

FORMATION OF A HIGHLY EFFICIENT SILICON SOLAR CELL WITH NANO HETEROJUNCTIONS BASED ON LEAD CHALCOGENIDES

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Summary: The paper solves the problem of increasing the efficiency of a solar cell based on a combination of two technologies: nanotechnology and technology for creating semiconductor heterojunctions.

It is shown that the use of three types of lead chalcogenide nanocrystals: PbS, PbSe, PbTe contribute to the increase in the efficiency of the solar cell.

A zone diagram of the heterojunction PbS:Si is constructed, by analogy with the construction of a zone diagram of a macroscopic heterojunction.

When analyzing the construction of the band diagram, a significant dependence of the density of the linear multi-exciton energy spectrum of electrons and holes in nanocrystals on the ratio of their effective masses is taken into account.

Key words: Solar cell, lead chalcogenides, nano heterojunction, zone diagram.

Introduction. Many energy collapses in recent years have led people to think about the need to urgently search for new energy sources to replace the gradually disappearing hydrocarbon reserves. Naturally, at the same time, renewable energy sources, including solar energy, are in the first positions.

The possibilities of solar energy are really impressive in their inexhaustibility, which cannot be said about the current applied cases of its development. The main problem is the low efficiency of solar panels and a number of operational problems using solar electricity.

One of the numerous approaches to the problem of increasing the efficiency of a solar cell is to study the problem in combination with two technologies: nanotechnology and technology for creating semiconductor heterojunctions. The possibilities of nanotechnology are considered due to the fact that a solar cell (with a silicon substrate) contains a large number of nanosized components and has extended functionality based on new principles and new manifestations of known physical phenomena in semiconductor materials [1, 2]. In particular, due to a significant transformation of optical phenomena in a solar cell due to a reduction in the size of its nano structural components, a certain improvement in the efficiency of solar conversion is considered in the work (dimensional restrictions in the nature of the movement of electrons in nanocrystals lead to changes in the electronic, optical, acoustic and other properties of the solar cell).

The use of the capabilities of semiconductor heterojunction technologies is being investigated due to the fact that the solar cell considered in the work is a complex structurally modified design. In it, a single solar cell (p-n junction) is replaced by a complex heterojunction device, in which many nanocrystals (NCs) are created on the surface of a silicon substrate (say, n-type) from another p-type semiconductor, followed by the formation of nano heterojunctions in them (NHJs PbX:Si). A particularly noticeable improvement in the efficiency of a solar cell is achieved when using lead chalcogenides (PbX: PbS, PbSe, PbTe) as a nanocrystal material, which led to a more detailed description of the properties of PbX - lead chalcogenides.

Properties of nanocrystals PbX. Three types of nanocrystals of PbX - lead chalcogenides are studied: PbS, PbSe, PbTe. They have three unique properties.

The first feature is that as the transverse dimensions of the nanocrystal increase (up to 20÷30 nm), the width of its multi-exciton energy levels significantly increases due to the Coulomb interaction. As noted in [4] for spherical nanoparticles with radius R, the increase is proportional to R^{-1} . In this case, the width between the last electron-filled level of the nanocrystal (analogous to the

valence band) and its first empty level (analogous to the conduction band) also increases, i.e., the analog of the band gap in the macrocrystal of lead chalcogenide E_g^{PbX} increases.

The second feature is that a change in the size and width of multi-exciton energy levels in nanocrystals lead chalcogenide leads to fast (10÷20 fs) radiative recombination of an electron generated in the process of absorption of a high-energy photon by them. The emerging series of low-energy photons, penetrating deep into the silicon substrate, are absorbed in them and are able to generate new electron-hole pairs (that is, they cause the phenomenon of carrier multiplication [5]). This can lead to a multiple increase in the contribution of the nanocrystalline component of the solar cell to the efficiency of light conversion [2].

Finally, the third feature nanocrystals of lead chalcogenide is that their growth is most favorably realized by the self-organization process in those areas of the substrate where nanocrystals PbX with a high dielectric permittivity naturally find areas of crystalline compatibility with silicon [6]. In these areas of the surface of the silicon substrate, nanocrystals lead chalcogenide form many nano heterojunctions PbX:Si.

Zone diagrams of NHJ PbX:Si. The study of light conversion mechanisms in nano heterojunctions based on PbS is carried out based on the consideration of their zone diagrams, which are built according to the same rules as the zone diagram of a macroscopic heterojunction PbS:Si (Fig. 1-a [7]). At the same time, the zone of the substrate - macro-sized silicon practically does not change, and the zones of nano-sized lead chalcogenides PbS (Fig. 1-b) - are completely updated: continuous energy zones have been replaced by a line series of multi-exciton energy levels. The width of the discrete levels between the series of line multi-exciton energy levels of holes and electrons is the same, since their effective masses are approximately equal ($m_p \approx m_n$). In nanosized lead chalcogenides, with a decrease in their size, the E_g^{PbS} - the width of the zone between the last electron-filled state and the first empty state increases (Fig.1-b).

This is a feature of the line multi-exciton energy spectrum in nanocrystals PbX, in contrast to the spectrum of nanocrystals of other semiconductor materials. For example [3], CdSe, due to the strong difference between the effective masses of electrons and holes ($m_p \gg m_n$), where the density of line multi-exciton energy levels of holes is much denser than that of electronic states (Fig. 1-c, constructed by analogy with Fig.1-b).

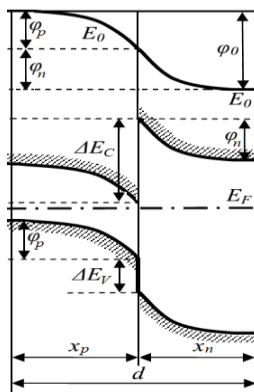


Fig.1-a: Macro heterojunction PbS:Si

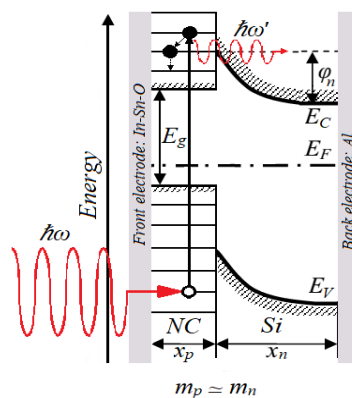


Fig.1-b: Nano heterojunction PbS:Si

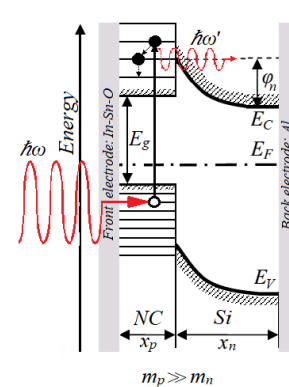


Fig.1-c: Nano heterojunction CdSe:Si

Conclusion. The problem of increasing the efficiency of the solar cell is solved in the work on the basis of a combination of two technologies: nano technology and technology for creating semiconductor heterojunctions.

It is shown that the use of three types of lead chalcogenide nanocrystals: PbS, PbSe, PbTe contribute to the increase in the efficiency of the solar cell.

A zone diagram of the heterojunction PbS:Si is constructed, by analogy with the construction of a zone diagram of a macroscopic heterojunction.

When analyzing the construction of the band diagram, a significant dependence of the density of the linear multi-exciton energy spectrum of electrons and holes in nanocrystals on the ratio of their effective masses is taken into account.

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Rezyume: Maqolada ikkita texnologiya: nano texnologiyasi va yarimo'tkazgichli geteroo'tishlarni yaratish texnologiyasi kombinatsiyasi asosida quyosh elementining samaradorligini oshirish muammosi ko'rilgan. Quyosh elementining samaradorligini oshirishda qo'rg'oshin xalkogenidlarining uch turdagi nanokristallaridan foydalanish yordam berishi ko'rsatilgan: PbS, PbSe, PbTe. Makroskopik PbS:Si geteroo'tishning zonaviy diagrammasi qurish analogi asosida nano geteroo'tishning zonaviy diagrammasi qurilgan. Zona diagrammasini tuzishda nanokristallardagi elektronlar va teshiklarning chiziqli ko'p eksitonli energiya spektrining zichligining ularning effektiv massalari nisbatiga sezilarli bog'liqligi hisobga olindi.

Резюме: В работе решена проблема повышения эффективности солнечного элемента на основе сочетания двух технологий: nano технологии и технологии создания полупроводниковых гетеропереходов. Показано, что повышению эффективности солнечного элемента способствуют применение трех типов nano кристаллов халкогенидов свинца: PbS, PbSe, PbTe. Построена зонная диаграмма nano гетероперехода PbS:Si, по аналогии построения зонной диаграммы макроскопического гетероперехода. При анализе построения зонной диаграммы учтена существенная зависимость плотности линейчатого мульти экситонного энергетического спектра электронов и дырок в нанокристаллах от соотношения их эффективных масс.

Kalit so'zlar: Quyosh elementi, qo'rg'oshin xalkogenidlari, nano geteroo'tish, zonaviy diagramma.

Ключевые слова: Солнечный элемент, халкогениды свинца, nano гетеропереход, зонная диаграмма.

**ANALYSIS OF THE CURRENT STATE OF PROBLEMS OF EUTROPHICATION OF
AQUATIC ECOSYSTEMS**

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Summary: *The article presents the results of the analysis of the distribution of biogenic elements in the aquatic ecosystems of the Aral Sea region by the method of principal components. The analysis performed shows that, in general, the studied system of characteristics of the state and distribution of biogenic elements in the studied water body does not differ in the stability of correlations; in certain periods of observation, correlations between the studied indicators weaken or even are absent.*

Key words: *Aral Sea Area, monitoring, biogenous elements, water ecosystems, eutrophication.*

The problem of environmental protection has an increasingly significant impact on international life, and is becoming one of the main directions of international cooperation of various countries. Studying the changing processes in the biosphere, influencing environmental factors, studying the laws of development of natural systems is one of the important tasks of modern ecology. An ecologically unstable environment is characterized by anomalously rapid changes in natural systems and intersystem interactions.

Despite the fact that the term "degradation of water bodies" is very common in scientific publications, there is still no generally accepted definition of it. Usually, only the definition of "environmental degradation" is given in the vocabulary related to ecology, which means the joint deterioration of the natural and social environment of human life. But man does not live directly in the water environment. Therefore, the degradation of water bodies, in the scientific literature, refers to the loss of the most diverse properties of water bodies that are potentially used by humans, namely, water management, fisheries, recreational potentials, social and cultural-historical importance. In general, anthropogenic degradation of water bodies can be defined as a joint process with complex factors associated with various types of human activity, not only the ecological condition of water bodies and watercourses, but also changes in their resource-exploitation parameters. Methodologically, the process of degradation of environmental elements is related to the development of an emergency environmental situation or environmental disaster. Moreover, in most cases, degradation processes are seriously studied only when such situations arise.

Despite the fact that the term "degradation of water bodies" is very common in scientific publications, there is still no generally accepted definition of it. Usually, only the definition of "environmental degradation" is given in the vocabulary related to ecology, which means the joint deterioration of the natural and social environment of human life. But man does not live directly in the water environment.

Therefore, the degradation of water bodies, in the scientific literature, refers to the loss of the most diverse properties of water bodies that are potentially used by humans, namely, water management, fisheries, recreational potentials, social and cultural-historical importance. In general, anthropogenic degradation of water bodies can be defined as a joint process with complex factors associated with various types of human activity, not only the ecological condition of water bodies and watercourses, but also changes in their resource-exploitation parameters. Methodologically, the process of degradation of environmental elements is related to the development of an emergency environmental situation or environmental disaster. Moreover, in most cases, degradation processes are seriously studied only when such situations arise.

Pollution of water bodies with excess biogenic elements increases the level of primary production: in eutrophic water bodies, there is a lot of development of microscopic water plants and

water "blooming" is observed. An increase in the number of microscopic water droplets reduces the clarity of the water.

A phenomenon characteristic of highly productive water bodies is the bloom of water with blue-green algae, most of which are poisonous.

Symptoms of eutrophication of water bodies include the covering of the water's edge by aquatic plants, as well as an increase in the number of epiphytes (plants that live on other plants) and "alien" microscopic aquatic organisms. The main source of biogenic elements entering water bodies is municipal and industrial wastewater, as well as agriculture. Reducing the load on biogenic substances, especially phosphorus, is very important to improve the condition of water bodies, because in many cases phosphorus is the biogenic element that controls the productivity of phytoplankton in inland water bodies.

The source of anthropogenic deposition of biogenic elements can be residential areas, agricultural land, waste water of industrial enterprises. Eutrophication is often accompanied by "blooming" of water, strong development of higher water plants. Eutrophication leads to a decrease in the fishery and recreational potential of water bodies, and has a negative impact on systems that purify water from water bodies for drinking water supply.

Currently, anthropogenic eutrophication is considered as the most important factor of negative impact of human activity on water bodies.

The change of abiotic factors can be determined directly, that is, by conducting a physico-chemical analysis of water bodies, as well as indirectly, by changing the structure and parameters of the population characteristics of living organisms in water bodies. It is known that primary trophic level producers, including phytoplankton, are the first stage in the development of eutrophication processes. Therefore, the change in their condition serves as an indicator of the processes taking place in water bodies.

The degree of influence of abiotic factors on water ecosystems against the background of geographic and climatic characteristics of the studied area can be determined using the method of ecological probability levels (EED) of environmental factors, this method: 1) to carry out diagnostics of the ecological state of the investigated ecosystem based on the biotic assessment of the ecological state of water ecosystems; 2) to calculate important physico-chemical EED of water environment; 3) makes it possible to classify important factors according to their danger to the ecosystem. The biotic concept of natural environment control is taken as the basis of this method. The basis for this concept is that it is necessary to assess the state of the ecosystem on the "normal-pathology" scale, not by the level of abiotic factors (for example, as in the concept of FHK), but by a complex of biological indicators.

In the growth of anthropogenic eutrophication of lakes, there is a change in the structure of phytoplankton, an increase in its number and biomass. It is considered that the appearance of diatom algae in plankton in spring is connected with the increase of light and its transition to the water bottom layers. A decrease in water transparency can lead to the development of diatom algae. This cloudiness is explained by the increase in the content of mineral substances in the water. At the same time, the decrease in water clarity in rivers and reservoirs is always associated with a decrease in the species composition of plankton algae.

Discharge of waste water into water streams and water bodies causes significant changes in their water quality. Zones of pollution appear, where natural hydrochemical and biological processes are disturbed, and the concentration of pollutant components exceeds the standards set by sanitary, fisheries and other indicators.

The method of assessing water quality for various water uses, which is used until now, is based on comparing the results of determining the chemical composition, physical properties and bacteriological characteristics of water at various points of the water body with the relevant norms of water quality indicators.

The method of summarizing these observations has not yet been sufficiently developed to be necessary to introduce it to the water management practice in general and to the activity of the body for monitoring and controlling the level of pollution of water bodies.

However, there is a strong demand for water quality indicators that can provide general information in space and time and take into account the temporal and spatial variability of pollution of water bodies. The general level of water body pollution, the duration and volume of clean and polluted river flows, the permissible load of this or that pollutant, the extent of pollution zones occurring in rivers, lakes and reservoirs, the accumulation of harmful substances in water bodies, and their value at different rates of external water exchange. removal requires registration on the basis of a complex approach to the assessment of the state of pollution of the water body.

Research of the hydrochemical regime of water bodies and related bioproductivity issues, including the hydrological and hydrochemical regime of water bodies and their influence on the activity of microorganisms; the nature of water bodies and their biohydrochemistry, taking into account anthropogenic influences; influence of hydrochemical factors on the bioproductivity of water bodies; processes of formation and destruction of organic substances and the influence of hydrochemical factors on them; it is very important to determine the conditions for the formation of the hydrochemical regime of water bodies and the bioproductivity potential of the water environment.

Pollution and self-cleaning of rivers, lakes and water bodies are interrelated processes that take place under the influence of local factors that act directly on the borders of the river or water body under consideration, and in general at the catchment area of the water body. These factors can be divided into natural and anthropogenic.

Description of the chemical-biological processes taking place in water bodies and the living environment affecting them is expanding and deepening. Modern mathematical models describing the conditions of the development of the process of transformation of substances in natural waters and the functioning of ecosystems of water bodies and streams use a large amount of data of hydrological, meteorological, hydrochemical, biological, sedimentological observations.

The use of simulation models allows to gain practical experience and to achieve a deep understanding of the decisive role of chemical, biological, chemical-biological, physical and physico-chemical processes in the self-cleaning of water bodies (reducing the concentration of biogenic pollutants in water bodies and water streams).

The mechanism of self-cleaning is quite complex, including oxidation, regeneration, adsorption, interaction of chemical ingredients, etc. covers a complex of processes. Because the discharge of untreated (or poorly treated) wastewater into natural waters is a common practice, the self-purification of water bodies is sometimes considered a natural process by which aquatic ecosystems are able to restore their properties.

The composition of BS in natural water is determined by the development conditions of regeneration processes during their feeding by plankton organisms and destruction by OV bacteria. The development of physical, chemical and biological processes in the water environment creates and determines certain characteristics of the spatial distribution of BS in natural water. This is clearly seen in oceanic waters where the specificity of BS spatial distribution from low to high latitudes has been determined. In this case, not only the concentration of BS, but also the interaction between individual biogenic elements and the organic and mineral fraction of certain elements changes. Large-scale spatial variations in BS stocks and composition in sea and ocean waters can be explained using a systematic approach and mathematical modeling.

It is especially important to research the interrelated issues of hydrochemical regime and bioproductivity of water bodies, including hydrological and hydrochemical regimes of water bodies and their influence on the activity of microorganisms; biohydrochemistry of water bodies, taking into account the characteristics of water bodies and anthropogenic influence; influence of hydrochemical factors on the bioproductivity of water bodies.

Processes of formation and destruction of organic substances and the influence of hydrochemical factors on them; It is important to determine the conditions for the formation of the hydrochemical regime of water bodies and the potential of the biological productivity of the water environment.

Development of mathematical models of eutrophication in the 1970s. was founded. All models of eutrophication can be conditionally divided into two groups: qualitative-analytical and empirical, imitative (portrait). The modeling situations for the first group of models are characterized by the use of a small amount of parameters, the study of stationary conditions of the process of eutrophication, which are average for the water body. The models of the second group are detailed, multi-component, and require a large amount of initial data. Simulation modeling is used to predict the eutrophication of water bodies, but does not allow to cover the ecosystem as a whole.

Local, one-dimensional and two-dimensional models of eutrophication processes are presented using mathematical methods of reservoir "blooming". As a result, it was determined that an important factor determining ecosystem transformation is the change in phosphorus load.

Thus, the study of scientific literature allows us to conclude that many factors affect eutrophication processes. The most important of them are: the presence and ratio of biogenic elements in water (including nitrogen and phosphorus), the dynamic regime of water, the composition and development of aquatic and higher plant species.

In recent decades, anthropogenic activity at the place of catchment of water bodies can be considered as a particularly important factor. According to the materials of scientific research, it can be concluded that eutrophication processes of water bodies can be achieved thanks to activities carried out in water catchment areas and directly in the water body. But until now, there are very few studies on determining the regional characteristics of anthropogenic eutrophication of water bodies.

In practice, there is no information on substantiating the causes of eutrophication of water bodies and developing methods and methods for reducing eutrophication processes. It should be noted that the analysis of the potential causes of ecological disturbance and the identification of important factors are carried out jointly for the entire complex of abiotic variables measured by the monitoring services.

Water environmental factors that lead to the degradation of water ecosystems are formed depending on the intensity and amount of biogenic elements entering water bodies and create certain conditions at the level of a specific biological regime and production and destruction processes that lead to their accumulation in ash.

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Rezyume: *Maqolada biogen elementlarining Orol dengizining suvi ekosistemalarida asosiy komponent metodi sifatida joylashgan analiz natijalari keltirilgan. Utkarilgan analiz natijasi*

kursatgichi buyicha umumiy urganilaetgan xarakteristik vaziyat sistemasi va biogen elementlarining joylashishi urganilaetgan suv ob'ekti korreliyatsion aloqalar barqarorligi bilan ajralmaydi, ayrim muddat kuzatuvlarida korreliyatsion aloqalar urganilaetgan kursatgichlar orasida kuchsizlanadi yeki umuman yo'q bo'lib ketadi.

Резюме: В статье приведены результаты анализа распределения биогенных элементов в водных экосистемах Приаралья методом главных компонент. Проведенный анализ показывает, что в целом изучаемая система характеристик состояния и распределения биогенных элементов в исследуемом водном объекте не отличается стабильностью корреляционных связей, в отдельные сроки наблюдений корреляционные связи между изучаемыми показателями ослабевают или даже отсутствуют.

Kalit so'zlar: Orolbuyi, kuzatish, biogen elementlar, suv ekosistemi, evtrofikatsiya jaraeni.

Ключевые слова: Приаралье, мониторинг, биогенные элементы, водные экосистемы, эвтрофикация.

UDC 517.9+519.6

COMPACT DIFFERENCE SCHEMES FOR THE ALLER-LYKOV MOISTURE TRANSFER EQUATION

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Summary: *The generalized Aller-Lykov equation is a mathematical model used in many applied problems of heat and moisture transfer. This refers to non-stationary problems of hydrogeology, agrophysics, biology, ecology, etc., which are mainly solved by numerical methods. In this article, difference schemes of higher accuracy (compact schemes) are constructed and studied for the non-stationary generalized Aller-Lykov equation. The construction of the scheme in space and time is conducted by the method of finite differences. The stability and convergence of the constructed difference scheme are proved, and accuracy estimates are obtained for a sufficiently smooth solution to the original differential problem. An algorithm for implementing the constructed scheme is proposed.*

Key words: *Aller-Lykov equation, difference schemes, stability, a priori estimates, convergence, accuracy.*

Introduction. Applied problems of hydrogeology, mathematical biology, ecology, structural physics, management, etc. belong to the area of heat and moisture transfer problems. Their mathematical models in most cases lead to a generalized non-stationary Aller-Lykov equation with local and non-local boundary conditions [1], [2]. In addition, such problems arise in the unified theory of sound propagation in saturated marine sediments, in the theory of elastic wave propagation in piezo-ceramic media, in the theory of oscillations of piezo-ceramic resonators [3],[4], and in the theory of wave propagation in dispersion media (loaded equations) [2], [5].

At present, in the theory of difference schemes, much attention is paid to numerical methods of higher accuracy in solving non-stationary equations with local and non-local boundary conditions, including heat and moisture transfer equations. However, numerical methods also have their limitations in terms of stability, accuracy, and economy.

In [6], a priori estimates were obtained for the one-dimensional Aller-Lykov equation with nonlocal boundary conditions, based on the method of energy inequalities; from these estimates, uniqueness, and stability with input data follow. A one-parameter difference scheme of the first order of approximation in both variables was constructed there. Similar studies were performed in [7], [8] for a third-order pseudo-parabolic equation with variable coefficients. Problems with local and nonlocal boundary conditions were considered. Difference schemes of the second order of accuracy in space and time were constructed. The corresponding a priori estimates of the difference schemes were obtained, and on their basis conclusions were drawn about the accuracy of the considered schemes. In [9], difference schemes of the finite element method of the third order of accuracy in time and space variables for the Aller moisture transfer equation were constructed and studied. Accuracy estimates were obtained under weak assumptions on the smoothness of solutions to the differential problem. Similar results were obtained in [10] for the general Aller equation. In this case, the fourth order of accuracy in time and the third order of accuracy in space were obtained. In [11], difference schemes of the finite difference method and the finite element method of various orders of accuracy in time and space variables for the Aller-Lykov moisture transfer equation were constructed and studied. In [12], difference schemes of the finite element method in a weak metric were considered, and the fourth order of accuracy in time variables and the third order of accuracy in space variables were obtained for the Aller-Lykov moisture transfer equation. Various non-stationary problems were studied in [13]-[18], where high-order Sobolev-type

equations with a second-order derivative with respect to time were mainly considered. Schemes of the finite element method of a high order of accuracy were constructed and studied with minimal requirements for the smoothness of the solution to the original differential problem.

In this article, based on the general results of the theory of difference schemes, difference schemes of higher accuracy are analyzed for solving the generalized Aller-Lykov equation. The initial boundary value problem of the first kind for this equation is approximated by the finite difference method. In this case, the main attention is paid to obtaining an accuracy estimate for difference schemes of higher accuracy in classes of smooth solutions. Schemes of higher accuracy in the theory of difference schemes are called compact difference schemes.

2. Statement of the problem. In closed domain $\bar{Q}_T = \{(x, t), 0 \leq x \leq l, 0 < t \leq T\}$ we consider the Aller-Lykov moisture transfer equation [15]

$$\theta \frac{\partial u}{\partial t} + \rho \frac{\partial^2 u}{\partial t^2} = Lu + \mu \frac{\partial}{\partial t}(Lu) + f(x, t), \quad (x, t) \in Q_T, \quad (1)$$

with boundary

$$u(0, t) = \mu_1(t), u(l, t) = \mu_2(t), \quad t \in (0, T], \quad (2)$$

and initial conditions:

$$u(x, 0) = u_0(x), \quad \frac{\partial u}{\partial t}(x, 0) = u_1(x), \quad x \in \bar{\Omega}. \quad (3)$$

Here $Lu = \frac{\partial^2 u}{\partial x^2}$, $Q_T = \bar{Q}_T \cap \Gamma$, θ, ρ, μ are positive constants.

Problems of (1)-(3) types arise in the mathematical modeling of the processes of moisture transfer, heat conduction, mathematical biology, control problems, etc.

In [19], for differential equation (1) with initial conditions (3) and boundary conditions

$$u(0, t) = u(l, t), \quad t \in (0, T], \quad (4)$$

$$\frac{\partial u}{\partial x}(0, t) = \frac{\partial u}{\partial x}(l, t), \quad t \in (0, T]. \quad (5)$$

the following a priori estimate is obtained

$$\left\| \frac{\partial u}{\partial t} \right\|_0^2 + \left\| \frac{\partial u}{\partial x} \right\|_0^2 + \int_0^l \left\| \frac{\partial^2 u}{\partial t \partial x} \right\|_0^2 d\tau \leq M \left(\int_0^l \|f\|_0^2 d\tau + \|u_1(x)\|_0^2 + \|u'_0(x)\|_0^2 \right), \quad (6)$$

for $k(l, t) = k(0, t)$, $\lambda = 1$. Here $\|u\|_0^2 = (u, u)$ is the norm in Hilbert space H with scalar product $(u, v) = \int_0^l u v dx$. From (6) follows the existence and uniqueness of the solution to the differential problem (1)-(3) with respect to the input data.

Estimate (6) is also valid for problem (1), (2) with boundary conditions of the form

$$u_x(0, t) = \mu_1(t), u_x(l, t) = \mu_2(t), \quad t \in (0, T]. \quad (7)$$

In addition to (4), (5), (7), one can obtain an estimate of type (6) for the Neumann problem, and for mixed boundary value problems.

3. Approximation in space. Equation (1) is first approximated with respect to space variables. To do this, we introduce $\Omega = \{x: 0 \leq x \leq l\}$ into uniform grid $\bar{\omega}_h = \{x_i = ih: i = 0, 1, 2, \dots, N; h = l/N\}$ with step $h = l/N$. Then, approximating equation (1) with respect to x , we obtain a system of ordinary differential equations

$$D \frac{d^2 u_h(t)}{dt^2} + B \frac{du_h(t)}{dt} + Au_h(t) = f_h(t), \quad (8)$$

$$u_h(0) = u_{0,h}, \quad \frac{\partial u_h}{\partial t}(0) = u_{1,h}, \quad (9)$$

where

$$D = \rho E, B = \theta E - \mu A, A = -A, Ay = y_{\bar{x}x}, \quad (10)$$

$y_{\bar{x}x} = (y_{i+1} - 2y_i + y_{i-1})/h^2$, where y approximates u at fixed node $x_i = ih$, $u_{0,h} = P_h u_0(x)$,

$u_{1,h} = P_h u_1(x)$ are the interpolants of the initial conditions, P_h is the projection operator, P_h :

$H_h \rightarrow H_h$ and $f_h(t) = P_h f(x, t)$. Here H_h is the space of discrete functions u_h approximating H .

The scalar product and the norm in H_h are defined as $(u, v) = \sum_{i=1}^{N-1} u_i v_i h$, $\|u\|_0^2 = (u, u)$.

The boundary conditions are approximated exactly.

The difference operators B and A approximate the differential operators $\theta E + \mu \frac{\partial^2 u}{\partial x^2}$ and $\frac{\partial^2 u}{\partial x^2}$, respectively, with the second order of the approximation error.

4. Approximation in time. Let the discrete function y approximate $u_h \in H_h$. Let us introduce uniform in t grid $\bar{\omega}_\tau = \{t_n = n\tau : n = 0, 1, 2, \dots; \tau > 0\}$. Problem (8), (9) is approximated by the difference scheme

$$Dy_{\bar{t}t} + By_t^* + Ay = \varphi, \quad y^n \in H_h, \quad (11)$$

$$y^0 = u_{0,h}, \quad \frac{y^1 - y^0}{\tau}(0) = u_{1,h}, \quad (12)$$

where $y_{\bar{t}t} = (y^{n+1} - 2y^n + y^{n-1})/\tau^2$, $y_t^* = (y^{n+1} - y^{n-1})/(2\tau)$, $y^n = y(t_n)$, $y^{n+1} = y(t_n + \tau)$, $y^{n-1} = y(t_n - \tau)$. Here D, B, A are determined according to (10).

The approximation error of the difference scheme (11), (12) has an approximation error $O(\tau + h^2)$ since the second initial condition has an approximation error $O(\tau)$. To obtain τ^2 , we approximate the second initial condition as follows [20]:

$$y^0 = u_{0,h}, \quad \frac{y^1 - y^0}{\tau}(0) = u_{1,h}(x_i) + 0.5u_{0,\bar{x}x,h}(x_i), \quad x_i \in \omega_h. \quad (13)$$

Then the difference scheme (11), (13) approximates the original problem (1)-(3) with the second order in τ and in h .

If the solution to the original differential problem has higher smoothness, then it is possible to construct a difference scheme of a higher order of approximation. The difference schemes with a higher order of approximation can be obtained in various ways. Next, we consider one of the options for increasing the approximation in space.

5. Scheme of higher accuracy. Based on the Taylor expansion formula, the following equation holds

$$Au = Lu - \frac{h^2}{12} L^2 u + O(h^4). \quad (14)$$

Then, substituting (14) into (11) and performing elementary transformations, we obtain the following difference scheme

$$\tilde{D}y_{\bar{t}t} + \tilde{B}y_t^* + \tilde{A}y = \tilde{\varphi}, \quad y^n \in H_h, \quad (15)$$

where

$$\tilde{D} = \theta E - \mu \Lambda + \theta \frac{h^2}{12} \Lambda, \quad \tilde{B} = \rho \left(E + \frac{h^2}{12} \Lambda \right), \quad \tilde{A} = -\Lambda, \quad \tilde{\varphi} = f + \frac{h^2}{12} \Lambda f.$$

Let the scheme error be $z = y - u$. Then substituting $y = z + u$ into difference scheme (13), (15), we obtain the problem for the approximation error

$$\tilde{D}z_{\bar{t}t} + \tilde{B}z_t^* + \tilde{A}z = \psi, \quad z \in H_h, \quad (16)$$

$$z^0 = 0, \quad z^1 = \tau u_{1,h}(x_i), \quad x_i \in \bar{\omega}_h, \quad (17)$$

where $\psi = O(\tau^2 + h^4)$.

6. Stability and convergence of the scheme. Difference equation (15) has the following canonical form of three-layer difference schemes:

$$\tilde{B}y_t^* + \tau^2 \tilde{R}y_{\bar{t}t} + \tilde{A}y = \tilde{\varphi}, \quad (18)$$

where $\tilde{R} = \frac{1}{\tau^2} \tilde{D}$, $\tilde{B} = \tilde{B}^* > 0$, $\tilde{R} = \tilde{R}^*$, $\tilde{A} = \tilde{A}^* > 0$. Likewise [21, p. 237], we check the fulfillment of the operator inequalities

$$\tilde{R} > \frac{1}{4} \tilde{A}, \quad \tilde{B}^* \geq 0. \quad (19)$$

Since, by construction $\tilde{B} > 0$, from (19), to fulfill $\tilde{R} > \frac{1}{4} \tilde{A}$, we obtain the following condition

$$\mu < \tau^2 + \frac{\theta h^2}{12}. \quad (20)$$

If condition (20) is satisfied, the operator $\tilde{R}$ from (18) becomes self-adjoint and positive-definite, i.e., $\tilde{R} = \tilde{R}^* \geq \varepsilon E$, for $\varepsilon = \theta$

The stability condition (20) is interesting in that there is no restriction between the time and space steps inherent in difference schemes for hyperbolic equations.

The following assertion holds.

Theorem 1. If condition (20) is satisfied, then for any $y^0, y^1 \in H_h$ of difference scheme (13), (15) the following a priori estimate holds

$$\|y^{n+1}\|_* \leq \|y^n\|_*, \quad n = 1, 2, \dots, K, \quad (21)$$

where

$$\|y^n\|_* = \frac{1}{4}(\tilde{A}(y^n + y^{n-1}), y^n + y^{n-1}) + \left(\left(\tilde{R} - \frac{1}{4}\tilde{A} \right) (y^n - y^{n-1}), y^n - y^{n-1} \right).$$

Estimate (21) means that the difference scheme (13), (15) is stable with respect to the initial data.

Next, based on the results of [20] (Theorem 4, p. 389), we obtain the following assertion about stability on the right-hand side.

Theorem 2. Let condition (20) be satisfied. Then the solution to the difference scheme (13), (15) is stable on the right-hand side, and for its solution, the a priori estimate is true for $t > \tau$

$$\|y^{n+1}\| \leq \frac{2\sqrt{\tau}}{\varepsilon} \left[\sum_{t'=1}^n \tau \|\tilde{\varphi}(t')\|^2 \right]^{1/2}, \quad (22)$$

where $\varepsilon = \theta$.

If $y^0 = y^1 = 0$, then the following theorem holds.

Theorem 3. If condition (20) is satisfied for scheme (13), (15), the following a priori estimate is true

$$\|y^{n+1}\|_*^2 \leq \|y^1\|_*^2 + \frac{1}{2} \sum_{k=1}^n \tau \|\tilde{\varphi}(t')\|_{\tilde{R}}^2. \quad (23)$$

The convergence of scheme (13), (15) follows from its stability and approximation. The error $z = y - u$ is a solution to problem (16)-(17). Using one of the a priori estimates (21)-(23), for z , for example, from (22), we obtain

$$\|z^{n+1}\| \leq \frac{2\sqrt{\tau}}{\varepsilon} \left[\sum_{t'=1}^n \tau \|\psi(t')\|^2 \right]^{1/2}.$$

This shows that the following theorem is true.

Theorem 4. If condition (20) is satisfied, the solution to scheme (13), (15) converges to the solution of the original problem (1)-(3) and has the second order of accuracy in time and the fourth order of accuracy in space, i.e. the following accuracy estimate holds

$$\|y(x_i, t_n) - u(x_i, t_n)\| \leq M(\tau^2 + h^4), \quad (x_i, t_n) \in \bar{\omega} = \bar{\omega}_h \times \bar{\omega}_\tau.$$

7. Algorithm for implementing scheme (13), (15). Since the inverse operator $\tilde{D}^{-1}$ exists, the scheme is calculated as an explicit scheme. Therefore, the scheme is easy to program.

Conclusions. In this article, based on the finite difference method, a numerical method of a high degree of accuracy was developed and studied for solving the first boundary value problem for the generalized Aller-Lykov equation. The stability and convergence of the constructed difference schemes were proved, and accuracy estimates were obtained on their basis. Note that in the stability condition (20) there is no restriction between the time and space steps inherent in difference schemes for hyperbolic equations.

The multidimensional boundary value problems for the Aller-Lykov equation can be studied similarly, and other boundary value problems can be considered.

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Rezyume: Umumlashtirilgan Aller-Lykov tenglamasi issiqliq va namlikni uzatishning ko`plab amaliy masalalarning matematik modeli hisoblanadi. Bunda asosan gidrogeologiyaning, agrofizikaning, biologiyaning va boshqalarning nostatsionar masalalarin sonli usullarda echish ko`zda tutiladi. Ushbu ishda Aller-Lykovning nostatsionar umumlashgan tenglamasiga yuqori aniqlikdagi ayirmali sxemalar (compact sxema) tuzilgan va urganilgan. Tuzilgan sxemalar fazo bo`yicha va vaqt bo`yicha chekli ayirmali sxemalar usulida amalga oshiriladi. Tuzilgan ayirmali sxemalarning turg'unligi va yaqinlashishi isbotlandi va berilgan differentsial` masalaning echimini etarli silliqiligidagi aniqlik baholari olindi. Tuzilgan sxemani amalga oshirish algoritmi taklif etildi.

Резюме: Обобщенное уравнение Аллера-Лыкова является математической моделью многих прикладных задач тепловлагопереноса. Имеется ввиду нестационарные задачи гидрогеологии, агрофизики, биологии, экологии и т.д., которые в основном решаются численными методами. В данной работе для нестационарного обобщенного уравнения Аллера-Лыкова построены и исследованы разностные схемы повышенной точности (компактные схемы). Построение схемы по пространству и по времени осуществляется методом конечных разностей. Доказана устойчивость и сходимость построенной разностной схемы и получены оценки точности при достаточной гладкости решения исходной дифференциальной задачи. Предложен алгоритм реализации построенной схемы.

Kalit so'zlar: Aller-Lykov tenglamasi, ayirmali sxemalari, turg'unlik, aprior baholar, yaqinlashish, aniqlik.

Ключевые слова: Уравнение Аллера-Лыкова, разностные схемы, устойчивость, априорные оценки, сходимость, точность.

**ANALYSIS OF THE DYNAMICS OF THE POPULATION OF THE SMALL JERBOA
(ALLACTAGA ELATER) IN THE CONDITIONS OF THE ARAL REGION**

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Summary: *The article presents the results of an analysis of the population dynamics of the small jerboa (Allactaga Elater) in the conditions of the Aral Sea region. It has been established that the intensity of reproduction of young females is inversely related to the density of the population. The adaptive role of the existence in populations of two seasonal generations that differ in the rate of growth and development.*

Key words: *Prearalie, population dynamics, population, reproduction, generation.*

Currently, according to many experts, the study of population dynamics in natural populations of jerboas (Allactaga) reveals various combinations of the three introduced dependences of population parameters on density [1, 4, 5]. We investigated the question of the significance of each of the three possible regulatory mechanisms, introducing various combinations of them into the assessment of the population dynamics of the small jerboa (Allactaga elater). In order to understand the causes of fluctuations in the dynamics of the populations of small mammals Let us consider the dynamics of the population size in those years where the density of females by the beginning of the breeding season takes the minimum and maximum values.

The study of the dynamics of meteorological, global, and cosmic factors made it possible to classify years according to the set of values of these factors into 5 types of years [5, 9]. It was shown that each of these types, while maintaining the dominance of background species, differs in the degree of predominance of certain animal species in the fauna, which corresponds to their ecological preferences.

Also important is the fact of establishing the role of the previous state of the population in the population dynamics not only of the previous year, which was known earlier, but also several years ago. Such "retro-links" are often reliable and useful for making forecasts, although a convincing interpretation of the reasons for such links cannot always be given. Most often, these relationships reflect the patterns of conjugation of long-term cycles of both individual animal species and processes in the biocenosis that are important for the species under study. An example of this is the population dynamics of the small jerboa (Allactagaelater) in the optimal parts of the range [3, 6].

Allactaga elater inhabits a variety of habitats in semi-desert and desert zones. The type of substrate and the projective covering of perennial vegetation are the leading factors in the selection of habitats by the species [9, 10]. Prefers sandy loam and light loamy soils, however, it is also found on dense clay and gravelly substrates, and in areas of compacted saline sands. He does not live in real sands, but often runs into them.

On the Ustyurt plateau, the small jerboa is numerous in places. It occurs in the tracts of Kosbulak, Churuk, along the eastern and southern chinks, near the Sarykama basin sh. It settles unevenly, usually in small groups on clay mounds with ephemeral-wormwood vegetation, on compacted sands and around wells, along dirt roads. Considering the dynamics of the population of the small jerboa, it can be noted that in the northern part of Ustyurt its number slightly exceeds from the 1980s to 2016 (Fig.1). There is a sharp fluctuation in the number of seasons and years, depending on climatic and feeding conditions, the nature of reproduction, and other population

parameters. In favorable years, the number of jerboa increases 2-3 times. In the period 1976-1985 with snowless winter and cold spring, an average of about 3-4 individuals per 1 km were observed. Desert areas are optimal for the species, where patches of perennial vegetation from small bushes and tall grasses are interspersed with completely devoid of vegetation spaces [9].

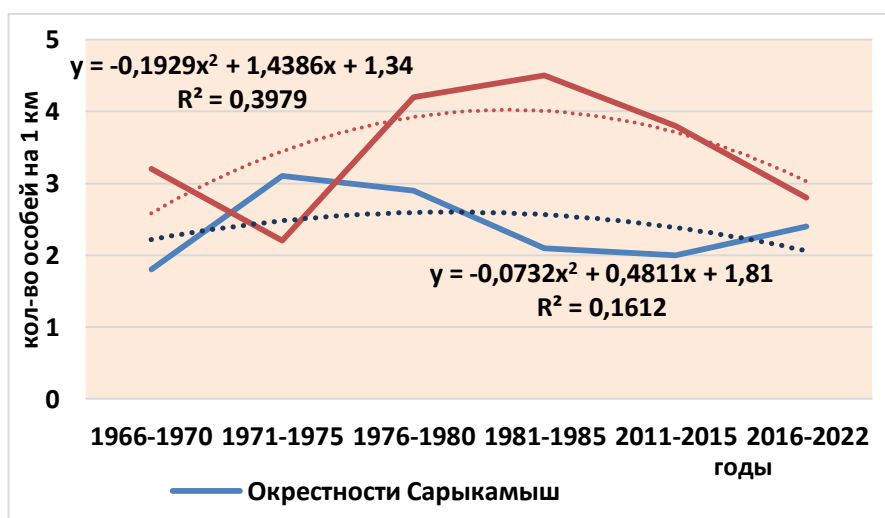


Fig.1. Dynamics of the population of the small jerboa on the Ustyurt plateau (1966-2022)

The analysis showed that when taking into account the feedbacks between the population density in the spring period, the amplitude of fluctuations decreased. When introducing into the statistical model the indicators of regulation mechanisms, changing demographic parameters (mortality and the rate of puberty of young animals), fluctuations in the dynamics of the number remained, but their amplitude also decreased. Also note that dependence on density leads to stabilization of the spring population. But at the same time, there may be a decrease in fluctuations and declines in density in the spring after the peak year. As the research results have shown, the density fluctuations obtained during the analysis are much similar to the literature data [6, 7].

During the calculations, we took into account the fact that the life span of individuals is limited to one year, therefore, the dynamics of population density before the start of reproduction is described by such an equation, where R (Malthusian parameter) does not depend on the mechanisms of endogenous regulation, and $f(N_t)$ represents the dependence of the spring density next year on the spring density of the current year, which is determined by the dependence of demographic parameters of the population on density during the reproductive period (Fig. 2).

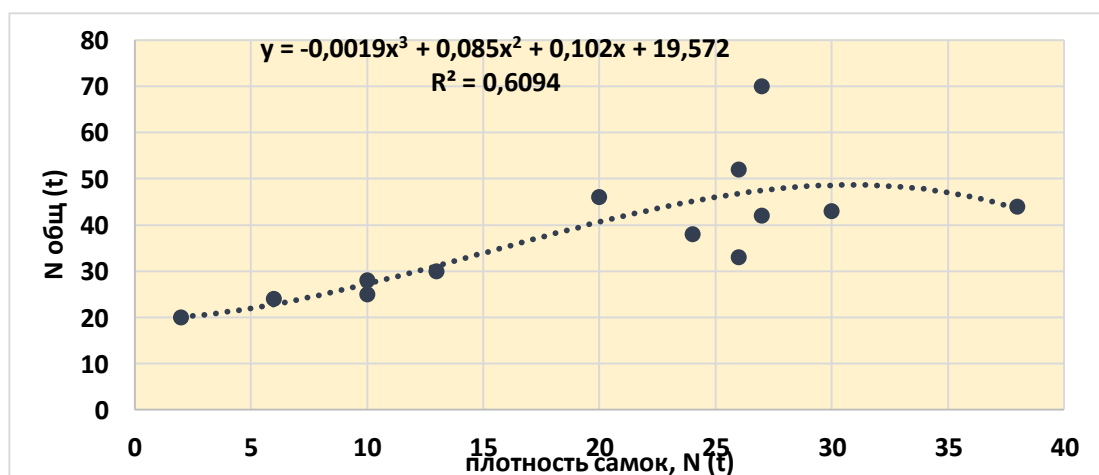


Fig. 2. Dependence of the population density of *Allactaga elater* on the density of females, where the interval between litters and the maturation rate depend on the density.

In the natural population, the spring density varies by 2 times and fluctuations do not have a pronounced period, and the density level in the autumn period, by the end of the reproductive process, remained stable from year to year. In this regard, based on the results obtained, it can be assumed that the mechanisms of endogenous regulation, expressed depending on demographic parameters on density, can lead to fluctuations in the population of the small jerboa *Allactaga elater*. According to the literature data [8, 10], it is fundamental that when introducing the dependence of population parameters on density during the breeding season, we get the dependence of the spring density of the next year on the spring density of the current year, which can lead to fluctuations, because it has a maximum inside the definition area. The value of the trend line depends on changes in the types of trajectories and is determined by the dependence of population parameters on density:

$$y = -0,001x^5 + 0,0436x^4 - 0,684x^3 + 4,3517x^2 - 8,873x + 24,584,$$

where $R^2 = 0,3471$

Thus, our studies allow us to conclude that the intensity of reproduction of the profit females (the rate of maturation and the degree of participation in reproduction) is inversely dependent on the density of the population. In the years of low spring numbers, young females matured faster, entered into reproduction earlier, so their role in reproduction was much higher than in the years of medium and low numbers.

A similar pattern appears at the end of the breeding season, but the level of autumn reproduction is focused not on spring, but on summer population density. The adaptive role of existence in populations of two seasonal generations, differing in the rate of growth and development, as well as the degree of participation in reproduction is undeniable. The different rate of puberty of early and late arrivals, leading to a clear age differentiation of fingerlings into two biologically peculiar generations, serves as the most important condition for the normal functioning of the population, ensuring its stability and uniform reproduction.

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Rezyume: *Maqolada Orolbo'yi sharoitida kichik qushayoq (Allactaga Elater) populyatsiyasi dinamikasini tahlil qilish natijalari keltirilgan. Yosh urg'ochilarning ko'payish intensivligi populyatsiya zichligiga teskari bog'liqligi aniqlangan. O'sish va rivojlanish tezligida*

farq qiluvchi ikki mavsumiy avlod populyatsiyalarida mavjudlikning moslashuv roli belgilab berilgan. **Kalit so'zlar:** Orolbo'yi, populyatsiya dinamikasi, populyatsiya, ko'payish, avlod

Резюме: В статье приводятся результаты анализ динамики численности популяции малого тушканчика (*Allactaga Elater*) в условиях Приаралья. Установлено, что интенсивность размножения молодых самок находится в обратной зависимости от плотности популяции. Адаптивная роль существования в популяциях двух сезонных генераций, различающихся скоростью роста и развития.

Kalit so'zlar: Orol dengizi, raqamlar, aholi, ko'payish, avlod dinamikasi.

Ключевые слова: Приаралье, динамика численности, популяция, размножение, генерация.

**RECEIVING A SODO-SULFATE MIXTURE FROM MIRABILITE OF THE TYUMRUK
BIRTHPLACE FOR GLASS MAKING**

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Summary: *This article describes the possibilities of obtaining a soda-sulfate mixture from mirabilite by its heat treatment followed by its treatment with recycle gases.*

Keywords: *Soda, process, soda-sulfat, mineral, Chemical, temperature.*

Soda ash and sodium sulfate are used in large quantities in glass production [1-2], and their production is accompanied by high energy and resource costs, as well as environmental consequences [3-5]. Soda ash in particular is characterized by the close connection of ongoing processes, the disruption of the regime at one stage of the process inevitably disrupts the normal rhythm of the entire production, which ultimately affects the quantity of the product. In addition, soda production is characterized by a large amount of industrial wastewater and waste, which do not yet have effective methods. Such disadvantages are also dry for a typed product such as sodium sulfate. On the other hand, soda-sulfate mixture is increasingly used in the production of glass - both a finished industrial product [6] and industrial waste [7].

This article describes the possibilities of obtaining a soda-sulfate mixture from mirabilite by heat treatment, and then recycling it with recycled gases.

It is known that sodium sulfate minerals occur in nature in the form of simple salts: Na_2SO_4 (thenardite), $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ (mirabilite), as well as double salts: $\text{Na}_2\text{SO}_4 \cdot \text{MgSO}_4 \cdot 4\text{H}_2\text{O}$ (astrakhanite), $\text{Na}_2\text{SO}_4 \cdot 3\text{K}_2\text{SO}_4$ (glaserite), $\text{Na}_2\text{SO}_4 \cdot \text{CaSO}_4$ (glauberite), $2\text{Na}_2\text{SO}_4 \cdot \text{Na}_2\text{CO}_3$ (berkeite). They can be represented by three groups of deposits [8-11]:

- solid deposits of glauberite, astrakhanite, mirabilite and thenardite in the form of layers and lenses in halogen layers;
- lake deposits, which are surface and bottom (intercrystalline) brines with mirabilite and bottom sediments of mirabilite and astrakhanite;
- underground salt springs enriched with sulfate compounds.

In addition, the waters of seas and oceans are an inexhaustible source of sodium sulfate.

Geographically, sulfate deposits are limited to the arid zone. In the CIS, the largest number of them is located in the Caspian, Arol, Balkhash regions, Western Siberia and Tien-Shan [11-12].

The objects of research were the natural wonder of the Tumryuk deposit located in the Kungrad region of the Republic of Karakalpakstan [5]. Dense, sticky sandy clay and clay soils up to 1 m thick cover the salt deposits of the mine. 40-80% of the surface of the stone is covered with a thin, up to 5 cm, loose white coating of thenardite flakes. The underground rocks are represented by sand, suspension, clay layers with a thickness of 7-8 m. The deposits are mainly composed of uneven granular aggregates of mirabilite. In the most studied Northern mine, the thickness of salts is from 0.4 to 2.2 m, in the South - 1.8-1.9 m, in the East - 1.9-2.8 m. The amount of Mirabit is from 70 to 98, 7% (mean 90.53). %, gypsum 0.1-8.3% (average 2.48%), epsomite ($\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$) - 0.06-2.40% (average 0.72%), halite 0.2 -0.3%. The amount of residue insoluble in salts is on average 6.0-12.0%.

The Severnaya place has 11.4 million tons of salt reserves, an average mineral thickness of 1.5 m, an average mirabilite content of 92.85% and a mass density of 1310 kg/m³. The projected resources of the South and East places are 2.0 million tons, with an average mirabilite grade of 80.9 and 82.9%, respectively [13, 14].

Research methods.

In quantitative chemical analysis, the amount of sodium and calcium was determined by flame photometry [14-15]. The amount of sulfate ion was determined by gravimetric method [16]. Determination of CO₂ was carried out by volumetric method [16]. Determination of solid phases was carried out by chemical, X-ray phase, infrared spectroscopic and thermogravimetric methods.

X-ray phase analysis was performed on a Dron-3 diffractometer using filtered copper radiation at a voltage of 40 kV, a current of 20 mA and a counter speed of 2 deg/min [17]. The values of the interplane spacings were found according to the reference angle [18-19] and the intensity of the diffraction lines was evaluated on a hundred-point scale. IR spectroscopic analysis was conducted to determine the nature of the interaction between the components of the mixture. The IR absorption spectra of the studied compounds were recorded on SPECORD-75 IR in the frequency range of 400-4000 cm⁻¹. Samples were prepared by pressing tablets with KBr [20].9

Experiments on the production of soda water were carried out in the laboratory set-up shown in Figure 2. one.

A sample mixture of return gases is obtained by mixing CO₂ coming from cylinder (1) through mercury flow meter (4) with CO₂ coming from cylinder (2) through mercury flow meter (5) and N₂ coming from cylinder (3) through the mercury flow meter (6), in the mixer (7). The resulting model mixture enters the reactor (8) with a known ratio of components. The reactor is a quartz tube with a diameter of 28-30 mm, which has a perforated plate (9) on which sodium sulfate is placed

The reactor is installed in an electric furnace (10), where the set temperature is maintained using an autotransformer (11). The temperature is measured by a THA type thermocouple (12) and a millivoltmeter (13).

The sulfur dioxide gas produced in the reactor was passed through traps (14) with alkali for absorption. The following composition of gas mixtures listed in Table 1 was used in the work.

Table 1.

Р _{парц.}	№ mixtures					
	1	2	3	4	5	6
N ₂	0,6529	0,6930	0,7248	0,7506	0,7719	0,7900
CO ₂	0,0000	0,0614	0,1101	0,1496	0,1825	0,2100
CO	0,3471	0,2456	0,1651	0,0998	0,0456	0,0000

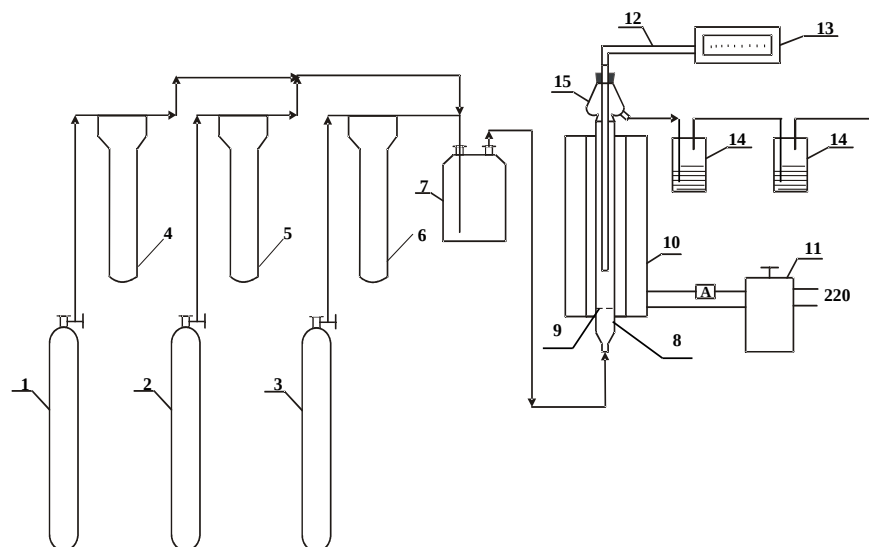
Table 2 shows the results of the chemical composition of the solid phase depending on the CO/CO₂ ratio.

Table 2.

Chemical composition of the solid phase depending on the CO/CO₂ ratio.

Time, min	Ratio CO/CO ₂	Losses masses, %	Na ₂ O, masses. %	SO ₃ , masses. %	CO ₂ , masses. %
5	0,1	2,87	44,95	51,44	3,61
	0,2	4,95	45,94	47,69	6,37
	0,3	6,86	46,88	44,12	9,01
	0,4	8,37	47,65	41,19	11,16
	0,5	9,55	48,27	38,81	12,91
	0,6	10,63	48,86	36,60	14,55
	0,67	11,26	49,20	35,28	15,52
10	0,1	3,80	45,39	49,78	4,83
	0,2	9,35	48,16	39,22	12,61
	0,3	11,09	49,10	35,65	15,25
	0,4	11,69	49,44	34,37	16,18
	0,5	12,07	49,65	33,57	16,78

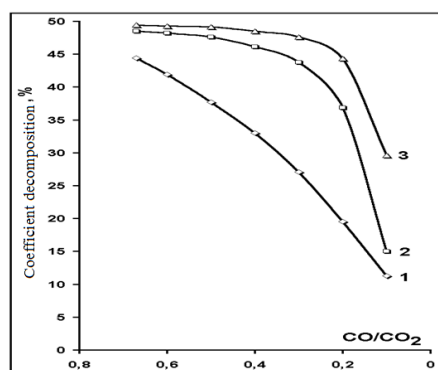
	0,6	12,22	49,74	33,25	17,02
	0,67	12,29	49,78	33,08	17,14
20	0,1	7,52	47,21	42,86	9,94
	0,2	11,24	49,19	35,34	15,48
	0,3	12,07	49,65	33,57	16,78
	0,4	12,29	49,78	33,08	17,14
	0,5	12,47	49,88	32,70	17,42
	0,6	12,50	49,89	32,65	17,46
	0,67	12,55	49,92	32,54	17,54



Picture. 1. Scheme of a laboratory device for the production of soda from sodium sulfate.

1 - cylinder with CO; 2 - cylinder with CO₂; 3 - cylinder with N₂; 4 - mercury flow meter for CO; 5 - mercury flow meter for CO₂; 6 - mercury flow meter for N₂; 7 - mixer; 8 - reactor; 9 - perforated plate; 10 - electric oven; 11-autotransformer;12-THA type thermocouple; 13-millivoltmeter; 14-trap

On picture. 2 shows the effect of the CO/CO₂ ratio on the degree of conversion of sodium sulfate to sodium carbonate.



Picture 2. Dependence of the degree of sodium sulfate decomposition on the CO/CO₂ ratio at different times of treatment with a gaseous reductant: 1 - 5 minutes, 2 - 10 minutes, 3 - 20 minutes.

As can be seen from the figure, an increase in the CO / CO₂ ratio from 0.1 to 0.2 with a five-minute treatment leads to an increase in the decomposition coefficient by 72.77%, when the CO / CO₂ ratio exceeds 0.2. by 0.3 - by 38.54%, CO/CO₂ ratio from 0.3 to 0.4 - by 21.91%,

CO/CO₂ ratio from 0.4 to 0.5 - by 14.21%, increase with CO / CO₂ ratio CO₂ from 0.5 to 0.6 - by 11.30%.

An increase in the CO / CO₂ ratio from 0.1 to 0.2 with a ten-minute treatment leads to an increase in the decomposition coefficient by 145.93%, and a CO / CO₂ ratio from 0.2 to 0.3 - by 18.57% . Increase of CO/CO₂ ratio from 0.3 to 0.4 - by 5.44%, CO/CO₂ ratio from 0.4 to 0.5 - by 3.21%, CO/CO₂ ratio from 0.5 to 0 up to .6 - an increase of 1.26%.

With a twenty-minute treatment, an increase in the CO / CO₂ ratio from 0.1 to 0.2 leads to an increase in the decomposition coefficient by 49.51%, and a CO / CO₂ ratio from 0.2 to 0.3 - by 7.38%. Increase in CO/CO₂ ratio from 0.3 to 0.4 - by 1.89%, CO/CO₂ ratio from 0.4 to 0.5 - by 1.42%, CO / CO₂ ratio from 0.5 to 0 with an increase of up to .6. - by 0.20%.

Regarding the increase in the degree of decomposition with the increase in the duration of interaction at the same ratio of CO / CO₂, the following can be noted: with an increase in the interaction time in the ratio of CO / CO from 5 to 10 minutes. CO₂ = 0.1, the decomposition coefficient increases by 32.63%, in the ratio CO / CO₂ = 0.2 - by 88.79%; With a ratio of CO / CO₂ = 0.3 - by 61.58%; with a ratio of CO / CO₂ = 0.4 - by 39.76%; With a ratio of CO / CO₂ = 0.5 - by 26.29%; With a ratio of CO / CO₂ = 0.6 - 14.90%; With a ratio of CO / CO₂ = 0.7 - 9.16%.

With an increase in the interaction time from 10 to 20 minutes with a ratio of CO / CO₂ = 0.1, the decomposition coefficient increases by 97.67%, with a ratio of CO / CO₂ = 0.2 - by 20.17%; with a ratio of CO / CO₂ = 0.3 - 8.82%; with a ratio of CO / CO₂ = 0.4 - 5.16%; with a ratio of CO / CO₂ = 0.5 - 3.34%; with a ratio of CO / CO₂ = 0.6 - 2.26%; With a ratio of CO / CO₂ = 0.7 - 2.04%.

If we talk about increasing the interaction time from 5 to 20 minutes with a ratio of CO / CO₂ = 0.1, then the decomposition coefficient is 162.16%, with a ratio of CO / CO₂ = 0.2 - 126, increases by 87%; with a ratio of CO / CO₂ = 0.3 - by 75.84%; with a ratio of CO / CO₂ = 0.4 - by 46.97%; With a ratio of CO / CO₂ = 0.5 - 30.51%; With a ratio of CO / CO₂ = 0.6 - 17.50%; With a ratio of CO / CO₂ = 0.7 - 11.39%.

Table 3 shows the results of the chemical composition of the solid phase depending on the duration of interaction of the CO/CO₂ gas mixture with sodium sulfate.

In the form. Figure 3 shows the effect of the duration of interaction of the CO/CO₂ gas mixture with sodium sulfate on the degree of conversion of sodium sulfate to sodium carbonate.

It can be seen from the figure that the decomposition coefficient increased to 127.39% as the CO/CO₂ ratio increased from 0.15, interaction time from 2 to 5 minutes, interaction time from 5 to 10 minutes. stretched. - by 32.91%, with an increase in time from 10 to 15 minutes - by 19.51%, time from 15 to 30 minutes - by 26.65%, time from 30 to 45 minutes - by 10.26%; with an increase in time from 45 to 60 minutes - by 5.02%.

When the CO/CO₂ ratio is 1.0, the decomposition coefficient increases to 93.17% when the interaction time increases from 2 to 5 minutes, and 20 when the interaction time increases from 5 to 10 minutes. will increase by 48%. From 10 to 15 minutes - by 13.81%, when the time increases from 15 to 30 minutes - by 16.15%, when the time increases from 30 to 45 minutes - by 3.81%; with an increase in time from 45 to 60 minutes - by 4.96%.

When the CO/CO₂ ratio is 2.0, the decomposition coefficient increases to 79.80% when the interaction time increases from 2 to 5 minutes, and 18 when the interaction time increases from 5 to 10 minutes. 05%, increases with growth. in the time from 10 to 15 minutes - by 11.36%, when the time increases from 15 to 30 minutes - by 11.18%, when the time increases from 30 to 45 minutes - by 3.86%; with an increase in time from 45 to 60 minutes - by 2.78%.

Table 3

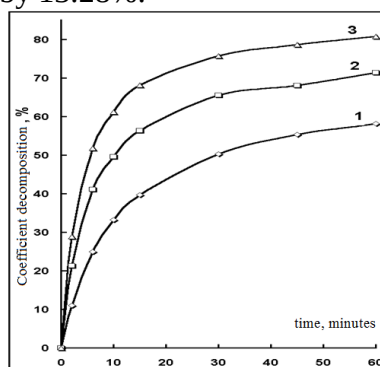
Chemical composition of the solid phase depending on the duration of interaction of the CO/CO₂ gas mixture with sodium sulfate.

Rario CO/CO ₂	Time, min	Losses masses, %	Na ₂ O, masses. %	SO ₃ , masses. %	CO ₂ , masses. %
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0,15	2	2,78	44,91	51,60	3,49
	5	6,32	46,61	45,14	8,25
	10	8,41	47,67	41,11	11,22
	15	10,05	48,54	37,80	13,66
	30	12,74	50,03	32,12	17,85
	45	14,03	50,79	29,25	19,96
	60	14,74	51,21	27,66	21,13
1,0	2	5,40	46,15	46,86	6,98
	5	10,42	48,74	37,05	14,21
	10	12,56	49,93	32,52	17,55
	15	14,29	50,94	28,68	20,38
	30	16,60	52,35	23,32	24,33
	45	17,24	52,75	21,78	25,46
	60	18,09	53,30	19,70	27,00
2,0	2	7,31	47,10	43,26	9,64
	5	13,13	50,26	31,27	18,47
	10	15,50	51,67	25,91	22,42
	15	17,27	52,77	21,72	25,51
	30	19,20	54,03	16,92	29,05
	45	19,94	54,53	15,02	30,44
	60	20,48	54,91	13,61	31,49

Regarding the increase in the level of decomposition with an increase in the CO / CO₂ ratio with the same duration of interaction, the following can be noted: with an increase in the CO / CO₂ ratio from 0.15 to 1.0 at the time of 2 interaction. minute, the decay coefficient increases by 93.85%, and the interaction time increases by 64.68% at 5 minutes; interaction time with 10 minutes - by 49.28%; interaction time with 15 minutes - by 42.15%; interaction time with 30 minutes - by 30.37%; interaction time with 45 minutes - by 22.75%; interaction time with 60 minutes - by 22.68%.

With an increase in the CO / CO₂ ratio from 1.0 to 2.0 with an interaction time of 2 minutes, the decomposition coefficient is 35.37%, with an interaction time of 5 minutes - 25, increases by 99%; interaction time with 10 minutes - by 23.45%; interaction time with 15 minutes - by 20.80%; interaction time with 30 minutes - by 15.62%; interaction time with 45 minutes - by 15.68%; interaction time with 60 minutes - by 13.28%.



Picture 3. The degree of decomposition of sodium sulfate depends on the duration of interaction of the CO/CO₂ gas mixture with sodium sulfate in the CO/CO₂ ratio: 1 – 0.15; 2 - 1.0; 3 - 2.0.

Table 4 shows the results of the chemical composition of the solid phase depending on the temperature of the CO/CO₂ gas mixture and the CO/CO₂ ratio = 0.67.

It can be seen from the figure that the increase in temperature from 300°C to 400°C with five minutes of processing leads to an increase in the decomposition coefficient by 1.92%, the temperature increases from 400°C to 500. °C - by 2.88%, when the temperature rises from 500 °C to 600 °C - by 3.36%, when the temperature rises from 600 °C to 700 °C - by 6.60%, when the temperature rises from 700 with increase from °C to 800 °C - by 9.72%.

An increase in the temperature from 300 °C to 400 °C with a ten-minute treatment leads to an increase in the decomposition coefficient by 2.76%, from 400 °C to 500 °C - by 6.48%, with a temperature of 500 °C to 600 °C - by 13.56%, with an increase in temperature from 600 °C to 700 °C - by 5.27%, with an increase in temperature from 700 °C to 800 °C - by 3.25%.

Table 4

Chemical composition of the solid phase depending on the temperature of the CO/CO₂ gas mixture.

Time, min	Temperature, °C	Losses masses, %	Na ₂ O, masses. %	SO ₃ , masses. %	CO ₂ , masses. %
5	250	1,92	44,51	53,10	2,39
	300	2,31	44,69	52,41	2,89
	400	2,80	44,92	51,56	3,52
	500	3,53	45,26	50,27	4,47
	600	4,38	45,66	48,74	5,60
	700	6,05	46,47	45,65	7,88
	800	8,52	47,73	40,89	11,38
10	250	3,53	45,26	50,27	4,47
	300	4,11	45,53	49,23	5,24
	400	4,81	45,86	47,96	6,17
	500	6,45	46,67	44,90	8,43
	600	9,89	48,45	38,14	13,41
	700	11,22	49,18	35,37	15,45
	800	12,05	49,64	33,62	16,74
20	250	8,52	47,73	40,89	11,38
	300	9,07	48,01	39,80	12,19
	400	9,73	48,37	38,45	13,18
	500	11,32	49,23	35,17	15,60
	600	12,69	50,00	32,24	17,76
	700	13,49	50,47	30,48	19,06
	800	13,90	50,71	29,55	19,74

An increase in the temperature from 300 °C to 400 °C with a twenty-minute treatment leads to an increase in the decomposition coefficient by 2.64%, from 400 °C to 500 °C - by 6.24%, with a temperature increase from 500 °C to 600 °C - by 5.40%, with an increase in temperature from 600 °C to 700 °C - by 3.16%, with an increase in temperature from 700 °C to 800 °C - by 64%.

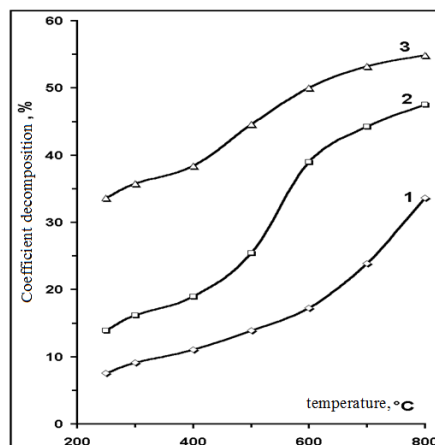
Regarding the increase in the degree of decomposition with increasing duration of interaction at the same temperatures, the following can be noted: the coefficient of decomposition increases as the interaction time increases from 5 to 10 minutes at 250 °C. 84.13%, at 300 °C - 77.63%; at 400 °C - by 71.74%; at 500 °C - by 82.76%; at 600 °C - by 125.69%; at 700 °C - by 85.38%; At 800 °C - by 41.43%.

With an increase in the interaction time from 10 to 20 minutes at 250 °C, the decomposition coefficient increases by 141.38%, at 300 °C - by 120.74%; at 400 °C - by 102.53%; at 500 °C - by

75.47%; at 600 ° C - by 28.31%; at 700 ° C - by 20.17%; At 800 ° C - by 15.40%. It should be noted that the temperature should not exceed 850 ° C to prevent the dissolution of sodium sulfate and carbonate.

In the picture. 4 shows the effect of the temperature of the CO/CO₂ gas mixture on the degree of conversion of sodium sulfate to sodium carbonate.

Picture 4. The dependence of the degree of decomposition of sodium sulfate on the temperature of the gas mixture and the interaction time in the ratio CO/CO₂ = 0.67: 1 - 5 minutes, 2 - 10 minutes, 3 - 20 minutes.



Analysis of the gas phase leaving the furnace showed that sulfur is released mainly in the form of SO₂. In the first minutes of the experiment (batch process), the amount of SO₂ in the gas phase briefly reached 3.5-4.3%, and then decreased. As the concentration of reducing agents increases in the gas phase (CO/CO₂ - 0.67), part of the sulfur is released in the form of H₂S. Calculations made it possible to determine that in an industrial fluidized bed furnace, the specific loading volume reaches 1000 kg / (m² h) or more, and the SO₂ content in the gas phase is 9-11%.

Thus, the process of converting sodium sulfate to soda ash and sulfur dioxide is effective (especially when gas reducing agents are used) and should be continued in laboratory tests and integrated model tests.

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Rezyume: Ushbu maqolada mirabilitdan soda-sulfat aralashmasini issiqlik bilan ishlov berish, so'ngra uni qayta ishlangan gazlar bilan qayta ishlash orqali olish imkoniyatlari tasvirlangan.

Резюме: В данной статье изложены возможности получения содо-сульфатной смеси из мирабилита путём его термической обработки с последующей обработкой его ретурными газами.

Kalit so'zlar: Soda, jarayon, soda-sulfat, mineral, Kimyoviy, harorat.

Ключевые слова: Сода, процесс, сода-сульфат, минеральная, химическая, температура.

TECHNICAL SCIENCES

ADVANCED WORK PRACTICES FINISHING WORKS

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Summary: *This article describes the international standard of quality of building materials in modern construction production, as well as competitive finishing materials and equipment, including the complex system of KNAUF, one of the world's leading manufacturing organizations, and normative technical documents.*

Key words: *finishing materials, cement plastering, plastering, pallet, foam concrete, foam polystyrene, adhesion.*

In modern conditions, the production of building materials must comply with international quality standards. It requires not only the modernization of obsolete equipment and the production of new competitive finishing materials, but also knowledge of their properties for further proper use at the construction site. Leading foreign firms - manufacturers of modern finishing materials, such as KNAUF, from the beginning of the 1990s began to invest in the domestic industry, reconstruct old enterprises, build new factories, stimulating the development of the construction industry in Uzbekistan.

In addition to the production of high quality materials, Knauf specialists are working to make building finishing processes more efficient by creating complete systems and developing regulatory and technical documentation for them.

Finishing materials are designed to improve the architectural, decorative and operational properties of buildings and structures, to protect structures from atmospheric and other influences.

KNAUF-MP 75 is a dry plaster mixture based on a gypsum binder with polymer additives. Designed for high-quality plastering of walls and ceilings by machine, for example, using plastering machines PFT G5, PFT G4, PFT Monojet, which provides a significant superiority in productivity compared to manual, especially with large volumes of work. Can be applied to all common solid substrates (masonry, cement plaster, concrete, etc.).

Specifications:

Minimum layer thickness: 5mm

Max: 30mm

Bulk weight: 850kg/m³

Grain size: up to 1.2mm

Solution output: 100kg=120l

Consumption: $\approx 10\text{kg/m}^2$

Drying: ≈ 7 days

Compressive strength: 3.8MPa

Bending: 1.9MPa

Density: $\approx 1000\text{kg/m}^3$

Thermal conductivity coefficient: 0.35W/m k

Storage - bags with dry mix KNAUF-MP 75 should be stored in dry rooms on wooden pallets. Pour the material from damaged bags and use it first. Shelf life in undamaged packaging is 6 months.

Surface preparation: Cleaning - the substrate must be dry with a temperature not lower than +5°C. Clean the surface from dirt, dust and delaminations, if necessary, clean the concrete from the remnants of formwork lubricant. Remove protrusions, protect metal elements from corrosion.

Priming - highly absorbent surfaces, such as silicate and ceramic bricks, aerated concrete, are primed with a brush, roller or sprayer with a Knauf-Grundirmittel primer to prevent uneven setting of the plaster mortar.

Dense, water-absorbing substrates, such as concrete, cement plasters, foam concrete, expanded polystyrene, are treated with a Knauf-Betokontakt primer to improve the adhesion (adhesion) of the plaster to the surface.

Allow primer to dry after application. Avoid dusting the primed surface.

Order of plastering works: Preparation for work. Works on machine plastering are carried out, as a rule, as part of a team of plasterers. Prepare the plastering machine for work according to the "Operating Instructions". Pour dry mixture KNAUF-MP 75 into the receiving hopper. Set the water flow according to the required mortar consistency.

Surface grouting - if the surface is to be prepared for painting or wallpapering, then after a short exposure (about 15 minutes), the surface of the plaster must be moistened with water and rubbed in a circular motion with a hard sponge or felt trowel to even out possible irregularities and traces of a trapezoid rail or a wide spatula.

Smoothing the surface - after a short exposure, until a matte surface appears, smooth the plaster with a wide spatula or a stainless metal trowel (trowel) with wide movements. Wallpaper can be glued to such a surface. To achieve a glossy surface, it is necessary during the day, but not earlier than 5 hours after the dry mixture has been mixed, to moisten the plaster again abundantly and smooth it again with a grater. After this treatment, it is not necessary to putty the surface of the plaster, it is suitable for high-quality painting.

After smoothing the surface of the ceilings, cut the plaster layer with a Stukzege saw to the full depth along the entire perimeter of the room to prevent cracking.

The advantage of Knauf gypsum plaster mixtures is as follows:

- ideal for leveling various wall and ceiling substrates (concrete, ceramic and sand-lime bricks, aerated and foam concrete, old and new cement plaster, CSP) before applying decorative coatings (paints, structural plasters, wallpaper, tiling, etc.). They allow to obtain absolutely even and smooth (glossy) surfaces that do not need to be additionally puttyed or sanded; consumption with the same thickness of the plaster layer is 2 ... 3 times less than that of cement-sand mixtures. This means that with the same amount of dry mix, you can plaster a 2-3 times larger surface and save money; very high productivity of plastering works.

One plasterer per shift is able to manually plaster up to 15 sq.m. (150 sq.m. by machine) with a layer thickness of 20 ... 30 mm and bring the surface to gloss for high-quality painting, while cement-sand mixtures for the same period you can plaster no more than 6 ... 7 square meters, in addition, it is still necessary to perform a puttying operation. It should also be noted that the greater the thickness of the plaster layer, the more time must be spent on leveling the same 6 ... , 30 mm, three bastings should be made with each exposure until hardening (about a day) before applying the next one; due to the low density of Knauf gypsum plasters, they can be easily applied to the surface in thicker layers without prior spraying. For one basting, it is possible to apply up to 30 mm manually and by machine; high adhesion and low specific gravity of plasters makes it possible to use "Rotband" for plastering smooth, poorly absorbent concrete ceilings, as well as deformable and flexible bases (DSP, polystyrene foam, etc.); regulate the humidity regime in the room, creating a favorable microclimate, as they are able to absorb (absorb) excess moisture in the air and store it, and if necessary, give it back; have low thermal conductivity ($A, = 0.25 \text{ W / m} \cdot \text{K}$), against ($R, = 0.6 \dots 0.7 \text{ W / m} \cdot \text{K}$) cement plasters and are good heat insulators that prevent heat loss, so the surfaces walls and ceilings, plastered with gypsum plasters, warm to the touch;

- do not shrink and do not form cracks, which ensures high surface quality, strong adhesion to the base and reliability;

- plaster mortars have a high water-holding capacity, which allows them not to delaminate and not dehydrate during application and processing, even on porous, moisture-absorbing substrates

and at elevated temperatures. As a result, the solutions retain high plasticity, are easily processed, adhere strongly to the base and gain the declared strength;

- they dry quickly, because after hardening (after 3 ... 4 hours) they can be dried, and not kept in humid conditions for several days, which is necessary for cement plasters, otherwise they will not gain the necessary strength. Therefore, the technological break before the final fine finish (painting, wallpapering, etc.) for gypsum plasters is much shorter;

- surfaces of gypsum plasters have high adhesion and are compatible with any type of decorative coating (paints, structural plasters, wallpaper and tile adhesives, etc.);

- convenient in the manufacture of decorative elements (stucco moldings) and carrying out repair and restoration work;

- are made of an environmentally friendly natural mineral and do not contain substances harmful to health.

In order for gypsum plasters to meet the indicated advantages, it is necessary to carry out plastering work by highly qualified plasterers. The technology of using gypsum plaster mixtures is somewhat different from working with cement mixtures. It is mandatory to have a complex - a special tool that includes a container (tank) and a mixer for preparing a solution, a rule for leveling, various spatulas and graters to make the surface smooth (gloss). All tools must be made of stainless materials (steel, plastic or other materials) to avoid rust stains on the surface of the plaster.

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Rezyume: *Ushbu maqolada zamonabiy qurilish ishlab ziqarishda qurilish materiallari sifatining jahon standartiga hamohangligi, shunindek raqobatbardosh fardozlash materiallari ba uskunalari, jumladan dunyoning etakshi ishlab shiqariybzi tashkilotlardan biri KNAUF majmualii sistemasi ba normatib tehnik hujjatlar tugrisida baen qilingan.*

Резюме: *В данной статье описаны международный стандарт качества строительных материалов в современном строительном производстве, а также конкурентоспособные отделочные материалы и оборудование, в том числе комплексная система КНАУФ, одной из ведущих мировых производственных организаций, и нормативно-технические документы.*

Kalit so'zlar: *сувоқ аралашма, цементли сувоқ, таглик, пенобетон, пенополистирол, адгезия.*

Ключевые слова: *штукатурная смесь, цементная штукатурка, поддон, пенобетон, пенополистирол, адгезия.*

**DEVELOPMENT OF METHODOLOGICAL AND TECHNOLOGICAL SOLUTIONS FOR
FIXING PROMISING TYPES OF WAGONS ON RAILWAY STATION TRACKS**

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Summary: *The scientific work presents the development of a methodology for modeling and calculating the norms for fixing heterogeneous in length and innovative articulated rolling stock on railway station tracks. Schemes of application of forces acting on various wagons fixed on station tracks with a "mountain" profile have been developed. The development of a method for determining the combination of forces is proposed due to a more accurate iterative calculation of the resulting force acting on each axis of the fixed composition, and its summation taking into account the wind load. A program has been developed for calculating the rate of fastening of wagons. The developed method and the obtained values of the anchoring standards make it possible to exclude errors related to human and technological factors, as well as to provide an accurate calculation of the number of brake shoes, taking into account the physical data of the secured wagons and the characteristics of the longitudinal profiles of the track.*

Key words: *innovative rolling stock, physical and mathematical model, brake shoe, longitudinal track profile, force application, scheme fixing standards*

INTRODUCTION

The operational activity of railway transport is inherently connected with ensuring traffic safety. State standards, rules, instructions [1-4] and other regulatory documents on the safety of station transport and technological processes, standards for securing rolling stock, labor protection, etc. require immutable execution. It should be taken into account that violations of the standards of securing can lead to unauthorized movement of rolling stock, to calculate the damage from which it is often not possible due to consequences of a crash or accident (fig. 1).

At present, the calculation of fixing of perspective (articulated) freight rolling stock heterogeneous in length on station receiving and forwarding tracks of variable profile is of particular importance. Existing methodological solutions for the calculation of fixing standards require improvement in terms of calculating the number of brake shoes due to the heterogeneity of the profiles of station tracks. The analysis of 153 longitudinal profiles of the receiving and sending tracks of 6 main stations of JSC "UTI" showed that 45% of the profiles of the tracks belong to the "mountain" type, 23% - to the monotone type, 20% – to the sawtooth and 12% – to the concave. It is known that the most problematic type of the longitudinal profile of the same road track, on which it is necessary to secure the rolling stock, from the point of view of the safety of station technological processes, is the longitudinal profile of the "mountain" type. It is this type of longitudinal profile that prevails on the tracks of the stations under consideration.

The study of the issues of securing rolling stock was started from the moment of the construction of the first railways. The national scientific experience in this direction was founded by the works of famous scientists – Doctors of Technical Sciences S. D. Ko-reishi, V. N. Obratsov, V. N. Nikitin, P. Sheikin, E. A. Sotnikov, V. K. S. Isaev, Candidates of Technical Sciences V. A. Rudanovsky, I. P. Starshov, M. V. Strelkov, V. A. Burakov, S. K. Tsymbalov, engineer N. I. Paches, etc. In the leading research institutes and universities of the country (VNIIZHT, NIIS, RUT (MIIT), etc.), research is continuing on the problems of securing wagons within the framework of scientific schools (Prof. I. N. Rosenberg, V. M. Lisenkov, A.M. Zamyshlyayev, I. A. Olgeizer, N. A. Kovalenko, R. A. Efimov, V. A. Kobzev, A.V. Savrukhin, etc.).

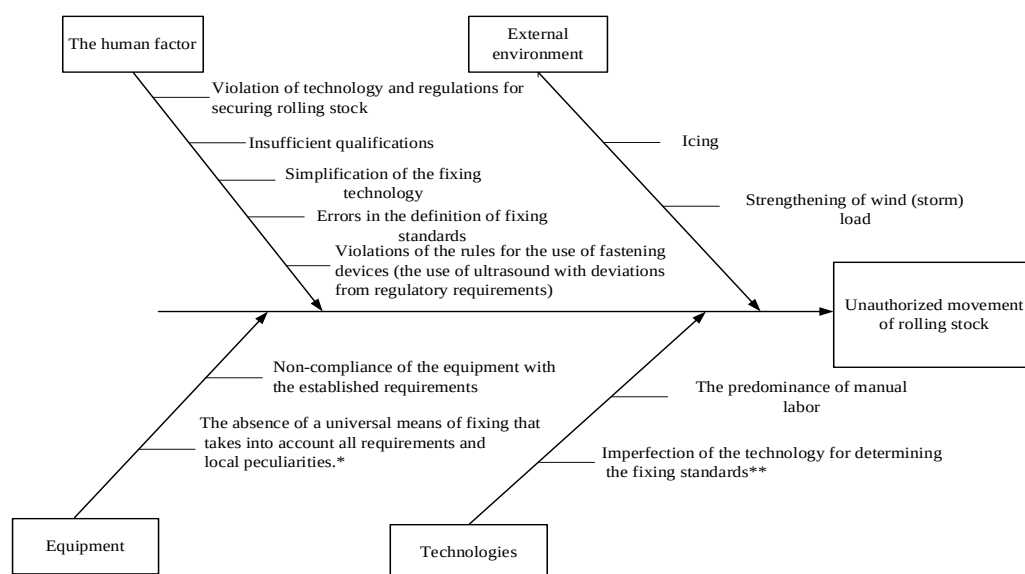


Fig. 1. Diagram of cause-and-effect relationships of spontaneous departure of rolling stock

* Each fastening device has a list of positive characteristics, but there are also disadvantages. For example, a brake shoe is a simple, universal tool, but it does not allow fixing rolling stock on tracks with slopes greater than 2.5 %, not equipped with devices that protect the output of rolling stock on train routes, and also requires the use of manual labor. It is difficult to produce rolling wheel pairs on the runners of brake shoes when using them in an amount of more than 10 pcs.

** The anchoring standards contained in the technical regulations of the stations are calculated for trains of the same kind (number of axles and length along the axes of automatic couplings). However, it is required to calculate the fixing standards for rolling stock of various kinds (wagons of conditional length, short-wheelbase, long-wheelbase, passenger, etc.). Difficulties in calculations will be even more significant when the trains include promising articulated wagons and eight-axle rolling stock, i.e. different in the number of axles and the length of the coupling axes of automatic couplings. It is also difficult to calculate the norms of fixing shoes in an arbitrary place of the path having a longitudinal profile "mountain", as a result of which it is necessary to perform several calculations of the norms of fastening for the same path.

MATERIALS AND METHODS

Substantiation of the relevance of the development of the methodology for calculating the norms of consolidation. Currently, there are unresolved problems on the road network related to the calculation of the norms for securing rolling stock. The difficulty lies in the fact that the existing calculation method is relevant for trains consisting of wagons with the same lengths along the axes of automatic couplings and with the same number of axles, which make up about 20% of the total number of freight trains [5-7]. There are no fixing standards for trains consisting of different axles of wagons in length and number.

When freight trains and wagons of various lengths and weights are included in the trains, there is a risk that the fixing standards in some cases will be insufficient, and in some other cases they will be excessive. The most relevant is the number of trains, which include variants of a combination of types of multi-axle wagons, as well as promising articulated rolling stock on three two-axle bogies (for example, a six-axle hopper wagon for transporting mineral fertilizers and grain, model 19-6978-01 articulated type, lifting capacity 113.5 tons, packaging 35.8 tons; a six-axle tank wagon for the transportation of liquefied petroleum gases, model 19-9541-01 of the combined type, carrying capacity 90 tons, container 57.9 tons), especially if the junction of the wagons falls on a fracture of the profile of the "mountain" type.

The fixing standards must be determined individually for a particular train composition, depending on physical conditions. this problem is for station tracks with a longitudinal profile of the “mountain” type.

The existing calculation method does not allow determining the number of brake shoes required to secure freight trains, which include combinations of types of multi-axle wagons, as well as promising articulated rolling stock on three two-axle bogies (for example, a six-axle hopper wagon for transporting mineral fertilizers and grain, model 19-6978-01 articulated type, carrying capacity 113.5 tons, container 35.8 t; six-axle tank wagon for transportation of liquefied petroleum gases, model 19-9541-01 articulated type, load capacity 90 tons, container 57.9 tons), especially if the articulation of the wagons falls on the fracture of the profile type “mountain”.

The fixing standards must be determined individually for a particular train composition, depending on physical conditions.

Physical and mathematical model of fixed rolling stock. To solve this problem, the author's development of the existing method of calculating the anchoring norms is proposed, including a single methodological approach with two calculation options:

– The I-th version of the calculation is based on the use of the formulas given in [3], taking into account the iterative wagon calculation of the means of fixing and the values of the average slopes of the track (for homogeneous rolling stock or close to homogeneous) [7];

–The II-th version of the calculation is based on the use of formulas for determining the forces acting on static rolling stock the composition, and in the author's interpretation of the iterative axial calculation of the means of fastening, depending on the slopes under each axle of the wagon (for different-native and articulated rolling stock).

The diagram of the application of forces acting on the fixed rolling stock is shown in Fig. 2.

In both variants, it is necessary to determine the slopes on which each mobile unit of the fixed composition is located. In the first variant, a wagon is used as a unit when it is necessary to determine the slope, including a straightened one. When placing the wagon on the profile elements with different slopes, it is necessary to determine the straightened slope, determined by the length of the wagon along the axes of the automatic coupling.

In the second variant, each axle of the wagon is taken as a unit separately, when the magnitude of the forces acting on the rolling stock is determined: the braking force of the shoes when starting from a place, the friction force of the train when starting from a place, the resulting force of air pressure along the track, the tangential component of the gravity of the train. When calculating the tangential component of the gravity of the train, the effect of this force for each axle of the wheelset of the wagon is considered separately, and then the summation of these forces is performed.

The forces acting on the stationary (fixed) rolling stock on the station track must satisfy the equilibrium condition

$$\sum F_o + \sum W_{fr} = W_{vn} + \sum Q_{\tau} \quad (1)$$

where $\sum F_o$ – is the braking force of the shoes when starting from a place;

$\sum W_{fr}$ – is the friction force when starting from a place;

W_{vn} – is the component of the air pressure force along the track;

$\sum Q_{\tau}$ – is the tangential component of gravity calculated for each axis of the wagon separately.

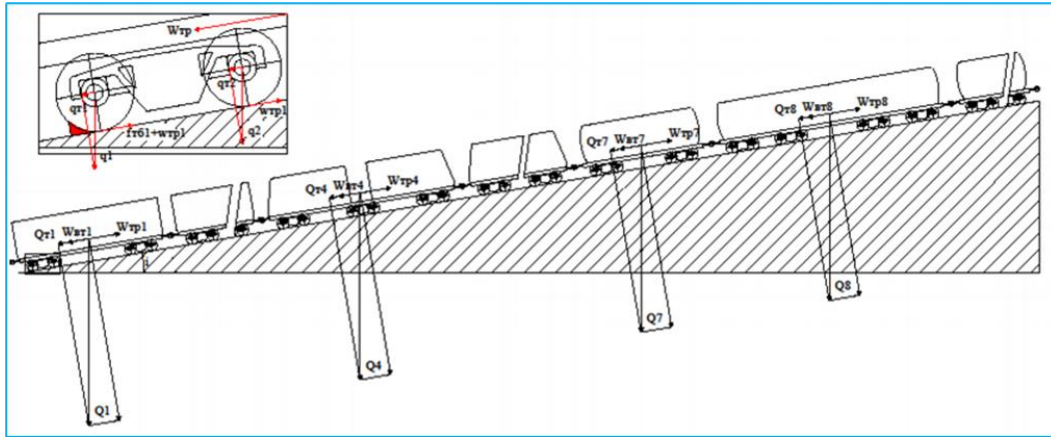


Fig. 2. Diagram of the application of forces on the fixed freight train

The values of the forces are determined by the formulas[11]:

$$\sum F_o = \sum_{i=1}^{k_s} f_{oj} q_{oj} 10^3 \quad (2)$$

$$\sum W_{fr} = \sum n q_i w_{fr} \quad (3)$$

$$\sum W_{vn} = \frac{17(4C_x + (n-4)C_{xx})S}{4(273+t)} v_{vn}^2 \quad (4)$$

$$\sum Q_{\tau} = \sum n q_i i \quad (5)$$

Where k_s – number of brake lining;

f_{oj} – is the coefficient of friction of steel on steel;

q_{oj} – axle load, which put a brake shoe, t/axle;

n – number of axles of rolling stock;

q_i – axle load with a - rod, t/axle;

w_{fr} – resistivity with composition when starting off kgf/ts;

C_x – coefficient of air resistance of a single wagon;

C_{xx} – coefficient of air resistance of a group of wagons in the middle of the train;

S – midsection (cross-sectional area) of the wagon, m²;

t – air temperature, ° C;

v_{vn} – wind speed, m/s;

i – the slope of the path.

Since in practice the fixing conditions differ from the calculated (ideal) ones, for the reliability of the fixing standards, we will introduce an additional correction – the standard deviations of the resistivity of the friction forces when starting the train from the place and the braking force of the shoes when starting from the place, proposed in [8-10].

Taking into account the standard deviations of the resistivity of the friction forces when starting the train from the place and the braking force of the shoes when starting from the place, the equilibrium equation (1) will take the form [11]

$$\sum n q_i i + \frac{17,8(4C_x + (n-4)C_{xx})S}{4(273+t)} v_{vn}^2 = q_{oj} 10^3 + \sum n q_i w_{fr} - t_x \sqrt{\sum_{i=1}^{k_s} \sigma_{fj}^2 q_{oi}^2 10^6 + n n \sigma_w^2 q_i^2} \quad (6)$$

is the standard deviation of the coefficient of braking action of the shoe

Where σ_{fj} – when starting from a place;
 σ_w – the standard deviation of the specific resistance of moving wagons, kgf/tp;
 t_x – a confidence interval equal to three.

Constant values are assumed to be equal to the values specified in the work [4]: $C_x = 1,76$, $C_{xx} = 0,88$, $S = 8,5 \text{ m}^2$, $f_{oj} = 0,15$, $w_{fr} = 1 \text{ kgf / tp}$, $t_x = 3$, $\sigma_{fj} = 0,55$, $\sigma_w = 0,25 \text{ kgf / tp}$.

To calculate the values of the braking forces of the shoes when starting from a place, the friction forces when starting the train from a place, the resulting force of air pressure along the path and the tangential component of gravity, it is necessary to determine the axial loads of the rolling stock. The difficulty is caused by the calculation of the impact of the tangential component of gravity, which must be determined for each axis separately. To determine this force, it is necessary to know the coordinate of each axis on the longitudinal profile of the path. Although these data are known and defined for each wagon operated on the JSC “UTY” network, they are not contained. To implement this technique, it is necessary to enter information about the distances of each axis of the wagon relative to the axes of the automatic couplings into the databases. To determine the tangential component of gravity, it is necessary to clarify the location of the composition relative to the elements of the longitudinal profile of the path. This operation can be performed by marking the installation locations of the extreme wagons on the tracks. Alternatively, it is possible to put a number of marks on the rail necks, which can be tied to the lengths of locomotives operated at stations, or to put markings in the fixing zone every 10 m. When fixing, it is necessary to install the rolling stock by combining the axis of the extreme automatic coupling with one of the marks. The placement of rolling stock is linked to the longitudinal profile of the track. Having information about the coordinates of each axis of the wagon, it is possible to determine the coordinates of the location of each axis of the fixed rolling stock relative to the elements of the longitudinal profile of the track, and then calculate the values of the slopes of the track on which each axis of the fixed train is located.

The algorithm of the modified calculation method and its approbation. To form an algorithm for determining the fixing standards, in addition to data on the location of each axis of the operated rolling stock, it is necessary to form an electronic array of information that should contain information about the characteristics of the longitudinal profiles of the tracks of stations and fix this information for each railway station separately. In order to improve the accuracy of the multivariate method of determining the norms of fixing rolling stock, a calculation program has been compiled in the MS Excel tabular processor. To increase the automation of the calculation, the proposed algorithm is planned to be used in a software package that will automatically load composition data from electronic systems operating in JSC “UTY”.

In the calculation algorithm, a condition is accepted under which the effect of the force of air pressure along the path will be independent of its direction, i.e. when determining the number of brake shoes to be laid from the head of the train, the condition of the effect of wind from the tail of the train to the head is accepted, and when determining the number of brake shoes from the tail of the train, the effect of from the air

It is accepted from the head to the tail on Wednesday. A condition has been introduced into the calculation algorithm under which the effect of wind occurs at an angle between the wind vector and the vector of the path axis equal to 30° . It is advisable to take into account the actual wind direction when its speed reaches values above 5-6 m/s.

Let's consider an example of calculating the fixing standards for the composition and on the path of the longitudinal profile.

The condition for the location of the rolling stock at the useful length boundary on the odd side is accepted. The calculation of the coordinates of each axis of the coiled pair of the wagons in question relative to the axes of the auto couplings is given in Table 1.

Table 1

Distance from axles of wagon couplings to axles of wheelsets, m

The ordinal number of the axis	Semiwagon	Four-axle tank	Eight-axle tank	Articulated six-axle wagon
1	1,71	1,185	1,14	1,825
2	3,56	3,035	2,99	3,675
3	10,36	8,985	5,265	8,845
4	12,21	10,835	7,115	10,695
5			14,93	15,865
6			16,78	17,715
7			18,13	
8			19,98	

Based on the data of the lengths of the wagons along the axes of the automatic couplings, the coordinates of each axis of the automatic coupling of the wagon of the train in question are determined. The calculation of the load on each axle of the wagons is given. Next, the slopes on which each axle of the wheelset of wagons is located are determined by determining the coordinates of their location on the longitudinal profile of the track. The calculations are summarized in table 2.

Table 2

Calculation of distances between the axle of the auto coupling of the head wagon to the axles of each wheel pair of subsequent wagons

Indicator	Wagon number								
	1	2	3	4	5	6	7	8	9
The distance of each axle of the wheelset relative to the coupling axis of the extreme from the head of the composition of the auto coupling of the wagon, m	1,71								
	3,56	15,63							
	10,36	17,48	29,55						
	12,21	24,28	31,4	43,585					
		26,13	38,2	45,435	63,125				
			40,05	50,605	64,975	82,665			
				52,455	70,145	84,515	101,57		
				57,625	71,995	89,685	103,42	113,54	
				59,475	77,165	91,535	109,37	115,39	134,66
					79,015	96,705	111,22	117,67	136,51
						98,555		119,52	138,64
								127,33	140,64
								129,18	148,45
								130,53	150,3
								132,38	151,65
The value of the slopes on which each axle of the wagon of the train in question is located, %									153,5
	1,5								
	1,5	1,5							
	1,5	1,5	1,5						
	1,5	1,5	1,5	1,5					
		1,5	1,5	1,5	2,2				
			1,5	2,2	2,2	2,2			
				2,2	2,2	2,2	2	2	
				2,2	2,2	2,2	2	2	2
				2,2	2,2	2,2	2	2	2
					2,2	2,2	2	2	2
						2,2		2	2

								2	2
								2	1,6
								2	1,6
									1,6
The value of q_{qti} is the tangent component of gravity acting on each axis,	0,01 5								
	0,01 5	0,030							
	0,01 5	0,030	0,030						
	0,01 5	0,030	0,030	0,030	0,044				
		0,030	0,030	0,030	0,044	0,042			
			0,030	0,044	0,044	0,042	0,041		
				0,044	0,044	0,042	0,041	0,035	
				0,044	0,044	0,042	0,041	0,035	0,035
				0,044	0,044	0,042	0,041	0,035	0,035
					0,044	0,042		0,035	0,035
						0,042		0,035	0,035
								0,035	0,035
								0,035	0,028
								0,035	0,028
									0,028
The value of Q_r is the tangential component of gravity,	0,06 0	0,120	0,120	0,236	0,264	0,253	0,164	0,280	0,259

The values of Q_r are calculated for each wagon, the effect of forces on the rolling stock is calculated separately for the 1st wagon from the head, then for the 1st and 2nd, then for the 1st, 2nd and 3rd, etc., up to the entire train with an increasing total[11]

RESULTS AND DISCUSSION

The choice is made of the axle of the wagon, under which it is planned to lay the brake shoe most rationally, i.e. it should have the greatest load, taking into account the requirement for mandatory fixing of the extreme wagons. The final values of the resultant forces acting on the composition are obtained.

From the obtained values, in order to fulfill the condition of guaranteed retention of rolling stock in the case of self-coupling, a minimum positive value is selected. In the case when the resulting force is less than zero, additional laying of the brake shoes is performed until the resulting value of the final force becomes positive. Similarly, the required number of brake shoes are calculated, which must be laid on the opposite side.

An example of calculating the resulting forces is given in Table 3.

Table 3

Calculation of the resultant forces acting on the fixed freight train from the odd side

Tangential component of gravity, for each car separately, tp	The tangential component of gravity, with an increasing total, tp	The friction force of the composition when starting from a place, tp	The friction force of the composition when starting from a place with an increasing total, tp	The component of the air pressure force along the path, tp	The braking force of shoes with an increasing total, tp	Standard deviations of the resistivity of the friction forces of the composition when starting from a place and the braking force of the tower poppy when starting from a place	The total amount of forces acting on the composition, tp
1	2	3	4	5	6	7	8
Q_{τ}	$\sum Q_{\tau}$	W_{fr}	$\sum W_{fr}$	$\sum W_{vn}$	$\sum F_{oj}$	$t_x \sqrt{\sum \sigma_f^2 q_o^2 10^6 + nn \sigma_w^2 q_o^2}$	
0,060	0,060	0,066	0,066	0,003	3,000	1,273	1,730
0,120	0,180	0,083	0,149	0,003	3,000	1,276	1,690
0,120	0,300	0,083	0,232	0,003	3,000	1,280	1,648
0,236	0,536	0,124	0,356	0,004	3,000	1,287	1,530
0,264	0,800	0,124	0,481	0,005	3,000	1,295	1,381
0,253	1,053	0,123	0,604	0,005	3,000	1,304	1,241
0,164	1,217	0,083	0,687	0,006	3,000	1,317	1,148
0,280	1,497	0,160	0,847	0,006	3,000	1,328	1,016
0,259	1,756	0,160	1,007	0,007	3,000	1,341	0,904
							0,904

It follows from column 8 of Table 3 that after laying two brake shoes under the head wagon, the minimum reserve of the resulting force has a positive value and is 0.904 tp. On the even side, the laying of the brake shoes is not required, since the minimum resultant force has a positive value before the laying of the brake shoes and is 0.249 tp. When laying one brake shoe under the head wagon, the minimum resultant force will have a negative value equal to -0.249 tp. This means that one brake shoe laid on the odd side will not be enough to guarantee the retention of the train.

CONCLUSIONS

This approach to the development of the calculation methodology will eliminate violations of the fixing standards associated with errors:

- human factor – inattention when using a large array of tabular data contained in the technical and administrative acts of stations;
- settlement nature – at the stage of making a decision on the uniformity / heterogeneity of the fixed rolling stock produced in accordance with the previously established procedure;
- of a technological nature – the risk of securing rolling stock on sections of station tracks with an average slope of more than 2,5% (at present, it is also not possible to determine the actual value of the average slope of the track on which the rolling stock is located, consisting of wagons of dissimilar type and length).

The main advantage of the proposed development of the method for determining the fixing standards is the refined calculation of the number of brake shoes, taking into account the physical data of the fixed rolling stock and the characteristics of the longitudinal profiles of the tracks.

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Rezyume: *Ilmiy ishda temir yo'l stansiya yo'llarida uzunli bo'yicha uzun bo'lgan va innovatsion harakatlanuvchi tarkibni maxkamlash me'yorlarini modellashtirish va hisoblash uslubiyotining rivojlanishi keltirilgan. "tog'li" ko'rinishli profiliga ega stansiya yo'llarida maxkamlangan turli xil vagonlarga ta'sir qiluvchi kuchlarni qo'llash sxemalari ishlab chiqilgan. Ruxsat etilgan vagonning har bir o'qiga ta'sir etuvchi hosil bo'lgan kuchni aniqroq hisoblash va shamolning tasir kuchini hisobga olgan holda uni yig'ish orqali kuchlar kombinatsiyasini aniqlash usulini ishlab chiqishni taklif qilindi. Vagonlarni mahkamlashning me'yorini hisoblash uchun dastur ishlab chiqilgan. Ishlab chiqilgan usul va mahkamlash me'yorlarining olingan qiymatlari inson va texnologik omillar bilan bog'liq xatolarni bartaraf etishga, shuningdek, mahkamlangan vagonlarning fizik ma'lumotlarini va bo'ylama yo'l profillarining xususiyatlarini hisobga olgan holda tormoz boshmoqlari sonini aniq hisoblashni ta'minlaydi.*

Резюме: *В научной работе представлена разработка методики моделирования и расчета норм закрепления разнородного по длине и инновационного сочлененного подвижного состава на железнодорожных станционных путях. Разработаны схемы приложения сил, действующих на различные вагоны, закрепленные на станционных путях с профилем «гора». Предложено развитие метода определения сочетания сил за счет более точного итерационного расчета результирующей силы, действующей на каждую ось закрепляемого состава, и ее суммирование с учетом ветровой нагрузки. Разработана Программа расчета нормы крепления вагонов. Разработанный метод и полученные*

значения норм закрепления позволяют исключить ошибки, связанные с человеческими и технологическими факторами, а также обеспечить точный расчет количества тормозных башмак с учетом физических данных закрепляемых вагонов и характеристик продольных профилей пути.

Kalit so‘zlar: innovatsion harakatlanuvchi tarkib, fizik-matematik model, tormoz boshmog‘i, yo‘lining bo‘ylama profili, kuchlarni qo‘llash sxemasi, mahkamlash me‘yorlari

Ключевые слова: инновационный подвижной состав, физико-математическая модель, тормозной башмак, продольный профиль пути, схема приложения сил, нормы закрепления

INNOVATIVE TECHNOLOGIES IN ROAD CONSTRUCTION

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Summary: *The article deals with the key areas of using innovative methods of road construction; researched innovative technologies used in the construction of roads in Uzbekistan; examples of innovative roadway materials are given; promising projects of foreign and Russian researchers were compared; a comparative analysis of the accumulated value during the operation of the roadway was carried out; methods have been developed to improve productivity in road construction.*

Key words: *road design, road surface, innovative materials, method, technology.*

INTRODUCTION

Everyone knows and understands that without the development of the country's transport system it is impossible to build an effective market economy.

Every year the intensity on the roads is increasing. Consequently, the load on the road surface also increases. In order to increase the service life and quality of the highway, one has to look for new building materials and construction methods.

Innovations in road construction allow the use of better and more environmentally friendly materials for construction, such as the reuse of recycled materials.

World experience shows that the formation and development of transport infrastructure is often a catalyst for the development of other sectors of the economy and entire regions. In the context of budgetary constraints in Uzbekistan, the implementation of the tasks of the state to maintain and expand the road network is often focused on minimizing the cost of work at the stage of direct construction, which does not correspond to the approach of developed countries based on managing the cost and costs of operating the road as the final asset throughout the entire life cycle. This vector is confirmed by the development of modern innovative technologies in the field of road construction.

MATERIALS AND METHODS

The specifics of the studied area and its importance in the national economic complex allows us to determine the following main areas of innovative technologies (Figure 1).

Let's consider these directions in more detail.

Examples of innovative materials in road construction include drainage asphalt, porous mastic asphalt mixes, colored asphalt mixes, modified bitumens, polymer-bitumen binders made from thermoplastics, etc.

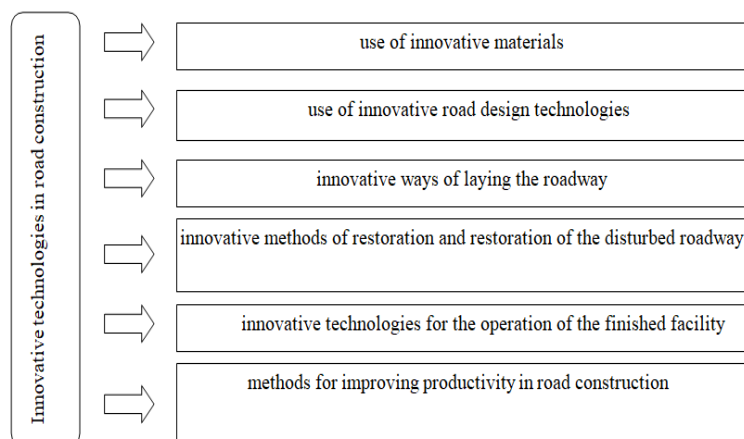


Figure 1. *Key directions of using innovative technologies in road construction*

RESULTS AND DISCUSSION

In Uzbekistan, the use of innovative materials in road construction is hampered by the lack of incentives and motives for contractors. However, from the point of view of the theory of the life cycle of a road as a final object, an asset, the costs of its subsequent maintenance and operation can many times exceed the savings at the construction stage. Thus, cement concrete pavement is more expensive than asphalt pavement by an average of 70-80%, while asphalt roads need to be repaired after 3-4 years of operation, while cement concrete roads during the first 10-12 years practically do not require expenses for repair.

The cost of design work usually forms 3-5% of the cost of contract contracts, while it is the savings in design costs, which is reflected in the quality and sophistication of design solutions, that most often is the source of contract price reduction⁴. Examples of modern software products for road design are AutoCAD Civil 3D (USA), CARD/1 (Germany), GIP (Russia), ROBUR (Russia).

Modern innovative methods of laying the roadway include the high-temperature pressing method, as well as a set of innovative methods for strengthening the soil, including the use of polystyrene foam boards as the basis of the roadway, soil stabilizers with a cementing catalytic-binding effect, geogrids and geotextile.

Innovative methods of repair and restoration of the roadway include the technology of cast asphalt concrete mixtures, infrared repair, hydrophobization, the use of nanophobes to restore the destroyed roadbed, and the method of chemical milling of irregularities.

The listed innovative technologies are often used in combination in the implementation of innovative projects in the field of road construction. In Uzbekistan, a system is being formed to inform stakeholders about innovations in the industry. Thus, Uzavtoyul compiles a list of progressive materials, new technologies and equipment in a special regularly updated section on the official website, publishes a catalog of innovations in the road industry in Uzbekistan once a year.

Foreign researchers offer promising innovative technologies that are focused on environmental friendliness and reducing environmental damage during the construction and operation of roads. For example, in the Future of High-Speed Rail report, the company

"ARUP" considers such promising technologies as "self-healing" concrete containing bacteria that can restore the integrity of the canvas with small cracks, a road with a solar panel base that can remotely charge electric vehicles moving along it.

The European company Heijmans describes the development of Dutch scientists as part of the Smart Road project, which involves the application of road markings with photoluminescent materials that are susceptible to temperature changes. In frosty weather, snowflake-shaped symbols appear on the road with such markings, warning the driver of icing. A similar material for applying road markings that glow at night is used in the pilot project of Rosnano "Innovative Road", which is intended for implementation in the Tashkent and Samarkand regions [2].

Thus, the emphasis on optimizing costs at the stage of road construction does not correspond to the best international practices, since one of the vectors for the development of the industry is the targeted optimization of the cost of the final asset throughout the entire life cycle. An analysis of modern innovations in road construction in different countries showed that modern technologies and materials are focused on extending the life of the road surface, minimizing the cost of maintaining it in good condition for a long time, and reducing environmental costs. The reason that hinders work in this direction and hinders the introduction of innovations in the road industry in Uzbekistan may be a conflict of interest between the contractor, the customer of the project and the owner of the road as the final asset due to a compromise between the initial investment and the subsequent costs of maintaining the final asset throughout its life cycle.

To correct the situation, the state should stimulate and develop investment in road construction projects with improved long-term life cycles, taking into account not only the initial design and construction costs, but also long-term costs in the future (expenses for road repair and operation, installation of fences, carrying road markings).

Innovative technologies in road construction include the following areas [3]:

- Use of innovative materials;
- Use of automated technologies for designing roads;
- Methods for increasing productivity in road construction;
- Use of innovative types of coating;
- Use of innovative ways to combat the formation of cracks and potholes in the road surface.

Consider some types of innovative technologies [4]:

1. Strengthening weak soils with crushed stone piles

When crushed stone piles are installed, the strength characteristics of the soil mass increase, where reinforcement is performed, as a result of which its bearing capacity and stability increase. This method makes it possible to reduce the base deformation value from 2 to 6 times. Also, the method allows to reduce the construction period and reduce the cost of the road, by saving on fuel for construction equipment.

2. Use of automated design technologies

Currently, the design of roads is carried out with a wide use of automated procedures, ranging from the collection and processing of geodetic information to the preparation of drawings and cost estimates. Design automation occupies a special place among information technologies. With the help of programs such as Credo, you can create a complete road project.

3. Low noise asphalt

This type of asphalt concrete pavement is divided into:

- Fine-grained surfaces;
- porous coatings;
- Rubberized asphalt.

Fine-grained surfaces are ordinary asphalt concrete surfaces that are mainly composed of fine-grained particles.

Porous coatings are coatings that have open pores so that water and air can freely escape.

Rubberized asphalt is asphalt, which includes crumb rubber obtained by processing used car tires. It provides additional ductility to the pavement, which gives air more time to escape from the pores at lower pressures as the tires pass over it.

The disadvantage of low-noise asphalt is the price. The preparation and installation of such asphalt can be much more expensive than conventional solutions.

4. Introduction of new building materials with new chemical properties.

This technology makes it possible to soften asphalt concrete and make it more elastic in conditions of negative temperatures by adding polymer additives to bitumen. This will lead to softening of asphalt concrete by 2-2.5 times. These developments allow you to deal with the formation of cracks and potholes. The given examples of technologies are only a small part of a large number of developments that in the future can change the idea of roads and the technology of its construction.

CONCLUSION

In conclusion, it can be said that the use of innovative technologies in road construction leads to getting rid of unnecessary costs. In addition, the quick completion of construction is guaranteed. Deep assimilation and implementation of innovative technologies is the main task of the road sector of our country today.

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Rezyume: Maqolada yo'l qurilishining innovatsion usullaridan foydalanishning asosiy yo'nalishlari ko'rib chiqilmoqda; O'zbekistonda yo'llar qurishda foydalanilayotgan innovatsion texnologiyalarni tadqiqqladi; yo'l polotnasining innovatsion materiallari misollari keltirildi; xorijiy va Rossiya tadqiqotchilarining istiqbolli loyihalari solishtirildi; yo'l polotnasidan foydalanishda to'plangan ahamiyatga nisbatan tahlil qilindi; yo'l qurilishi unumdorligini oshirish usullari ishlab chiqildi.

Резюме: В статье рассматриваются ключевые направления использования инновационных методов дорожного строительства; исследовал инновационные технологии, используемые при строительстве дорог в Узбекистане; приведены примеры инновационных материалов дорожного полотна; сравнивались перспективные проекты зарубежных и российских исследователей; проведен сравнительный анализ накопленного значения при эксплуатации дорожного полотна; разработаны методы повышения производительности дорожного строительства.

Kalit so'zlar: Yo'llarni loyihalashtirish, yo'l qoplamasi, innovatsion materiallar, usul, texnologiya.

Ключевые слова: проектирование дорог, дорожное покрытие, инновационные материалы, метод, технология.

USE OF COMPUTER TECHNOLOGIES IN TEACHING TECHNICAL DRAWING

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Summary: *In this article, the issues of improving the knowledge and skills of students in computer graphics in the educational system, as well as passing the entire subject using computer graphics, using it as a didactic and technical tool in the educational process are covered.*

Key words: *Computer technology, computer graphics, information technology, engineering graphics.*

In today's high-tech era, it is impossible to imagine the design processes and construction documents, the production of products without efficient computing technologies. The rapid development of science and technology, global information systems and the introduction of modern technologies into our lives have a great impact on the life and development of society along with the changes in the way of life of people. This, in turn, requires the development of the educational process in accordance with the times, the systematic and systematic application of new teaching methods and technologies, and the continuous improvement and enrichment of the knowledge and skills of specialists.

The introduction of new pedagogical and innovative technologies into education is not only the need of the hour, but also a vital necessity in our high-tech era. At the same time, these technologies provide for the student to easily perform simple calculations, document preparation processes and other tasks that are monotonous and boring in the educational process, which only lead to loss of time, far from creative thinking, saving time with the help of a computer.

The purpose of applying modern technologies to the educational process is to improve the quality of education and train personnel who can automate any engineering calculations, design works and processes using modern computer technologies, reduce the amount of time and expenses, and increase efficiency.

For this purpose, it is necessary to provide the students with the use of graphic editors in the execution of calculation-graphic and project work and open a wide way for this. In the training of engineers, it is appropriate to entrust graphic design systems with cartography and typography, electronics, architecture and construction, mechanics and mechanical engineering, designing and modeling processes of details of machines and mechanisms, as well as drafting construction documents. This task can be performed by the implementation of project construction documents, production automation and management using modern CAD-CAE-CAM systems, organization of the training process and engineering personnel training.

The globalization of information exchange, as well as the sharp increase in the number and quality of scientific innovations in the fields of science, technology and production, by themselves, put the students on the agenda to provide fast and detailed information about them. The positive satisfaction of this demand, first of all, it is carried out in the educational process, which is a convenient and acceptable form of acquiring scientific-theoretical and practical knowledge.

In the era of emerging and globalizing information society, the fate of humanity depends on how well computer training is organized for all people participating in information exchange, educational process and production, aimed at mastering this labor tool.

To select the necessary information for computerization of education, and in a broad sense for informatization, to put it into an educational form, to use information technology in order to give this information to students for assimilation, explanation and memorization, to increase the general knowledge of specialists and the quality of professional training, to the educational process of information technologies that meet world standards means introduction.

Pedagogical scientists A.A. Abdugadirov and M. Tojiev noted: "Informatization of education is a process of improving all components of the educational system based on the use of information technologies in order to prepare students for full and effective participation in public and professional activities in the context of an information society."

As a result of research in the field of science and technology development, it can be concluded that the necessity of fully introducing computer technologies into the educational system is based on the following:

- firstly, when comparing computer equipment with previously used technical means of teaching or didactic materials in the educational and educational process, the technical and operational possibilities of the computer are limitless;

- secondly, it is explained by the fact that the issue of training personnel with knowledge of modern information technologies plays a decisive role in the development of science and technology.

According to most researchers, computer technology qualitatively changes the means, methods, form and content of education and training and creates the following opportunities:

- bring out and develop the individual abilities of students and harmonize them with their personal qualities;

- forms students' ability to know and strive for excellence;

- always updates the method, form and content of education and training.

In this regard, it is worth quoting the opinion of researcher S.A. Tursunov: «as a result of computerization of education, two main goals are achieved: first, computer literacy is provided, which is a set of knowledge, skills and abilities that allow students to be ready to use computing technology in their practical activities. Secondly, computer technologies are widely used to solve educational, developmental and educational problems.» Some researchers estimate the role of the computer in the educational process so highly that they even believe that in the future electronic machines will completely replace teachers and will be able to perform their tasks more thoroughly and efficiently. True, it makes computer training more interesting, reliable and effective, and provides students with a wide opportunity to easily use and master the database in it. But it can never replace the teacher, the computer has the ability to teach students independently and can be the best modern assistant to the teacher. Also, compared to other technical means, the computer is distinguished by its flexibility, that is, the possibility of using different teaching methods and, most importantly, being objective in the individual assessment of the student. In turn, the computer, unlike the teacher, evaluates students objectively in any situation.

Development of mental activity of students depends to a large extent on educational tools. However, the quality of training sessions and the level of students' learning is determined not by the number and variety of technical tools, but by the level of their ability to carefully select and coordinate them with the teacher's explanation in the course of the learning process.

A tool is an auxiliary learning material necessary for the successful use of a particular teaching method or methods. Educational tools consist of equipment, laboratory equipment, information and technical tools, instructional tools, symbols, textbooks, training manuals, radio, television, computer, etc.

Today, the computer has entered the educational process as a didactic and technical tool. It is distinguished from other tools by its breadth of possibilities and convenience.

Activities of the teacher in organizing the educational process using computer technologies:

1. To motivate and stimulate the cognitive activity of the teacher;
2. To manage acquired knowledge and communication with students with the help of computer technologies;

3. To discuss issues and organize debates;

4. To help students in situations where computer technology tools cannot help;

5. It will be focused on analyzing the course of the training and drawing conclusions.

Many pedagogic scientists believe that the computer-based learning environment can cause a number of problems:

- it is difficult for students to imagine a large amount of integrated and interconnected information on a small monitor screen;
- the existence of a situation of simply moving the flow of information to students using computer technology tools;
- excessive algorithmization of thinking activity and increased logical thinking;
- reduction of socialization due to separation of students from each other and reduction of their interaction;
- as a result of excessive motivation of students to work with the computer, there is a situation of deviation from the main educational goal;
- the risk of social stratification (not all students have a personal computer).

Computer graphics is one of the rapidly developing directions of new information technologies, and it forms the content of the automatic design system. A modern automatic design system not only converts a drawing into an electronic one, but computer technology is distinguished by the breadth of its database and the ability to use effective methods of geometric modeling of objects. Engineering education that is not based on information technologies cannot be called modern, because the use of new information technologies in engineering education is a socio-economic need of today.

Therefore, improving the knowledge and skills of students in computer graphics and achieving educational efficiency in the educational system has become one of the urgent issues of the day.

Based on the above considerations, the use of computer graphics in the teaching of technical drawing can be carried out in two ways:

1. Learning computer graphics only after the students have certain graphic knowledge and skills, the possibility of students mastering the elements of computer graphics will increase. It is required to allocate an appropriate study hour for computer graphics or to organize graphic assignments using computer graphics in independent lessons and group activities.
2. From the beginning of the academic year, introduce the elements of computer graphics and conduct the whole subject in parallel with computer graphics - in this case, students will be more interested in working with computers, and learning the basics of drawing may become secondary. Also, in order to pass the whole subject using computer graphics, the teacher must be a professional expert in computer graphics.

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Rezyume: *Ushbu maqaloda talim tizimida talabalarning kompiyutor grafikasinda bilim ba malakalarni oshirish, shunigdek, butin fanni komfiyotor grafikasidan foydalanib utish, talim jarayonida uhdan didaktib ba texnik bosita sifatuda foydalahish masalalari eritilgan.*

Резюме: *В данной статье освещены вопросы совершенствования знаний и умений учащихся по компьютерной графике в образовательной системе, а также прохождения*

всего предмета с помощью компьютерной графике, использования ее в качестве дидактического и технического средства в учебном процессе.

Kalit so'zlar: *Kompiyutor texnologiyasi, kompiyutor grafikasi, axborot texnologiyasi, muxandislik grafikasi.*

Ключевые слова: *Компьютерные технологии, компьютерная графика, информационные технологии, инженерная графика.*

A NEW METHOD OF MANUFACTURING PRODUCTS FROM NON-AUTOCLAVED FOAM CONCRETE

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Summary: *The results of theoretical and experimental studies on the development of a new method for manufacturing products from non-autoclaved foam concrete are presented in the article. It is shown that the proposed method for manufacturing constructional products from non-autoclaved foam concrete provides high physical and mechanical properties of the product and increases its operational reliability.*

Key words: *foam concrete, non-autoclaved product, powdered sulfur, strength, frost resistance, properties, internal impregnation, cement, foaming agent, compression, bending, composition, bulk density, mineral filler.*

Currently, new innovative technologies are bursting with great force into the construction industry. The technology for the manufacturing of products from foam concrete can be attributed to the category of technologies, which gained a second life only now. The popularity of foam concrete is not accidental and is explained by the fact that it is easy to manufacture not only in large factories with expensive equipment but also directly at a construction site or in a small enterprise. The practice has long proved that if technology has become available to small and medium-sized businesses, then it will have great development [1, 2].

At present, there are only a few medium-sized enterprises and a large number of small ones in Uzbekistan. It is very difficult to estimate the exact number, but it can be assumed (based on the sales of several equipment manufacturers) that today there are about 100 small-scale production enterprises manufacturing foam concrete in Uzbekistan. This number is insufficient as most manufacturers feel the need for the products of enterprises manufacturing foam concrete products. Most likely, in the near future, the number of manufacturers of foam concrete products in the construction industry will increase several times. Most of these industries are in the stage of initial explosive development, and after mastering the basic production of blocks, they begin (or will begin) to look for options to increase productivity and introduce new developments related to the improvement of foam concrete technology [3, 4].

As is well known, in foam concrete, porization is performed by introducing foam concentrates into the mix. The binder is used in conjunction with a silica component containing silicon dioxide. The silica component (ground quartz sand, river sand, fly ash from thermal power plants, and ground granulated blast-furnace slag) reduces binder consumption and the shrinkage of foam concrete and improves its quality. Quartz sand is usually wet ground and used as a sand slurry. Grinding increases the specific surface of the silica component and increases its chemical activity. Generally, it is economically beneficial to use industrial by-products: fly ash, blast-furnace slag, and nepheline sludge for the manufacture of foam concrete. The technology for preparing foam concrete is quite simple. A foaming agent or ready-made foam is added to the cement-sand mix. After mixing the components, the mix is ready for the molding of various products from it: wall blocks, partitions, lintels, floor slabs, etc. Foam concrete can be advantageously used for pouring into molds of floor slabs, roofs, and monolithic construction. Unlike aerated concrete, a less energy-consuming non-autoclaved technology is used in the production of foam concrete [5, 6].

In addition to the ease of production, foam concrete has many other positive properties. For example, in the process of its preparation, it is easy to impart this material the required density by varying the amount of foaming agent. As a result, it is possible to obtain products with a density from 200 kg/m³ to the most extreme values of lightweight concrete 1200-1500 kg/m³.

Due to the sharp increase in demand for foam concrete products, interest in improving the technology for manufacturing products based on it has increased. In the Laboratory of Construction Materials of the Tashkent State Transport University, research work has been conducted for several years to develop effective technologies for molding products from non-autoclaved foam concrete; the studies make it possible to increase the strength and reliability of the manufactured materials.

A new method for the manufacture of constructional products from non-autoclaved foam concrete includes the preparation of a raw mix by mixing Portland cement, mineral aggregates and fillers, water, and foam (prepared separately) pouring the foam concrete mass into molds, curing to gain cutting strength, cutting the mass into products. At that, powdered sulfur is used as a filler in the amount of 5-7% by weight of cement, and the products are subjected to heat treatment in drying chambers at a temperature of 130°C for 3 hours.

The method proposed for implementation relates to the manufacturing of products from non-autoclaved foam concrete for construction. As the results of the patent search show, there are a number of new methods for the manufacture of non-autoclaved foam concrete. In particular, there is a known method for the manufacture of products from foam concrete, that includes the preparation of a mix by joint grinding of a binder and mineral filler, mixing them with water and a pore-forming additive at an excessive pressure in the mix, which increases at the beginning of unloading into a mold, unloading the mix into a mold and molding [7]. There is also another method for manufacturing foam concrete products, including the preparation of a raw mix, its porization with a separately prepared foam, pouring the foam concrete mass into molds, curing to development of cutting strength, cutting mass into products, storing them on pallets and transporting them to a warehouse until development of grade strength [8]. The disadvantages of these manufacturing methods are the low physical, technical, and operational characteristics of the resulting foam concrete products, namely low strength and frost resistance, and a relatively low product quality category.

The closest method to the proposed one is a method for manufacturing products from non-autoclaved foam concrete, including the preparation of a raw mix by mixing Portland cement, mineral aggregates and fillers, water and separately prepared foam, pouring the foam concrete mass into molds, curing to the development of cutting strength, cutting mass into products and final surface treatment of finished products with an aluminum hydroxide sol of a concentration of $(0.39 - 0.41) \cdot 10^{-4} \%$ [9].

The disadvantages of this manufacturing method are the low strength of foam concrete and the insufficient reliability of the operational properties of the resulting products. To eliminate these shortcomings, the authors have proposed a new method for manufacturing building products from non-autoclaved foam concrete; this method provides high physical and mechanical properties of the product and high operational reliability.

This goal is achieved by the fact that the manufacture of products includes the preparation of a raw mix by mixing Portland cement, mineral aggregates and fillers, water and separately prepared foam, pouring the foam concrete mass into molds, curing to the development of cutting strength, and cutting mass into products. A distinctive feature of our development is that powdered sulfur is used as a filler, introduced in an amount of 5-7% by weight of cement, and the product is subjected to final heat treatment in drying chambers at a temperature of 130°C for 3 hours.

The technical result of the proposed method is achieved when the foam concrete product is heated to 130°C, powdered sulfur, uniformly distributed in the structure of the hardened binder, turns into a liquid state (melting point of sulfur is 113 °C) and, under gravitational forces, is gradually absorbed by the solid shell of air bubbles of foam concrete. Thus, there is an "internal impregnation" of the foam concrete product with sulfur thermoplastic throughout the entire volume. After completion of the heat treatment during the cooling process, sulfur hardens and gives higher strength to the inter-pore partitions of foam concrete due to the filling and solidification of micropores and micro-defects on the solid surface of air bubbles. This explains the increase in the

strength of samples of non-autoclaved foam concrete when using a new method for manufacturing foam concrete products.

Using the known method, when the surface of foam concrete products is treated with aluminum hydroxide sol, the strength of only inter-pore partitions of the surface layers of foam concrete products increases. In contrast, in the proposed manufacturing method, the strengthening of the inter-pore partitions of foam concrete occurs throughout the entire volume of the product, which significantly increases its operational reliability, and the stability of indices of physical, technical, and operational properties of non-autoclaved foam concrete increases significantly. Below are several examples of specific implementations of the proposed method [10].

According to the proposed method, the product is manufactured as follows.

1. Dosing of raw materials: Portland cement PC400 D0 ... D20 and PC500 D0 ... D20 with a content of tricalcium aluminate no more than 6%, mineral aggregates and fillers, for example, quartz sand with a maximum grain size of 0.63 mm and powdered sulfur with a specific surface area of 3000 cm²/g and water.

2. Mixing raw materials in the mixer.

3. Porization of the mix with the separately prepared foam. Substances that meet the requirements of SN 277-80 can be used as foaming agents, for example, a foaming agent based on sulfonates "Penostrom", a foaming agent based on glue rosin "Pioneer", a protein-based foaming agent "Ekopen", etc.

4. Transportation and laying the foam concrete mix into molds.

5. Curing of foam concrete to development of cutting strength.

6. Cutting of foam concrete mass into products.

7. Stacking of products on pallets and placement in a drying chamber.

8. Heat treatment of products at a temperature of 130⁰C for 3 hours.

9. Transportation of products to the warehouse.

In the case study of non-autoclaved foam concrete products, standard samples were selected for testing. Experiments were conducted for foam concrete of a density D400, D500, and D600. The following materials were used as initial ones: Portland cement PC500 D0 from the Akhangaran cement plant, foaming agent - PB-Lux, quartz sand from the Maysky quarry with an average diameter of 0.16 mm, ground sulfur produced by the Shurtan Mining and Chemical Combine with a specific surface area of 3000 cm²/g.

For comparative studies, the products from foam concrete were manufactured using the known method. The manufacture of products from non-autoclaved foam concrete according to the known method was conducted similarly to the above scheme, with the exception of items 7 and 8. For the known method, after cutting the foam concrete mass into products, the surface of the products was treated with an aluminum hydroxide sol with a particle concentration of the dispersed phase $(0.39 - 0.41) \cdot 10^{-4}$ %; the treatment was done using a construction sprayer at an aluminum hydroxide sol consumption of 2.5 l/m².

During the case study by the known method, check standard samples were also selected for testing.

The results of testing samples made by two methods - the known one and the proposed one - are given in Table1.

Table 1.

The results of testing samples of non-autoclaved foam concrete obtained by known and proposed methods

No. of sample	Average density, kg/m ³	Concentration of aluminum hydroxide sol, (10 ⁻⁴) %	The amount of sulfur, % by weight of cement	Compressive strength, MPa	Value of Coefficient of variation, %
Known method					

1	400	0.39	-	0.9	15.0
2	500	0.40	-	1.6	14.2
3	600	0.41	-	2.9	15.8
Proposed method					
4	400	-	5	1.8	9.8
5	500	-	6	2.9	8.5
6	600	-	7	5.2	9.6

The analysis of the results obtained shows that products from non-autoclaved medium-density foam concrete D400 ... D600, manufactured by the proposed method (samples No. 4, 5) have higher compressive strength and are characterized by significantly more stable strength properties compared to products manufactured by the known method (samples No. 1, 3).

Thus, the proposed method for manufacturing construction products from non-autoclaved foam concrete provides high physical and mechanical properties of the product and higher operational reliability.

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Rezyume: Мақолада неавтоклав кўпикбетондан буюмлар тайёрлашнинг янги усулини ишлаб чиқиш бўйича олиб борилган назарий ва экспериментал тадқиқотларнинг натижалари келтирилган. Тадқиқотларда аниқланишича таклиф қилинаётган неавтоклав кўпикбетондан буюмлар тайёрлашнинг янги усули юқори физик-механкавий хоссалар ва эксплуатацион ишончилиikka эга бўлган буюмларни тайёрлаш имкониятларини таъминлаб беради.

Резюме: В статье приведены результаты теоретических и экспериментальных исследований по разработке нового способа изготовления изделий из неавтоклавного пенобетона. Показано, что предлагаемый способ изготовления строительных изделий из неавтоклавного пенобетона обеспечивает получение изделий с высокими физико-механическими свойствами, а также повышенной эксплуатационной надёжностью.

Kalit so'zlar: ko'pikbeton, noavtoklav, buyum, kukunsimon oltingugurt, mustaxkamlik, muzlashga chidamlilik, xossalar, ichkaridan shimdirish, tsement, ko'pik xosil qilgich, siqilish, egilish, tarkib, to'kilma zichlik, mineral mikroto'ldirgich.

Ключевые слова: пенобетон, неавтоклавный, изделие, порошкообразная сера, прочность, морозостойкость, свойства, внутренняя пропитка, цемент, пенообразователь, сжатие, изгиб, состав, насыпная плотность, минеральный наполнитель.

**ARTIFICIAL INTELLIGENCE TECHNOLOGIES IN THE EDUCATIONAL PROCESS
OF HIGHER EDUCATION INSTITUTIONS: ANALYSIS OF THE CURRENT
SITUATION AND PROSPECTS**

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Summary: *The article discusses in detail the current state and prospects of the use of artificial intelligence technologies in the educational process of higher education institutions, especially in technical higher education institutions. In particular, the stages of improving the effectiveness of the educational process with the help of artificial intelligence, its positive effects and the problems of its implementation in the field were analyzed.*

Key words: *digital technology, artificial intelligence, digital learning, virtual reality.*

The essence of the digital transformation of education is the use of the growing potential of digital technologies for each student, including the use of artificial intelligence methods, the use of virtual reality, the development of a digital learning environment in educational institutions, providing access to the general broadband Internet system, the necessary education through the personalization of the educational process based on working with big data is expressed in achieving results.

At the current stage of introducing modern information technologies into the higher education system in our country, both students and teachers are provided with ample opportunities to use various online educational platforms. At the same time, both teachers and students face a number of problems related to the individualization of educational programs, the rational organization of educational activities, and the differentiation of educational materials. There are problems with the organization. At the same time, existing learning management systems (LMS, Learning Management System) do not have the ability to intellectualize the independent learning process, taking into account individual characteristics, needs and interests [1,3].

Modern education is becoming a mobile and open system. The introduction of information and communication technologies and electronic educational resources into the educational process contributed to the formation of a new paradigm of education.

Artificial intelligence technologies determine the development of the world economy today. The funds spent on them constitute the main investments of venture capital in the United States. A similar commotion is taking place in Europe, Japan, and China. According to the data of international experts, from 2014 to 2017, investments in artificial intelligence technologies tripled and amounted to nearly 40 billion dollars. In 2018, the global market for technological solutions based on artificial intelligence was 21.5 billion dollars, and according to experts, it is predicted to reach almost 140 billion dollars by 2024. Due to the introduction of technological solutions developed on the basis of artificial intelligence in various sectors of the economy and public relations, the growth of the world economy in 2024 is expected to be at least 1 trillion US dollars [2].

In the last decade, completely new classes and types of artificial intelligence systems have appeared, such as:

- "smart assistants" (agents), for example: Cortana from Microsoft, Siri from Apple, Now from Google, Echo from Amazon, etc., which can combine several "smart" functions and capabilities at the same time: speech recognition, personal information about a specific user the ability to analyze data and interpret it at a certain basic level, help with Internet searches and online shopping, etc;

- artificial intelligence - robotic systems equipped with special sensors and sensors allow to analyze and control them or to quickly respond to changes in various parameters and data of the surrounding physical world, for example, temperature, air humidity, pressure, etc. A more sophisticated subclass of such systems are the various algorithms and technologies used in the development of unmanned automated vehicles;

- self-learning artificial intelligence systems capable of answering various questions that require knowledge of factual information;

- artificial intelligence systems that train the winners of various intellectual games (chess, checkers, revers, go and even poker) to win.

Despite this rapid development of artificial intelligence systems, we believe that artificial intelligence will never completely replace human labor.

Artificial intelligence technologies can be used in various industries and sectors: industry, construction, transport, communication, education, science, health, finance, trade, culture, tourism, housing and utilities, etc [6].

Today, publishers of educational literature are trying to follow modern trends and release electronic analogues of educational publications in subjects. As part of the research, an analysis of electronic applications of modern educational manuals was carried out, which showed a primitive approach to the interactivity of teaching, methodologically unregulated working with multimedia attached files (audio, video files). Thus, the number of attempts and their combinations are not taken into account, this experience is not collected for further analysis of "shift" or the decrease of individual learning results, and the time of completing the tasks is not recorded. Undoubtedly, there is a need to develop and implement in the educational process a real "working" mechanism for the formation of a personal learning environment based on artificial intelligence that takes into account the individual learning abilities and needs of each student. The obtained results of the training data allow to determine the regularities and correlations [4,5].

Thus, the intellectual environment in educational systems enables the implementation of the principle of flexibility, the principle of evaluating student knowledge based on analysis using machine learning methods, and the principle of automatic collection of data on student actions. It should be noted that traditional online education systems are based on modern Internet technologies (Skype, Microsoft Correspondence in Teams chat, etc.), but at the same time they are not intellectual enough. Studying according to a given educational scenario, self-navigation through an electronic educational resource cannot provide an individual educational approach. Ensuring the rational organization of the individual educational process in higher education institutions, taking into account the level of preparation and abilities and interests of students, introducing artificial intelligence systems in the territory of our country. Proposals based on the following main components have been developed:

- frame - product method of knowledge expression;

- modeling systems of individual learning process based on neural network technologies.

The first component consists of the knowledge base, which includes methodological and didactic elements of the independent learning process, the level of preparation, development and usefulness of the perception of the educational course. The use of hierarchical structures of frames and productive rules is proposed as a model of knowledge presentation.

The second component is the "intellectual core" of the system, which allows analyzing and correcting the individual educational scenario of students based on knowledge about the current independent education process (reading, analysis of literary works) and information about previous educational processes (directions for their correction) from the knowledge base. , the neural network can analyze the independent learning process in individual sessions of the intellectual environment activity, determine the change in the state of this process and manage it without the help of a conceptual analyzer [7,8].

The use of artificial intelligence can bring significant changes in the field of education and create new opportunities for its reshaping. The introduction of artificial intelligence technologies into the field of education increases the efficiency of the educational process and the funds spent on its organization.

Artificial intelligence makes it possible to create an individual educational trajectory for each student for successful study at HEI (Higher Education Institutions) and further professional growth.

Here are some promising directions for using artificial intelligence.

Adaptive and personalized education implies the selection of the necessary educational content for the needs of each student with a different mastery level, with the ability to monitor the progress in learning and change its trajectory depending on the results.

The automatic evaluation system allows to objectively assess the level of students' knowledge, analyze information about educational results, make recommendations, and develop effective individual development plans.

Intermediate learning is a special computer program that helps the student to reinforce the material taught, determines when it is likely to be forgotten and provides recommendations for repetition.

A proctoring system with the ability to remotely analyze the behavior of the student taking the exam is also promising: the frequency of looking away from the monitor, attempts to change the tab in the browser, the presence of strangers or voices, etc. It should be noted that, on the one hand, the above-mentioned cases can be objective in the assessment, but on the other hand, the imperfection of the system leads to inaccuracies in some cases.

The level of digitization in HEIs in our country differs sharply from each other, therefore, in order to ensure the tasks defined in the Strategy, it is necessary to establish the appropriate digital capacity, appropriate material and technical base, multi-level educational system, data analysis, artificial intelligence and its application in the relevant fields. The necessary digital educational environment creation and development contributes to increasing the level of digital competence of all participants of the educational process.

In conclusion, it can be said that the prospective directions of the use of artificial intelligence in the field of higher education have been analyzed, and their effective implementation will allow choosing the most optimal educational strategy adapted to the individual abilities and needs of students and the needs of the labor market and the methodology, methodology and didactics of online education based on the use of neural network technologies are still in the formative stage, so it is very important to meet the progress and attract the interest of the public, leaders and pedagogical staff in such conditions.

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Rezyume: Maqolada oliy ta'lim muassasalarinig o'quv jarayonida, xususan texnika oliy ta'lim muassasalarida tajriba va amaliy mashg'ulotlarini tashkil etishda sun'iy intellekt texnologiyalarini qo'llashning joriy holati va istiqbollari to'g'risida batafsil to'xtab o'tilgan. Jumaladan, sun'iy intellekt yordamida o'quv jarayoni samaradorligini oshirish bosqichlari, uning ijobiy ta'siri va sohaga joriy etish muammolari tahlil qilingan.

Резюме: В статье подробно рассматриваются современное состояние и перспективы использования технологий искусственного интеллекта в образовательном процессе высших учебных заведений, особенно в технических вузах. В частности, были проанализированы этапы повышения эффективности образовательного процесса с помощью искусственного интеллекта, его положительные эффекты и проблемы его реализации на местах.

Kalit so'zlar: raqamli texnologiya, sun'iy intellekt, raqamli o'qitish, virtual haqiqat.

Ключевые слова: цифровые технологии, искусственный интеллект, цифровое обучение, виртуальная реальность.

UDK 621.315.592

**EFFECTS OF LOW INTENSITIES OF LASER RADIATION ON THE
ELECTROPHYSICAL CHARACTERISTICS OF GALLIUM ARSENIDE DIODE
STRUCTURES WITH A SCHOTTKY BARRIER**

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Summary: In this article, the effect of low intensities of laser radiation at a radiation density less than critical on the electrical characteristics of arsenide gallium diode structures with a Schottky barrier Cr-n-n⁺-GaAs is investigated. The possibility of controlling their parameters at relatively low laser radiation intensities is shown.

Key words: laser, diode structures, Schottky barriers.

As is known, in the manufacture of semiconductor diodes in the process of technological processing in the base and near-contact regions of the semiconductor, defects arise, leading to a deterioration in the functional characteristics and parameters of the devices.

Their improvement can be achieved by additional athermal treatment at the final stage of device manufacturing by exposure to microwave, laser, or ultrasonic radiation. Among them, laser processing of semiconductor device structures draws attention with its mobility, accessibility, and good controllability [1]. Thus, to date, a lot of experience has been accumulated in the laser method of forming ohmic contacts to a variety of semiconductor materials. The influence of laser treatments on the properties of semiconductor materials, including GaAs, is also considered. Several models are proposed for the mechanisms of action of laser radiation associated with the threshold energy density of laser radiation, at which changes in the surface morphology of GaAs and InP crystals are observed. According to the authors of [2], these changes are caused by the decomposition of compounds at temperatures below the melting point and are explained in terms of the thermal mechanism. The authors of the papers suggest that the mechanism of laser exposure is determined by specific conditions and, depending on the parameters of laser radiation, can be both thermal and athermal.

At the same time, the influence of the action of laser radiation on the electrical properties of barrier contacts at low laser radiation intensities, when there is no decomposition of a semiconductor material, such as GaAs, has practically not been studied.

Therefore, the study of the influence of laser influences on the electrical characteristics of gallium arsenide semiconductor devices remains relevant [3].

A model object for such studies is a gallium arsenide diode structure with a Schottky barrier, in which the metal-GaAs interface is most sensitive to such impacts. This is confirmed by studies of the effect of low doses of ionizing radiation, performed on gallium arsenide diode structures with a Schottky barrier [4]. In this paper, we present the results of studying the influence of low laser radiation intensities at a radiation density less than the critical one on the electrical characteristics of gallium arsenide diode structures with a Cr-n-n⁺-GaAs Schottky barrier. Diode structures of Cr-n-n⁺-GaAs were created by deposition of chromium with a thickness of ~80 nm through a mask with a diameter of ~1.3 mm onto an unheated preliminarily chemically cleaned n-n⁺-GaAs surface. The area of diode structures in this case was 1.3×10^{-2} cm². The concentration of dopant in diode structures in the n-film is $\sim 4 \times 10^{15}$ cm⁻³, in the substrate $\sim 10^{18}$ cm⁻³, the thicknesses of n and -n⁺ layers are 20 and 300 μm, respectively.

The ohmic contact to n+ GaAs was formed using gold-germanium eutectic with its subsequent gold plating. A ruby laser with a wavelength of 0.69 μm was used as a laser source (spot area 10^{-3} cm^2 , pulse duration 40 ns, radiation intensity was measured within $P=400\text{-}1400 \text{ W/cm}^2$). Before and after laser treatment, direct branches of current-voltage characteristics (CVCs) of diode structures at room temperature were measured, from which the ideality factor n and the height of the Schottky barrier were determined.

On fig. Shown is the direct CVC branch of the Cr-n-n+-GaAs diode structure measured at room temperature before and after laser irradiation.

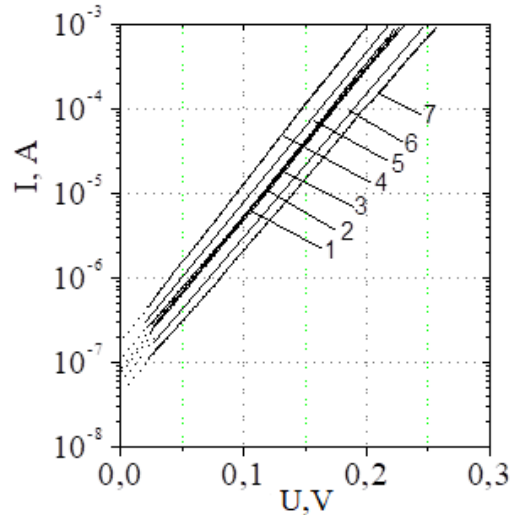


Fig. Direct branches of the CVC of a diode with a Cr-n-n+-GaAs Schottky barrier depending on the intensity of laser radiation: 1-out, 2-7, respectively 400, 600, 800, 1000, 1200, 1400 W/cm^2 .

From fig. it can be seen that the I–V characteristics presented on it are described by the known exponential dependence of the current I on the voltage U

$$I = I_0 \cdot \exp\left[\frac{q \cdot U}{n \cdot k \cdot T}\right] \quad (1)$$

$$\text{where } I_0 = A^* \cdot T^2 \cdot S \cdot \exp\left[-\frac{q \cdot \varphi_B}{k \cdot T}\right] \quad (2)$$

here - saturation current, $q=1.6 \cdot 10^{-19} \text{ C}$ - electron charge, n - ideality coefficient, $k=1.38 \cdot 10^{-23} \text{ J/deg}$ - Boltzmann constant, T - temperature, S - contact area, A^* is the effective Richardson constant of GaAs.

The values of φ_B and n calculated from the direct branches of the CVC shown in Fig. from Table. It can be seen that the change in the parameters of diode structures with a Cr-n-n+-GaAs Schottky barrier depending on the intensity of laser radiation is nonmonotonic. At laser radiation intensities of 400 and 600 W/cm^2 , the parameters of the diode structures do not change.

An increase in laser irradiation to 800 and 1000 W/cm^2 is accompanied by a slight decrease in the barrier height φ_B and an increase in the ideality factor n . Irradiation of diode structures at $P=1200 \text{ W/cm}^2$ leads the CVC to the initial (initial) state.

The processing of Schottky diodes at a radiation intensity of 1400 W/cm^2 leads to an increase in φ_B compared to the initial value by 0.04 V, and the value of n decreases by 0.08. In this case, the value of the saturation current nonmonotonically (as well as the height of the Schottky barrier) changes with an increase in the radiation intensity from 400 W/cm^2 to 1400 W/cm^2 (table).

Table. Electrophysical parameters of Cr-n-n+GaAs Schottky diodes before and after laser treatment.

Options	Laser radiation intensity, W/cm ²						
	Исх.	400	600	800	1000	1200	1400
φ_B , B	0.71	0.71	0.71	0.70	0.69	0.71	0.74
n	1.13	1.13	1.13	1.15	1.21	1.13	1.08
I_s , A	9.8×10^{-8}	9.2×10^{-8}	9.0×10^{-8}	1.1×10^{-7}	10^{-7}	5.7×10^{-8}	4.1×10^{-8}

The observed changes in the parameters of the Schottky barriers during laser treatment at 800 and 1000 W/cm² are apparently associated with the destruction of the oxide film at the Cr-GaAs interface, which consists of oxides of gallium and arsenic, and the formation in the near-contact region of GaAs of a thin layer enriched in donors, which can be own defects. These circumstances cause a decrease in the barrier height φ_B and a decrease in the value of n.

Increasing the laser radiation intensity to 1200, 1400 W/cm² can lead to further modification of the near-contact layer, enriching it with arsenic vacancies, which are acceptors; in this layer, an inversion of the conduction type occurs. Such a modification of the GaAs near-contact region causes an increase in φ_B and a decrease in n.

A similar modification of the near-contact GaAs layer to a depth of up to 20–30 μm was reported by the authors of [6] under the action of laser radiation on the structure of GaAs-Te single crystals and the electrical characteristics of gallium arsenide MIS structures [7]. In both cases, the laser radiation intensities were much higher. However, according to [8], if the laser radiation density is less than the critical one (as is the case in our case), it can be assumed that the processes stimulated by such laser radiation at the phase boundaries and on the GaAs surface are of an athermal nature, i.e., changes in the near-contact layers should extend over thicknesses not exceeding 10 nm.

Such an order of thickness of the modified GaAs layers and the corresponding concentrations of the donor (acceptor) impurity will determine the parameters of the Schottky barriers. As regards the presence of a thin layer of native oxides on the GaAs surface, such a layer up to 2 nm thick occurs on a real GaAs surface [8].

The possibility of its removal by the thermal method was ruled out in our case, since the substrate was not warmed up before chromium deposition. To clarify the mechanism that determines the change in the parameters of Cr-n-n + GaAs Schottky diodes, it is necessary to study the mass transfer of chromium, gallium, and arsenic stimulated by laser radiation in the near-contact region of GaAs and to determine the phase composition of the transition layer product in the region of the Cr-GaAs interface.

From the results obtained, it can be assumed that the effect of laser irradiation on the parameters of diode structures with a Cr-n-n+-GaAs Schottky barrier indicates the possibility of controlling their parameters at relatively low laser radiation intensities.

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Rezyume: Bu maqolada Shottki bar'erli Cr-n-n⁺-GaAs arsenidgalliyli diodli strukturalarning elektrofizik xususiyatlariga kritik nurlanish zichligidan kichik bo'lgan past intensivlikdagi lazer nurlanishining ta'siri tadqiq qilingan. Nisbatan past intensivlikdagi lazer nurlanishi bilan ularning parametrlarini boshqarish mumkinligi ko'rsatilgan.

Резюме: В данной статье исследовано влияние малых интенсивностей лазерного излучения при плотности излучения меньше критической на электрофизические характеристики арсенидгаллиевых диодных структур с барьером Шоттки Cr-n-n⁺-GaAs. Показана возможность управления их параметрами при сравнительно невысоких интенсивностях лазерного излучения.

Kalit so'zlar: lazer, diodli struktura, Shottki to'sig'i.

Ключевые слова: лазер, диодная структура, барьер Шоттки.

UDC 519.85

MATHEMATICAL AND SOFTWARE ASPECTS OF SOUND PROCESSING

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Summary: *We can get an imprint of a fragment of the ether and all the reference fragments, and all that remains for us is to learn how to quickly search for candidates and compare fragments. Let's look at the comparison problem first. It is clear that the prints will never match exactly due to noise and distortion. But it turns out that the frequencies coarsened in this way survive all distortions quite well (frequencies almost never "float"), and a sufficiently large percentage of frequencies coincide exactly - thus, we only have to find the shift at which there are many coincidences among the two frequency sequences. An easy way to visualize this is to first find all pairs of points that matched in frequency, and then build a histogram of the time differences between the matched points. If two fragments have a common area, then the histogram will have a pronounced peak (and the position of the peak indicates the start time of the matched fragment)[1].*

*The purpose of this work is to analyze the sound, which is necessary in various studies. The results of processing, analysis of sound, specifically music of different genres are given. To work with neural networks, we use Google Colab is a free service that provides GPUs and TPUs as runtime environments. **Google Colab** is a service that allows you to run Jupyter Notebook [3,4].*

Jupyter Notebook is a shell for interactive computing in python .

Key words: *sound, short-time Fourier transform, discrete Fourier transform , filter, frequency response, audio analysis , window, sample, and audio signal , chalk-frequency cepstral coefficients, spectral centroid, zero-crossing frequency, chromaticity frequency, spectral frequency rolloff.*

1. Introduction The development of computer technology has significantly changed many areas of human activity, creating new opportunities and increasing the efficiency of traditional types of work. One of the areas in which the computer has made a real revolution is audio technology and, in particular, musical activity in its diverse applications.

Even early personal computers differed from calculators and mainframes in that they could make sounds using a small speaker installed in their case. And although the acoustic capabilities of the PC were more than modest, already at the dawn of the computer era, music editors appeared, with the help of which it was possible to create a "sound file" for connecting to a particular program written by the user.

With the advent of sound cards, new opportunities have opened up for users. And it's not even that the sound quality has improved by an order of magnitude [3,4]. A new (*sound*) subsystem has appeared - a set of software and hardware designed for :

- **recording audio signals** coming from external sources, such as a microphone or tape recorder. During the recording process, the input analog audio signals are converted into digital ones and can then be stored on a PC hard drive;
- **playback of previously recorded** audio data using an external speaker system or headphones (headphones). During playback, the audio signal is read from the storage medium, converted from digital to analog, and sent to the speaker system;
- **mixing** (mixing) when recording or reproducing signals from several sources;
- **simultaneous recording and playback of** sound signals;
- **audio signal processing** : editing, combining or separating signal fragments, filtering, changing its level, etc.;

Sounds are time-varying signals in the real world, and indeed, their entire meaning is tied to such time-varying. Therefore, it is interesting to develop methods of sound analysis that allow us to capture at least some of the distinctive features of sounds that change over time in order to facilitate the tasks of understanding, comparing, modifying and resynthesis .

2. Mathematical foundations of sound processing

2.1. Short-time Fourier Transform

The Short Time Fourier Transform (STFT) is nothing but a Fourier analysis performed on slices of a time domain signal. To simplify the formulas a bit, we will represent the STFT assuming a unitary sampling rate ($F_s = T^{-1}=1$).

There are two additional STFT representations: a representation and a representation based on DFT[2].

2.2. View Filterbank Suppose we have a prototype of an ideal low-pass filter, the frequency response of which is shown in Fig.1. Let $w(\cdot)$ and $W(\cdot)$ be the impulse response and transfer function, respectively, of such a filter prototype.

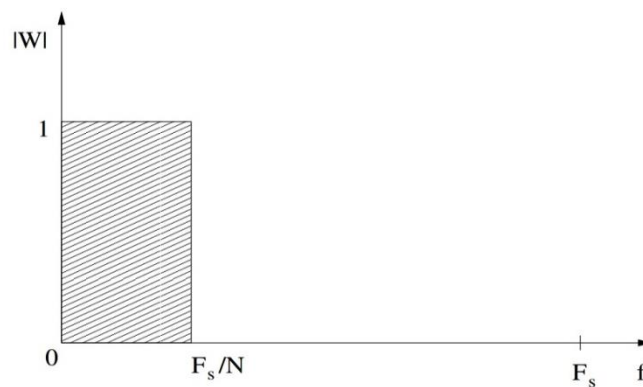


Fig.1. Frequency response of a low-pass filter prototype

The modulation of the signal $y(n)$ by the carrier signal $e^{j\omega_0 n}$ is defined as the (complex) multiplication $y(n)e^{j\omega_0 n}$. In the frequency domain, this means shifting the frequency by $\Delta\omega = \omega_0$ (shift theorem). In other words, modulating a signal means moving its low frequency content into the region around the carrier frequency. On the other hand, we call signal demodulation $y(n)$ its multiplication by $e^{-j\omega_0 n}$, which translates the components around ω_0 into the neighborhood of dc .

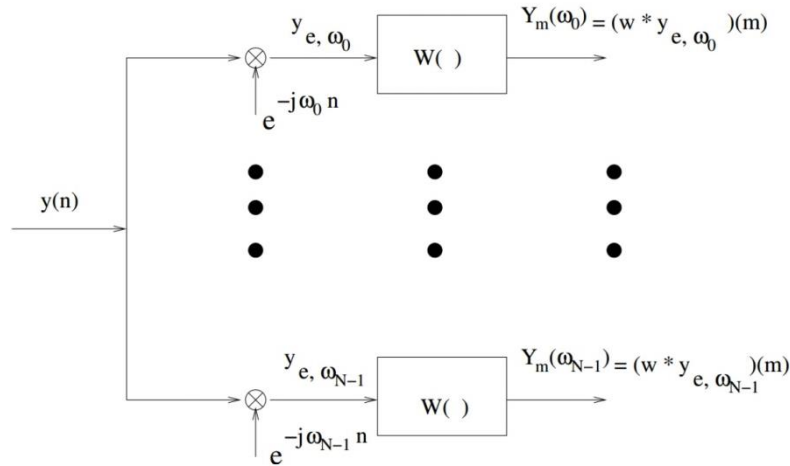
With the help of demodulation, we can get a filter bank that cuts the spectrum (between 0Hz and F_s) into N equal non-overlapping parts. Namely, we can convert the input signal to a frequency and filter it with a prototype low-pass filter to isolate a specific slice of the frequency spectrum. This procedure is shown in Fig. 2.

2.3. DFT View (Discrete Fourier Transform)

The scheme of Fig.2 can be obtained by the Fourier transform of the "window" sequence. Recall that the DTFT of an infinite sequence

$$Y(\omega) = \sum_{n=-\infty}^{\infty} y(n)e^{-j\omega n} \quad (1)$$

If DTFT (discrete-time Fourier transform) is computed for the $y(\bullet)$ portion weighted by analysis



Rice. 2: Decomposition of the signal into a set of non-overlapping frequency slices $\omega_0, \dots, \omega_{N-1}$ - center frequencies of the analysis channel bands

For window $w(m - n)$, we get the STFT frame:

$$Y_m(\omega) = \sum_{n=-\infty}^{+\infty} w(m - n)y(n)e^{-j\omega n} = e^{-j\omega n} \sum_{r=-\infty}^{+\infty} w(r)y(m - r)e^{j\omega r} \quad (2)$$

where the third term of the equality is obtained by defining $r \triangleq m - n$, m is a variable that takes into account the temporary dislocation of the window. Thus, STFT turns out to be a function of two variables, one can be considered as frequency, and the other as a time shift.

DTFT is a periodic function of a continuous variable and can be inverted using an integral calculated over a period

$$w(m - n)y(n) = \frac{1}{2\pi} \int_{-\pi}^{\pi} Y_m(w)e^{j\omega n} d\omega \quad (3)$$

With proper $(m = n)$ window alignment, we can calculate $\text{если } w(0) = 0$,

$$y(n) = \frac{1}{2\pi w(0)} \int_{-\pi}^{\pi} Y_n(w)e^{j\omega n} d\omega \quad (4)$$

STFT in its formulation (2) can be considered as a convolution

$$Y_m(\omega) = (w * y_s)(m) \quad (5)$$

where $y_s(n) = y(n)e^{-j\omega n}$ demodulated signal. If the impulse response of an ideal low-pass filter is given, and if $\omega = wk$ is given, then a channel is obtained from the filterbank Fig.2. In general, $w(\cdot)$ will be the impulse response of a non-ideal low-pass filter, but the filterbank representation will still be relevant.

In practice, we need to calculate STFT on a finite set of N points. In what follows, we assume that the window has length $R \leq N$ samples, so we can use DFT on N points, thereby obtaining a frequency axis sample between 0 and 2π multiples $2\pi/N$.

The k -th point in the transform region (for example, the k -th DFT cell) is given by

$$Y_m(k) = \sum_{n=0}^{N-1} w(m - n)y(n)e^{-j\frac{2\pi kn}{N}} \quad (6)$$

and, using the inverse DFT

$$w(m - n)y(n) = \frac{1}{N} \sum_{k=0}^{N-1} Y_m(k)e^{j\frac{2\pi kn}{N}} \quad (7)$$

By properly aligning the window $(m = n)$ and assuming we get

$$y(n) = \frac{1}{Nw(0)} \sum_{k=0}^{N-1} Y_n(k)e^{j\frac{2\pi kn}{N}} \quad (8)$$

More generally, we can reconstruct (resynthesis) a time domain signal using

$$y(n) = \frac{1}{Nw(m-n)} \sum_{k=0}^{N-1} Y_m(k) e^{\frac{j2\pi knN}{N}} \quad (9)$$

where, $w(m-n) \neq 0$, which is true, given an integer, for a non-trivial window defined for

$$m + n_0 \leq n \leq m + n_0 + R - 1 \quad (10)$$

Figure 3 shows the operations associated with the analysis and resynthesizes of an STFT frame (R = 5, N = 8). Reconstruction is possible for $1 \leq n \leq 5$ ($n_0 = -2$).

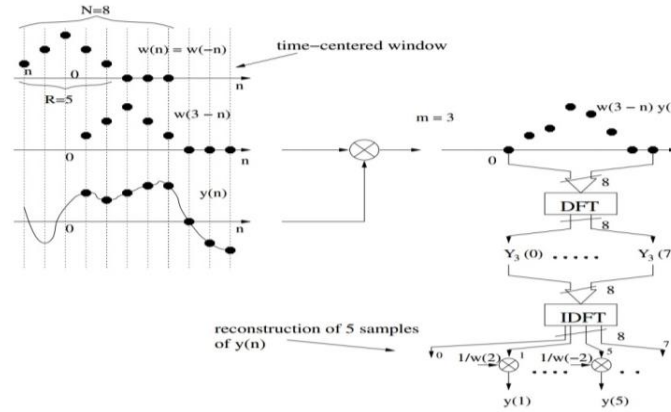


Fig.3: Analysis and resynthesizes of the STFT framework

2.4. Window

Rectangular window

The simplest analysis window is a rectangular window.

$$w_R(n) = \begin{cases} 1 & n = 0, \dots, R-1 \\ 0 & \text{в другом случае} \end{cases} \quad (11)$$

We consider a filter that has (11) as an impulse response, the frequency response of which is determined by the Fourier transform $w_R(n)$:

$$W_R(\omega) = \sum_{n=-\infty}^{+\infty} w_R(n) e^{-j\omega n} = \sum_{n=0}^{R-1} e^{-j\omega n} = \frac{1-e^{-j\omega R}}{1-e^{-j\omega}} = \frac{e^{-j\omega \frac{R-1}{2}} \sin \frac{\omega R}{2}}{\sin \frac{\omega}{2}} \quad (12)$$

Real part of the function $\text{sinc}_R(\omega)$ shown in Figure 4 for various window lengths R.

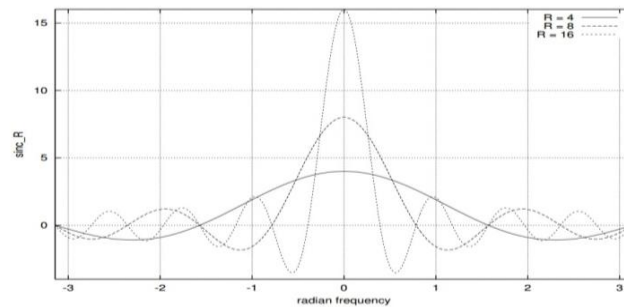


Fig.4. $\text{sinc}_R(\omega)$ for different values of the window of length R.

In Fig. 4, you can see that $2\pi/R$ is the zero closest to dc. Thus, it can be said that if we use the rectangular window as the prototype of the filter shown in Fig.2, the equivalent bandwidth is $2\pi/R$. If we neglect the aliases for a moment, we realize that we can destroy every channel. $Y_m(\omega k)$ by the coefficient R without losing any information.

A superficial look at expression (12) seems to indicate that the shifted $\text{sinc}R$ replicas produce smoothing in the base range $-\frac{2\pi}{R}, \frac{2\pi}{R}$. Indeed, if we sum the shifted replicas, we check that the smoothing components are cancelled. Thus, using this window, it is possible to reduce the output channels by a factor equal to the length of the window. Also, if we choose $N=R$, we can perform one FFT (*fast Fourier transform*) per frame and advance the window by N samples at each step[2].

According to (7), the reconstruction (resynthesizes) of the analyzed signal can be obtained by summing the filter, as shown in Fig.5. The reconstruction can be interpreted as a bank of oscillators driven by the analysis data. The two stages shown in Figures 2 and 5, taken as a whole, are often referred to as a phase vocoder.

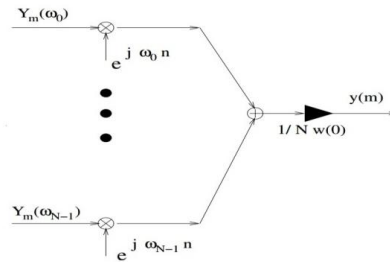


Fig.5. signal recovery from a set of non-overlapping frequency slices. $\omega_0, \dots, \omega_{N-1}$ are the center frequencies of the analysis channel bands.

Between the analysis step in Figure 2 and the synthesis step in Fig.5, a decimation step can be inserted. Namely, with the help of a rectangular window, we can reduce the intermediate sampling rate to F_s / R . of course, in order to do the filter bank summation in Fig.5, an interpolation step would be required to bring the sample rate back to F_s .

For a rectangular window, the window is shifted in time by R samples after each DFT calculation . This time shift is technically called the jump size. In the case of a rectangular window, hop sizes less than R do not add any information for analysis.

3. Audio analysis Audio analytics —a field that includes automatic speech recognition (ASR), digital signal processing, and music classification, tagging, and generation—is an emerging subdomain of deep learning applications. Some of the most popular and widespread machine learning systems such as Alexa, Siri and Google virtual assistants Home , are products based on models that extract information from audio signals [16].

Audio fragments are presented in the format .wav . Sound waves are digitized by sampling at discrete intervals known as sampling rates (typically 44.1 kHz for CD-quality audio, i.e. 44,100 samples per second).

Each sample represents the amplitude of the wave in a certain time interval, where the bit depth (or dynamic range of the signal) determines how detailed the sample will be (typically 16 bits, i.e. the sample can vary from 65,536 amplitude values).

In signal processing, sampling is the transformation of a continuous signal into a series of discrete values. The sampling rate is the number of samples in a certain fixed amount of time. A high sampling rate results in less information loss, but more computational overhead.

Audio Processing Applications:

These include:

- Indexing music collections according to their audio features.
- Music recommendation for radio channels.
- Similarity search for audio files (Shazam).
- Speech processing and synthesis - artificial voice generation for conversational agents.

3.1. Audio Processing with Python

Sound is represented in the form of an audio signal with parameters such as frequency, bandwidth, decibel, and so on. A typical audio signal can be expressed as a function of amplitude and time [18-20].

Some devices can capture these sounds and present them in a machine-readable format. Examples of these formats:

- wav (Waveform Audio file)
- mp3 (MPEG-1 Audio layer 3)
- WMA (Windows media audio)

The audio processing process involves extracting acoustic features relevant to the task at hand, followed by decision trees that include knowledge discovery, classification, and pooling. The Python libraries help with this task.

3.2. Python Audio Libraries

We will use two libraries to collect and play audio:

1. **Librosa** Librosa can work with any sound signals, but is mainly focused on music. It allows you to create a complete system for extracting musical information (MIR). The module is well documented , and there are many tutorials on how to use it.

We can use ffmpeg module with many ready-made solutions for converting audio signals .

2. **IPython.display.Audio** Python.display.audio allows you to play audio directly in Jupyter notebook .

The sampling rate is the number of samples (fluctuations) of sound transmitted per second, measured in Hz or kHz.

IPython.display.audio is used to play audio.

Using **librosa.display.waveplot** , an array of audio data can be visualized.

3.3. Spectrogram processing in python A spectrogram is a visual representation of the frequency spectrum of an audio or other signal as it changes over time. They are sometimes also called sonograms . On two-dimensional graphs, the frequency is set on the first axis, and the time is set on the second.

To create a spectrogram in Python , we use **librosa.display.specshow** .

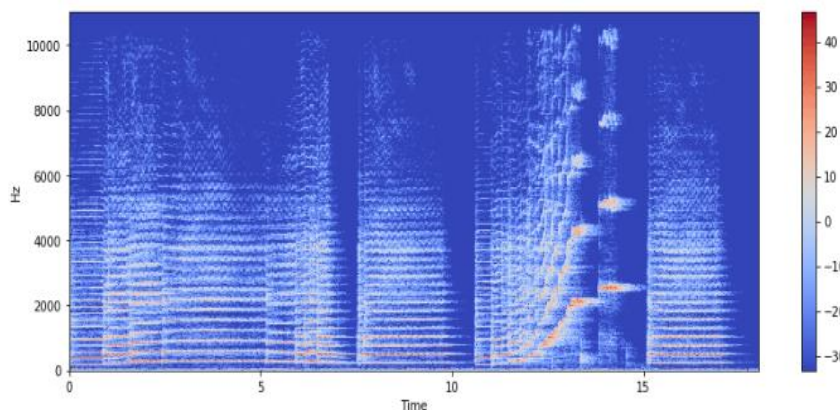


Fig.6. Audio file spectrogram

The vertical axis is the frequencies (from 0 to 10 kHz) and the horizontal axis is the time of the clip. Since all significant changes occur in the lower part of the spectrum, the frequency axis can be converted to a logarithmic one.

Entity Extraction Each sound signal has many characteristics, from which the desired ones should be selected . The process of extracting information for analysis is called feature extraction or entity extraction (feature extraction) [17].

Zero crossing frequency Zero crossing frequency (zero crossing rate) is the frequency of the sign change of the signal, i.e. the frequency with which the signal changes from positive to

negative and vice versa. This feature is widely used for both speech recognition and musical information extraction. For metal and rock, this parameter is usually higher than for other genres, due to the large number of drums.

Let's calculate the zero crossing frequency for our Python example :

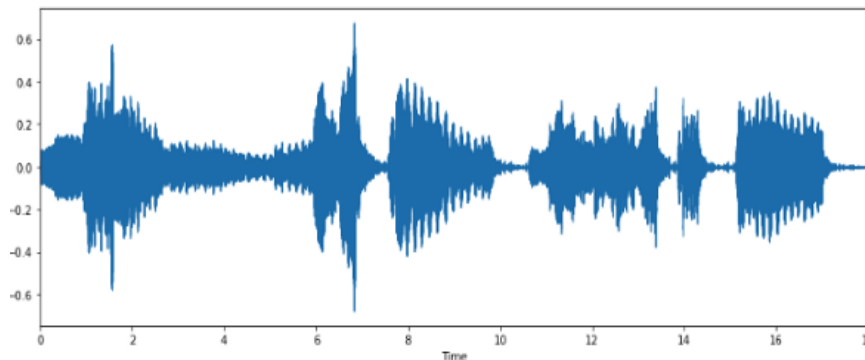


Fig.7. Determining the frequency of the zero crossing

Spectral centroid The spectral centroid indicates where the "center of mass" of the sound is located and is calculated as a weighted average of all frequencies.

In blues compositions, the frequencies are evenly distributed, and the centroid lies somewhere in the middle of the spectrum. In the metal, a pronounced frequency shift is observed towards the end of the composition; therefore, the spectroid lies closer to the end of the spectrum.

Let us calculate the spectral centroid for each frame using **librosa.feature.spectral_centroid**:

Spectral rolloff It is a measure of a waveform that represents the frequency below which a certain percentage of the total spectral energy lies, eg 85%.

librosa.feature.spectral_rolloff calculates the frequency rolloff for each frame.

Chalk-frequency cepstral coefficients Mel-frequency cepstral coefficients (MFCC) of a signal are a small set of characteristics (usually around 10-20) that succinctly describe the overall shape of the spectral envelope. This parameter simulates the characteristics of the human voice.

We can also scale so that each coefficient measurement has zero mean and unit variance.

Color frequency Chromaticity (chroma features) is an interesting and powerful representation of musical sound, in which the entire spectrum is projected into 12 containers representing 12 different semitones of the musical octave[20].

For calculations, we use **librosa.feature.chroma_stft** :

After getting acquainted with the structure of an acoustic signal and the features of the process of extracting musical information, let's consider Python libraries for working with sound.

Let's try to model a genre classifier of music. It will come in handy if you need to parse a bunch of unknown mp3 files.

Genre classifier of music Before training a classification model, we need to transform the raw data from the audio samples into a more meaningful representation. Let's convert the clips to **wav format** so that Python can work with them using the SoX module .

Now let's extract all the necessary information from the audio files:

- chalk-frequency cepstral coefficients,
- spectral centroid ,
- zero crossing frequency,
- color frequencies,
- spectral rolloff.

We will save all these functions in **.csv** file.

You can use existing classification algorithms to classify songs into genres, or use spectrograms directly, or extract entities and apply classification models to them.

Genre classification is just one of many applied branches of musical information extraction .

4. Results To begin with, let's ask ourselves a question: who needs to recognize ads on the radio anyway? This is useful for advertisers who can track the actual release of their commercials, catch cuts or interruptions; radio stations can monitor the release of network advertising in the regions, etc. The same recognition problem arises if we want to track the playback of a piece of music, or recognize a song from a small fragment [16-18].

More strictly, the task is formulated as follows: we have a certain set of reference audio fragments (songs or commercials), and there is an audio recording of the broadcast, in which some of these fragments presumably sound. The task is to find all the fragments that have sounded , to determine the moments of the beginning and the duration of the playback. If we analyze broadcast recordings, then the system as a whole needs to work faster than real time.

Everyone knows that sound (in the narrow sense) is the waves of compression and rarefaction propagating in the air. A sound recording, for example, in a wav file, is a sequence of amplitude values (physically, it corresponds to the degree of compression, or pressure).

But we do not perceive these frequency fluctuations directly, but hear sounds of different frequencies and timbres. Therefore, another way of visualizing sound is often used - spectrogram, where time is represented on the horizontal axis, on vertical - frequency, and the color of the dot indicates the amplitude.

The task of finding a fragment on the air can be divided into two parts: first, find candidates among a large number of reference fragments, and then check whether the candidate really sounds in this fragment of the air, and if so, at what moment the sound begins and ends. Both operations use the “fingerprint” of the sound fragment for their work. It must be noise-resistant and compact enough. This imprint is constructed as follows: we divide the spectrogram into short time segments, and in each such segment we look for the frequency with the maximum amplitude (in fact, it is better to look for several maxima in different ranges, but for simplicity, we will take one maximum in the most meaningful range). A set of such frequencies (or frequency indices) is a fingerprint. It is very rude to say that these are “notes” that sound at every moment of time.

5. Conclusion

The basic definition of video is nothing but images and sound arranged along the time axis. Video can be characterized by aspect ratio, frame rate, interlaced or progressive scan, color model, compression method, etc. [5-12].

Given M video fragment, $X[n]$ is the first frame and $X[n+M-1]$ is the last frame and $Y[n]$ is a vector stacking all of them together to form a fragment (part) of the entire video.

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Rezyume: Biz efir parchasi va barcha mos yozuvlar bo'laklarining izini olishimiz mumkin va biz uchun qolgan narsa nomzodlarni tezda qanday qidirish va parchalarni solishtirishni o'rganishdir. Keling, avvalo taqqoslash muammosini ko'rib chiqaylik. Shovqin va buzilish tufayli tazyiqlar hech qachon to'liq mos kelmasligi aniq. Ammo ma'lum bo'lishicha, bu tarzda qo'pollashtirilgan chastotalar barcha buzilishlarga juda yaxshi bardosh beradi (chastotalar deyarli hech qachon "suzmaydi") va chastotalarning etarlicha katta foizi to'liq mos keladi - shuning uchun biz faqat ko'p tasodiflar mavjud bo'lgan siljishni topishimiz kerak. ikki chastota ketma-ketligi orasida. Buni tasavvur qilishning oson usuli - avval chastotada mos keladigan barcha juft nuqtalarni topish va keyin mos keladigan nuqtalar orasidagi vaqt farqlarining gistogrammasini yaratish. Agar ikkita fragment umumiy maydonga ega bo'lsa, u holda gistogramma aniq cho'qqiga ega bo'ladi (va cho'qqining pozitsiyasi mos keladigan fragmentning boshlanish vaqtini ko'rsatadi)[1].

Ushbu ishning maqsadi turli tadqiqotlarda zarur bo'lgan tovushni tahlil qilishdir. Ovozni, xususan, turli janrdagi musiqalarni qayta ishlash, tahlil qilish natijalari berilgan. Neyron tarmoqlar bilan ishlash uchun biz Google Colab-dan GPU va TPU-larni ish vaqti muhiti sifatida taqdim etadigan bepul xizmatdan foydalanamiz. Google Colab — Jupyter Notebook [3,4] ishga tushirish imkonini beruvchi xizmat.

Jupyter Notebook - bu python-da interaktiv hisoblash uchun qobiq.

Резюме: Мы можем получить отпечаток фрагмента эфира и всех эталонных фрагментов, и все, что нам остается, это научиться быстро искать кандидатов и сравнивать фрагменты. Сначала рассмотрим задачу сравнения. Понятно, что отпечатки никогда не будут точно совпадать из-за шумов и искажений. Но оказывается, что загруппированные таким образом частоты довольно хорошо переносят все искажения (частоты почти никогда не "плавают"), и достаточно большой процент частот совпадает точно - таким образом, нам остается только найти сдвиг, при котором совпадений много среди двух частотных последовательностей. Простой способ визуализировать это — сначала найти все пары точек, совпадающие по частоте, а затем построить гистограмму разницы во времени между совпавшими точками. Если два фрагмента имеют общую площадь, то гистограмма будет иметь ярко выраженный пик (причем положение пика указывает на время начала совпадающего фрагмента)[1].

Целью данной работы является анализ звука, что необходимо в различных исследованиях. Приведены результаты обработки, анализа звука, конкретно музыки разных жанров. Для работы с нейронными сетями мы используем Google Colab — бесплатный сервис, предоставляющий GPU и TPU в качестве среды выполнения. Google Colab — это сервис, позволяющий запускать Jupyter Notebook [3,4].

Jupyter Notebook — это оболочка для интерактивных вычислений на python

Kalit so'zlar: tovush, qisqa muddatli Furye o'zgarishi, diskret Furye o'zgarishi, filtr, chastotali javob, audio tahlil, oyna, namuna va audio signal, bo'r chastotali tsepstral koeffitsientlar, spektral markaz, nolga o'tish chastotasi, xromatiklik chastotasi, spektral chastota rolloff.

Ключевые слова: звук, кратковременное преобразование Фурье, дискретное преобразование Фурье, фильтр, частотная характеристика, аудиоанализ, окно, выборка и звуковой сигнал, мел-частотные кепстральные коэффициенты, спектральный центроид, частота пересечения нуля, частота цветности, спектральная частота. скат.

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THE PROBLEM OF MONITORING THE STATE OF INFORMATION SECURITY OF THE AUTOMATED BANKING SYSTEM

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Summary: In the article discusses the structure of the information system in banking, the classification of the automated banking system and promising directions for the development of the automated banking system, lists the evolution of information security problems in the banking sector, depending on the degree of development of information technology.

Key words: automated banking system, information system, information security, information security incident monitoring systems, information security tools.

I. INTRODUCTION

Banking is one of those areas of human activity where the use of information technology (IT) is most effective, since the entire range of functions performed by banks can be fully automated. An automated banking system (ABS) is understood as an automated system that implements a banking technological process or part of it. Obviously, any failure in the movement of information flows in the ABS or violation of the rules for accessing them can lead to problems in the bank's operation and, as a result, to additional costs or lost profits. Therefore, banks, in order to protect their interests in the information sphere, apply enhanced measures to ensure the security of information systems (IS) in order to avoid cases of misuse of information, fraud, disruption of important operations and unauthorized disclosure of confidential information (CI) [1,2]. If the bank does not pay due attention to such threats, then sooner or later there will be a security breach of its ABS. The difficulties that the bank encounters in this case can very quickly force other credit institutions to close its refinancing lines or encourage customers to withdraw or not renew their deposits, which will quickly cause a liquidity crisis. In the context of a constant increase in the number of previously unknown threats and vulnerabilities in IS, an increasing number of information security tools (ISP) appear. This leads to the problem of operational processing of data on information security (IS) violations received from the information security facility.

II. MAIN PART

Modern IT in the banking sector is associated with the transition from traditional ABS to multifunctional integrated systems for managing the bank's activities. These systems take advantage of the opportunities offered by new communications, data warehousing technologies, paperless technologies, various forms of remote customer service, smart card, electronic money and wallet settlement systems, as well as through the use of artificial intelligence (AI) systems and adoption support tools. solutions (DSSS) [2,3].

Technologically, ABS are built on the principle of centralization of data processing and storage. ABS, being a multi-level hierarchical system, consists of modules that differ, as a rule, in functional features and are made in a single technological key, which are united around one financial core and operate on a single software and hardware platform. Each module is a software and information model of one of the functional areas of banking, for example, modules for loans, deposit accounting, etc.

Typically, there are three main modules in the ABS, each of which, in turn, consists of smaller modules and is a separate automated system (AS). These include: AS "Bank Management"; AS "Operating Day of the Bank"; AS "Banking electronic services".

AS "Bank Management" includes modules for the implementation of the main complexes of banking operations and expert systems (ES). The modules consist of separate automated

workstations (AWS) of bank employees, united in local area networks (LANs). ES are designed to control financial risks, manage bank resources, analyze the profitability of operations, analyze customer data and assess its potential as a consumer of services. AS "Operating Day of the Bank", which is the central module of the ABS, provides the preparation of an information base for solving all other tasks of the bank: settlement and cash services for legal entities; maintenance of accounts of correspondent banks; credit, deposit, currency transactions; any types of deposits of individuals and operations on them; stock transactions; payments using plastic cards;

AS "Banking electronic services" allows you to: make electronic payments using plastic cards; carry out interbank electronic settlements using special computer networks; conduct banking activities through the global computer network Internet.

Usually, the classification is carried out: according to the size of the banks to which the ABS is oriented, and the technological level of the ABS [3,4].

According to the size of banks, there are:

1) ABS for large banks, which accompany the provision of banking services in the main branch of the bank using high-performance microprocessor systems, and which, using expensive communication platforms, terminal systems and networks, connect banks with their numerous branches;

2) ABS for medium-sized banks that do not contain an explicit core of the system and have a LAN that unites the workstations of bank employees;

3) ABS for small banks that use personal computers connected in a LAN.

In terms of cost and requirements for computing facilities, ABS offered on the market are designed for medium and small banks.

Depending on the technological level, six generations of ABS are distinguished [5,6,7,8,9]:

1) stand-alone personal computers', MS DOS operating system, database management systems (DBMS) - FoxPro, Clipper; the basic element of the technology is an accounting entry; stand-alone workstations that are not connected or weakly connected according to data; exchange of information on floppy disks from computer to computer;

2) networked personal computers, MS DOS operating system, LAN operating system - NetWare Novell, DBMS - FoxPro, Clipper, Clarion; the basic element of the technology is accounting entry; stand-alone workstations connected by data through files on the server; file server technology;

3) networked personal computers, MS DOS operating system, Windows, LAN operating system - NetWare Novell, Windows NT, DBMS - own development based on the Btrieve records manager; the basic element of the technology is an accounting entry, less often a document; stand-alone workstations linked by data and weakly linked by functions; transition from "file-server" technology to "client-server" technology;

4) networked personal computers, operating system MS DOS, Windows, operating system LAN - NetWare Novell, Windows NT, DBMS - professional relational network; basic element of technology - accounting entry (rarely), document, transaction; stand-alone workstations linked by data and sometimes by functions; two-level technology "client - server";

"Client" is a set of programs that is designed for the work of a specific user. The term "server" refers to such software, the functions and capabilities of which are simultaneously used by a large number of users.

5) personal computers in a distributed network with several application servers', Windows operating system, less often UNIX, LAN operating systems - multitasking multi-user operating systems, DBMS - professional relational network; the basic element of the technology is a document or transaction; logical workstations, strongly connected in terms of data and functions within the LAN, weakly in terms of data within a distributed network; three-level technology "client - server";

6) heterogeneous network environment', DBMS - professional relational with an open interface (or several different DBMS); the basic element of the technology is a document (rarely) or a transaction; logical workstations, dynamically formed using component technology, strongly connected in terms of data and functions.

At present, fifth-generation ABSs are the most common, and sixth-generation ABSs are promising.

Let us list and briefly comment on the promising directions for the development of ABS [10,11]:

1) Improvement of remote service technologies. There is a gradual expansion of the range of electronic banking services provided, with the help of which almost any banking operation of the client can be performed, with the exception of cash services. These services include: management of bank accounts via the Internet for legal entities and individuals, i.e. "clientbank" and "internet bank" systems; maintenance of accounts from a mobile device, i.e. WAP-banking and SMS-banking; customer service by phone, i.e. telephone banking. This also includes the provision of brokerage services, which consists in providing individuals with access to Russian and international currency and stock markets (Internet trading).

2) Improving cashless payments based on plastic cards. It includes issuing smart cards and credit cards, expanding the range of additional services for plastic card holders, developing a network of payment terminals, developing and implementing electronic (digital) money and electronic wallet technologies.

3) Development of intelligent software. Such software is designed for forecasting, planning, performance evaluation and simulation of various situations in banks. Expert systems and neural network technologies are used. Neuropackages are used in the banking sector for managing a portfolio of securities, solving problems of financial analysis and planning, mortgage lending, credit risk assessment, etc.

4) Development of effective methods for storing large amounts of information. The direction is based on the use of electronic information data warehouse technology and the "client-server" architecture, which ensures the simultaneous operation of a large number of users and the processing of virtually unlimited amounts of information.

It should be noted that the client-server technology can be two-tier and multi-link. In the first case, the system consists of clients that directly interact with the database server; in the second, there is one or more intermediate links - application servers that perform a number of system and user functions. The server contains not only the database, but also search programs, which allows you to request the data the user needs; in addition, part of the application data processing may also be performed by the server.

5) Use of multimedia tools. Allows you to work not only with text and still images, but also with moving video, motion graphics, voice and high-quality sound.

6) Improving the AS for combating money laundering. It is necessary for banks to effectively combat the legalization of funds obtained illegally. In their work, such systems are based on the analysis of the client's behavior profile and his transaction history.

The identification of the facts of money laundering by the client is based on the performance of certain actions by him. These actions are described in the system in the form of rules. When this or that rule is fulfilled, the system issues a notification to the bank employee. An example of such rules are: the purchase of currency in excess of the threshold value; carrying out consecutive withdrawals of funds in an amount slightly less than the threshold; multiple transactions to the same account within a month; division of large transactions into several small ones, which are carried out within a short time and, possibly, in different branches of the bank; frequent receipt or sending of large sums of money abroad, etc.

7) Improving methods for ensuring the security of banking information and banking operations. Due to the constantly growing number of cases of fraud in banking, and, in particular, in remote banking (RBS).

So one of the serious problems, as the practice of recent years shows, has become "phishing" - a type of Internet fraud, the purpose of which is to gain access to confidential data of bank customers - logins and passwords, as well as information about their plastic cards by sending invitations to a fake (phishing) bank website, outwardly indistinguishable from the real one.

The methods of combating this type of fraud are: installation by the bank of security certificates on its Internet resources to confirm their identity; the use of dynamic data (one-time passwords) recorded on variable code cards or generated by hardware generators based on the information contained on the client's bank card for client authentication in RBS systems. In addition, the bank may provide significant discounts or distribute licensed anti-virus software among RB system customers completely free of charge.

The evolution of information security problems in the banking sector, depending on the degree of IT development, can be traced in Table 1, the information for which is borrowed from [12,13].

Table 1.

Stages of IT development in the banking sector and their corresponding IS problems

<i>Used IT</i>	<i>Information security problems</i>
<i>Manual processing.</i>	<i>Malicious access is very difficult. Highly intelligent barriers. Complex attacks.</i>
<i>Processing using computers (floppy disks).</i>	
<i>Division automation.</i>	<i>Lots of inputs to the ABS. Malicious access is technically possible, but difficult. Knowledge of system components is sufficient for successful attacks by intruders.</i>
<i>Specialized ABS.</i>	
<i>Integrated ABS</i>	<i>Numerous malicious access points. Qualified ABS personnel are the real source of threats.</i>
<i>Development of electronic services</i>	<i>Malicious access is difficult to control. Mass non-intelligent intruder (client) and staff. Opportunities for internal attackers are increasing. Simple effective attacks.</i>

III. CONCLUSION

It should be noted that in the process of ABS operation, it is necessary to timely assess the impact exerted by various factors, both on the efficiency of the system itself and its individual subsystems. Evaluation of the efficiency of the ISMS functioning, which is one of such ABS subsystems, requires significant intellectual efforts from the security administrator and is associated with certain time costs.

The effectiveness of monitoring may decrease due to the occurrence of violations in any of the ISMS components, however, as practice shows, the most negative impact occurs when errors occur in the operation of the information security system that are part of the monitoring system. At the same time, during the period of inactivity of the information security system or their incorrect functioning, additional threats of missing information security incidents arise, the implementation of which leads to a decrease in the efficiency of the ABS operation. In this regard, it is necessary to promptly identify and eliminate the causes of violations in the operation of the information security system, which is often very difficult for a security administrator to do, and sometimes simply impossible.

This is explained by the presence of many factors that are difficult to take into account, affecting the functioning of the ISMS and the decision-making process by the administrator, which create a high degree of uncertainty (anxiety).

Therefore, the task of developing such an ISMS that would provide more effective monitoring of IS incidents by reducing the uncertainty associated with the administrator's lack of awareness of the current state of reliability of the security tools included in the ISMS is relevant.

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Rezyume: Maqolada bank ishida axborot tizimining tuzilishi, avtomatlashtirilgan bank tizimining tasnifi va avtomatlashtirilgan bank tizimini rivojlantirishning istiqbolli yo'nalishlari ko'rib chiqiladi, bank sohasida axborot xavfsizligi muammolarining rivojlanish darajasiga qarab sanab o'tiladi. axborot texnologiyalarini rivojlantirish.

Резюме: В статье рассматривается структура информационной системы в банковской деятельности, классификация автоматизированной банковской системы и перспективные направления развития автоматизированной банковской системы, перечислено эволюция проблем информационной безопасности в банковской сфере в зависимости от степени развития информационных технологий.

Kalit so'zlar: avtomatlashtirilgan bank tizimi, axborot tizimi, axborot xavfsizligi, axborot xavfsizligi hodisalarini monitoring qilish tizimlari, axborot xavfsizligi vositalari.

Ключевые слова: автоматизированная банковская система, информационная система, информационная безопасность, системы мониторинга инцидентов информационной безопасности, средства защиты информации.

UDK.546.05(541.49)

STUDY OF THE CONDUCTOMETRIC TITRATION OF BARIUM NITRATE WITH A UREA LIGAND

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Summary: Conductometric titration of urea ligand with barium nitrate is presented in the article. In this article, a salt solution is prepared in a 50 ml solution and the ligand is slowly added to it. It presents information based on graphs and tables.

Key words: Conductometry, conductometric titration, barium nitrate, ligand, urea, electrical conductivity.

At present, the study of conductometric titration of complex compounds is the most convenient and effective method of physicochemical methods.

Conductometry is the oldest, simplest and least selective of all electrochemical methods of analysis. The conductometric method of analysis is based on measuring the electrical conductivity of a solution. The concentration of a substance in this method is determined by the results of measuring the electrical conductivity. The essence of the method lies in the fact that the specific electrical conductivity χ of the solution is measured during titration and a titration curve is built, which is linear (Fig. 1). The abscissa shows the volume (V) of the solution used during the titration. The titrant volume at the equivalence point is determined from the break of the curve and the results of the analysis are calculated according to the law of equivalents. Conductometric titration uses reactions in aqueous and non-aqueous solutions. During the course of the titration, the electrical conductivity will change markedly if ions with high mobility are introduced or removed.

For the conductometric titration of urea with barium, we prepare 0.001 M barium nitrate. (That is, to prepare a 0.001 M solution of 50 ml, 13.05 mg of barium nitrate is needed.) To prepare a 0.001 M solution of 50 ml, 3 mg of moshevine is required.

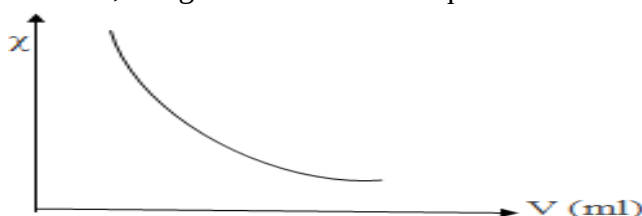


Fig 1. Graph of conductometric titration of a solution of a substance (Ba*K)

This graph shows the conductometric titration of barium nitrate with urea.

Conductometric titration of barium nitrate and urea depending on temperature (tab 1)

Electrical conductivity	Temperature	Substance
257 $\mu\text{S}/\text{sm}$	21,1 $^{\circ}\text{C}$	Ba(NO ₃) ₂ 50ml
248 $\mu\text{S}/\text{sm}$	22,0 $^{\circ}\text{C}$	+ CO(NH ₂) ₂ 1ml
243 $\mu\text{S}/\text{sm}$	22,0 $^{\circ}\text{C}$	+ CO(NH ₂) ₂ 1ml
239 $\mu\text{S}/\text{sm}$	22,0 $^{\circ}\text{C}$	+ CO(NH ₂) ₂ 1ml
234 $\mu\text{S}/\text{sm}$	22,0 $^{\circ}\text{C}$	+ CO(NH ₂) ₂ 1ml
230 $\mu\text{S}/\text{sm}$	22,1 $^{\circ}\text{C}$	+ CO(NH ₂) ₂ 1ml
226 $\mu\text{S}/\text{sm}$	22,2 $^{\circ}\text{C}$	+ CO(NH ₂) ₂ 1ml
222 $\mu\text{S}/\text{sm}$	22,2 $^{\circ}\text{C}$	+ CO(NH ₂) ₂ 1ml
218 $\mu\text{S}/\text{sm}$	22,2 $^{\circ}\text{C}$	+ CO(NH ₂) ₂ 1ml
215 $\mu\text{S}/\text{sm}$	22,3 $^{\circ}\text{C}$	+ CO(NH ₂) ₂ 1ml

211 $\mu\text{S/sm}$	22,3 ⁰ C	+ CO(NH ₂) ₂ 1ml
208 $\mu\text{S/sm}$	22,3 ⁰ C	+ CO(NH ₂) ₂ 1ml
205 $\mu\text{S/sm}$	22,4 ⁰ C	+ CO(NH ₂) ₂ 1ml
201 $\mu\text{S/sm}$	22,4 ⁰ C	+ CO(NH ₂) ₂ 1 ml
198.2 $\mu\text{S/sm}$	22,5 ⁰ C	+ CO(NH ₂) ₂ 1 ml
195.2 $\mu\text{S/sm}$	22,5 ⁰ C	+ CO(NH ₂) ₂ 1 ml
192.2 $\mu\text{S/sm}$	22,5 ⁰ C	+ CO(NH ₂) ₂ 1 ml
189.4 $\mu\text{S/sm}$	22,5 ⁰ C	+ CO(NH ₂) ₂ 1 ml
186.9 $\mu\text{S/sm}$	22,6 ⁰ C	+ CO(NH ₂) ₂ 1 ml
184.2 $\mu\text{S/sm}$	22,7 ⁰ C	+ CO(NH ₂) ₂ 1 ml
181.6 $\mu\text{S/sm}$	22,7 ⁰ C	+ CO(NH ₂) ₂ 1 ml
179.1 $\mu\text{S/sm}$	22,8 ⁰ C	+ CO(NH ₂) ₂ 1 ml
176.7 $\mu\text{S/sm}$	22,8 ⁰ C	+ CO(NH ₂) ₂ 1 ml
174.3 $\mu\text{S/sm}$	22,9 ⁰ C	+ CO(NH ₂) ₂ 1 ml
172.0 $\mu\text{S/sm}$	22,9 ⁰ C	+ CO(NH ₂) ₂ 1 ml
169.7 $\mu\text{S/sm}$	23 ⁰ C	+ CO(NH ₂) ₂ 1 ml
167.5 $\mu\text{S/sm}$	23 ⁰ C	+ CO(NH ₂) ₂ 1 ml
165.4 $\mu\text{S/sm}$	23 ⁰ C	+ CO(NH ₂) ₂ 1 ml
163.4 $\mu\text{S/sm}$	23,1 ⁰ C	+ CO(NH ₂) ₂ 1 ml
161.4 $\mu\text{S/sm}$	23,1 ⁰ C	+ CO(NH ₂) ₂ 1 ml
159.4 $\mu\text{S/sm}$	23,2 ⁰ C	+ CO(NH ₂) ₂ 1 ml
157.4 $\mu\text{S/sm}$	23,2 ⁰ C	+ CO(NH ₂) ₂ 1 ml
155.6 $\mu\text{S/sm}$	23,2 ⁰ C	+ CO(NH ₂) ₂ 1 ml
153.7 $\mu\text{S/sm}$	23,3 ⁰ C	+ CO(NH ₂) ₂ 1 ml
152.2 $\mu\text{S/sm}$	23,3 ⁰ C	+ CO(NH ₂) ₂ 1 ml
150.5 $\mu\text{S/sm}$	23,4 ⁰ C	+ CO(NH ₂) ₂ 1 ml
149.0 $\mu\text{S/sm}$	23,4 ⁰ C	+ CO(NH ₂) ₂ 1 ml
147.4 $\mu\text{S/sm}$	23,4 ⁰ C	+ CO(NH ₂) ₂ 1 ml
145.8 $\mu\text{S/sm}$	23,5 ⁰ C	+ CO(NH ₂) ₂ 1 ml
144.2 $\mu\text{S/sm}$	23,5 ⁰ C	+ CO(NH ₂) ₂ 1 ml
142.6 $\mu\text{S/sm}$	23,6 ⁰ C	+ CO(NH ₂) ₂ 1 ml
141.1 $\mu\text{S/sm}$	23,6 ⁰ C	+ CO(NH ₂) ₂ 1 ml
139.6 $\mu\text{S/sm}$	23,6 ⁰ C	+ CO(NH ₂) ₂ 1 ml
138.2 $\mu\text{S/sm}$	23,6 ⁰ C	+ CO(NH ₂) ₂ 1 ml
136.7 $\mu\text{S/sm}$	23,7 ⁰ C	+ CO(NH ₂) ₂ 1 ml
135.3 $\mu\text{S/sm}$	23,7 ⁰ C	+ CO(NH ₂) ₂ 1 ml
133.9 $\mu\text{S/sm}$	23,7 ⁰ C	+ CO(NH ₂) ₂ 1 ml
132.6 $\mu\text{S/sm}$	23,7 ⁰ C	+ CO(NH ₂) ₂ 1 ml
131.3 $\mu\text{S/sm}$	23,7 ⁰ C	+ CO(NH ₂) ₂ 1 ml
130.0 $\mu\text{S/sm}$	23,7 ⁰ C	+ CO(NH ₂) ₂ 1 ml
128.7 $\mu\text{S/sm}$	23,8 ⁰ C	+ CO(NH ₂) ₂ 1 ml

Conductometric titrations are most commonly used. In conductometric titration, the analyzed solution is placed in a cell with electrodes, the cell is placed on a magnetic stirrer and titrated with the appropriate titrant. The titrant is added in equal portions. After adding each portion of the titrant, the electrical conductivity of the solution is measured and a graph is plotted between the electrical conductivity and the volume of the titrant.

As you can see, in the first table, the electrical conductivity was determined in a prepared solution of 50 ml of barium nitrate. Then, by adding 1 ml of urea ligand to it, the electrical

conductivity is determined in a conductometer. In this case, the electrical conductivity is measured and recorded when the ligand is added to every 1 ml of the solution.

The principle of conductometric titration is based on the fact that during the titration, one of the ions is replaced by the other and invariably these two ions differ in the ionic conductivity with the result that conductivity of the solution varies during the course of titration.

When a ligand is added to a salt, their electrical conductivity also affects the temperature. As can be seen from the table, electrical conductivity is inversely proportional to temperature.

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Rezyume: *Karbamid ligandni bariy nitrat bilan konduktometrik titrlash maqolada keltirilgan. Ushbu maqolada 50 ml eritmada tuz eritmasi tayyorlanadi va unga ligand asta-sekin qo'shiladi. U grafik va jadvallarga asoslangan ma'lumotlarni taqdim etadi.*

Резюме: *В статье представлено кондуктометрическое титрование лиганда мочевины нитратом бария. В этой статье готовят солевой раствор в 50 мл раствора и медленно добавляют к нему лиганд. Он представляет информацию на основе графиков и таблиц.*

Kalit so'zlar: *Konduktometriya, konduktometrik titrlash, bariy nitrat, ligand, karbamid, elektr o'tkazuvchanlik.*

Ключевые слова: *кондуктометрия, кондуктометрическое титрование, нитрат бария, лиганд, мочеви́на, электропроводность.*

UDC 699.86

PROBLEMS INCREASING THE ENERGY EFFICIENCY OF RESIDENTIAL BUILDINGS IN RURAL AREAS

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Summary: *In this article creation and improvement of energy efficiency of the outer walls of buildings from an insulating layer, an effective heat-insulating material the external barrier is the amount of heat that comes from spending information about yourself delineated.*

Key words: *wall, barrier structures, energy efficiency, the heat insulator.*

Today, the introduction of energy-saving technologies and alternative energy sources in each area is considered a very important task. In order to carry out the same processes in high-quality and fast images in our country, since 2017, in cooperation with the United Nations Development Program and the Ministry of Construction of the Republic of Uzbekistan, a joint project "Assistance in the development of energy-efficient rural residential buildings in Uzbekistan" has been implemented. and with the support of a grant from the Global Environment Facility (GEF).

The main goal of the project is to provide the rural population of Uzbekistan with improved and comfortable living conditions that do not harm the environment. For this purpose, an amount of \$ 136.6 million was invested.

The project provides for the achievement of four interrelated results:

- the development and implementation of a green mortgage mechanism for rural housing and the growing demand for low-carbon housing;
- supply chain for enhanced logistics, energy-efficient and low-carbon country houses;
- improved legal and regulatory framework, standards for energy-efficient and low-carbon housing construction;
- raising public awareness of the benefits of energy-efficient and low-carbon housing.

According to the data obtained, now almost half of the energy produced in our country is consumed by residential areas. In Central Asia and Eastern Europe, about 40% of the total amount of greenhouse gases (IG) emitted into the atmosphere is accounted for by the housing sector. According to UN estimates, the population of our republic may increase by more than 20% in the next 15 years. In turn, energy consumption in the residential sector will also grow by 30% by 2050. This will become a threat to the energy security of the country and will lead to an increase in the amount of IG that will be sent into the atmosphere.

Therefore, as in all areas, procedures and rules in housing construction are changing all over the world. In particular, special attention is paid to improving energy efficiency in our country, the use of inexpensive energy carriers in housing construction. The construction of green spaces in the regions is being intensively carried out.

Taking into account wind loads in low-rise buildings, it is advisable to install wind-resistant residential buildings in the urban planning solution from the side that will protect from the wind, with a decrease in floors, which will provide thermal protection of wind-resistant houses. The use of the urban planning method of "closed" courtyards to protect from wind noise, highways and streets leads to heat savings [2].

Too high a temperature under the influence of sunlight and evening cooling are felt as discomfort. The cause of the phenomenon in both cases is the result of the heat exchange process through external structures. In the summer, when the air in the hive is heated, the structure is not in a state of heat accumulation.

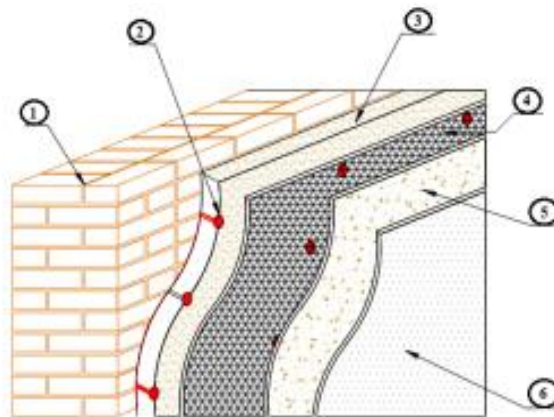
As a planning solution that increases the comfort of living and allows you to maintain heat in the room, we can recommend rational proportions of the length and width of the room. It was found that the ability of a rectangular room to withstand the effects of external heat is halved compared to a deep room. In an expanded (large area) room, the temperature regime and especially radiation improves, but at the same time natural lighting and ventilation deteriorate. Consequently, the corresponding ratio of the depth and width of the rooms of the rooms can be obtained in the range of 1.4-1.6. With this ratio, the temperature regime of the rooms becomes more stable.

In the course of studying the effect of low temperatures during a night's sleep on the human body, scientists have proved that the air temperature can be reduced to 14-15 ° C [3]. Such temperature control is carried out by introducing control of heat supply to heating devices depending on the room.

To increase the thermal efficiency of residential buildings, it is recommended to use such architectural techniques as the orientation of the building to the cardinal directions, taking into account the prevailing direction of the cold wind, maximum glazing of the southern facades and minimum glazing of the northern facades. When constructing low-rise housing, these design and layout methods should be used. The mentioned construction technologies and planning solutions should be used in low-rise housing construction.

How much heat a building loses depends on the structural design of the exterior fences and on what material it is made of, the density of the material and other indicators. Some materials (brick, stone materials) transfer heat better than organic and other polymeric (wood, foam, asbestos) materials. This difference is due to the type of external barrier structures, material density, humidity, coefficient of thermal conductivity and specific thermal conductivity, as well as the temperature difference between external and internal air.

Basalt insulation is currently used for thermal insulation of almost all structures, and is also used as a fire-fighting agent. It is mainly used as heat and sound insulation of walls, roofs, partitions, curtains, etc. The installation of a basalt insulation layer on the walls is shown in the figure below (Figure 1).



1-picture. Installing the insulation layer of the outer wall

1 - a wall 400 mm thick was brought; 2 - Special hardener mixture Dyubel, pitch 500 × 500 mm; 3 - layer of basalt 50 mm thick; 4 - special coating for metal with narrow basalt; 5 - 10 with a layer of thick sandy mortar; 6 - travertine.

The raw materials for mineral wool and thermal insulation materials based on it are all kinds of logins, dolomites and marls from basalt, granite, diabase, diorite, trachyte and other volcanic rocks.

2.01.04-2018 in the norms and rules of urban planning, it is recommended to use single-layer and multi-layer structures for exterior fences. The coefficient of thermal conductivity of materials in the dry state in the thermal insulation layers of sliding structures should usually not exceed 0.14 W/ (m °C).

The outer barrier of the building, that is, by spending ourselves, we will determine the amount of heat using the following formula [4]:

$$Q = \frac{1}{R} \cdot F(t_i - t_m) \cdot n \cdot \eta$$

It's here: Q — the main amount of heat spent through external barriers, B_t ;

F — outer set Surface m^2 ;

t_i — calculated indoor air temperature, $^{\circ}C$;

t_m - calculated outside air temperature (temperature value in the coldest five-day period), $^{\circ}C$;

n - external barrier structures with a coefficient that depends on the relationship to the external surface of the outside air;

η — coefficient of additional heat consumption at the borrower's account;

R — thermal resistivity (thermal resistance) of the calculated external barrier, $m^2 \cdot \text{deg}/B_t$.

For the formula above, we accept that both sides of the barriers do not change temperature and that the heat flow passes through the barriers (from hot to cold) is also the same invariant (stationary).

In order to ensure the best operational properties when using external blocking structures, it is necessary to place layers on their inner side with a higher thermal conductivity and a higher resistance to isolation. A hot-retaining layer made of effective heat-insulating materials should be placed on the outside or in the middle part of the blocking structure.

Conclusion should be noted that the heat from the intensity of work with solar energy effectively protect the external barrier, energy-efficient buildings, passive solar heating of the element in the development of thermal protection system, the features of the solutions lead to the magnitude of the effect of energy intensity, with the skillful use of deep learning planning is very important.

For this reason, the outer wall of the building, which is used in practice to increase the current and thermal insulation that comes in the process of repairing the material and other thermal insulation materials, it is desirable to cover the outer layer on the outer wall.

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Rezyume: Ushbu moddaning tashqi devorlar tashqi devorlarining energiya samaradorligini, samarali issiqlik izolyatsion materialdan energiya samaradorligini oshirish, tashqi to'siqni samarali isitish materiallari sizning o'zingiz haqingizdagi ma'lumotni sarflashdan kelib chiqadigan issiqlik miqdori.

Резюме: В этой статье создание и улучшение энергоэффективности внешних стен зданий из изоляционного слоя, эффективный теплоизлучающий материал. Внешний барьер-это количество тепла, которое получает информацию о себе.

Kalit so'zlar: Devor, to'siq tuzilmalari, energiya samaradorligi, issiqlik izolyator.

Ключевые слова: стена, барьерные конструкции, энергоэффективность, тепловой изолятор.

SOCIAL SCIENCES

DIRECTIONS TO INCREASE THE EFFICIENCY OF INVESTMENT ACTIVITY IN ENTERPRISES

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Summary: *In the development of the economies of different regions of the world, the imbalance between supply and demand for investment, the flow of investment from developed to developing economies is growing. This paper studies the case of "Taxiatash" JSC's investment strategy in Uzbekistan and gives some recommendations to improve investment efficiencies of enterprises.*

Key words: *investment, investment strategies, investment projects, Taxiatosh JSC, Uzbekistan*

Introduction

According to the UNCTAD Investment Trends Monitor, "the share of foreign direct investment globally is expected to decline in 2020, from \$ 1.5 trillion (42%) in 2019 to \$ 859 billion". Such a low level was last observed in the 1990s. It is the lowest figure since the global financial crisis of 2008-2009. In 2021, despite forecasts for a global economic recovery, UNCTAD estimates that foreign investment flows are expected to remain low due to uncertainty over the evolution of the COVID-19 pandemic. In turn, the existence of many problems related to improving the efficiency of investments remains one of the key factors determining the need to improve the financial management of investment activities.

In international practice, one of the most pressing issues in the investment decisions of companies is the assessment of investment efficiency, the correct choice of the evaluation mechanism, the management of investment projects. The optimal formation of the capital structure of companies, the minimization of the cost of capital and ensuring financial stability on the basis of established standards are directly related to the effective development of investment policy. It is also important to assess the effectiveness of investment activities in this area, to conduct research on the organization of the strategic management process, the improvement of the investment risk management system. This situation determines the target areas that are planned to be addressed within the chosen dissertation research topic.

Increasing the volume of investments in the real sector in Uzbekistan, thereby accelerating socio-economic development, raising living standards and incomes, ensuring comprehensive and effective use of natural, mineral resources, industry, agriculture, tourism and labor potential of each region, districts and cities, First of all, economic reforms aimed at reducing the gaps in the level of socio-economic development of the regions through the rapid development of industrial and export potential are being consistently implemented. The Action Strategy for the Further Development of the Republic of Uzbekistan states that "the implementation of an active investment policy aimed at modernization, technical and technological renewal of production, implementation of production, transport and communication and social infrastructure projects will improve the investment climate. Active attraction of foreign direct investment "has been identified as one of the priorities.

Related work

One of the important conditions for the effective organization of investment policy of enterprises is to increase the efficiency of investment activities, assess the cost-effectiveness of projects, make decisions to minimize investment risks. In addition, in today's pandemic, effective organization of investment activities and maintaining a minimum level of financial stability is one of the key issues facing joint-stock companies. The results of the study show that one of the key

aspects in the process of improving investment activity is to focus on evaluating the effectiveness of investment activities, taking into account external and internal factors.

A number of definitions and approaches have been given by our foreign and local scientists to ensure the efficiency of investment activities of enterprises. Including B.Y.Heo and W.H. According to Heolar, the evaluation of the effectiveness of investment activities should be determined using profitability indicators. One of the main criteria for assessing the effectiveness of investment activities is financial efficiency, in addition, the level of social efficiency of investment activities is partially reflected in the rate of return. According to I. Marcelin, the efficiency of investment activity depends on the main directions of the enterprise's investment activity aimed at achieving medium and long-term goals, especially in the process of investment cycle duration, multifactorial and changing market conditions. According to Makarenko, an important component of investment activity is to ensure a favorable investment climate. Socio-economic dynamics, the efficiency of the global division of labor and, on this basis, the growth of the national economy depend on the organization of the investment climate. It is based on the fact that the efficiency of investment activities of the enterprise depends directly on the investment climate of the national economy. According to P.N. Zavlin, ensuring the effectiveness of investment activities depends on the degree of determining the impact of external and internal factors on the implementation of the tasks set for investment activities. According to the scientist, investment plays an important role in increasing financial stability by ensuring efficiency.

According to O. Astanakulov, the company noted the complexity of the first stage of investment activity. In his view, the greater the probability at this stage depends on a more selective in-depth analytical approach. Based on the results of such analyzes, the enterprise's investment activities are planned and implemented. In our opinion, the efficiency of investment activities is achieved by selecting long-term and short-term investment projects based on the company's investment strategy, using models of net present value (NPV), internal rate of return (IRR), value added (EVA), without exceeding the established norm .

Analysis and results

The state of investments in key sectors and industries of the economy of the Republic of Karakalpakstan is analyzed, the investment strategy of JSC "Taxiatosh dan products" is developed, as well as the impact of macroeconomic factors affecting the flow of investments is analyzed using a regression model.

Modernization of the economy, deepening of reforms, creation of new production capacities and fixed assets, modernization of existing equipment and technologies in industries and sectors of the economy, their support depends on the correct and effective implementation of investment processes. In this regard, special attention is paid to the implementation of an active investment policy aimed at modernization of production, technical and technological renewal, production, agriculture, transport and communications and social infrastructure projects. To this end, emphasis is placed on the use of centralized, decentralized funds, foreign investments and loans, as well as their effective use.

Currently, many companies are using modern models to increase the efficiency of investment activities, using similar models, developed an investment strategy for JSC "Taxiatosh Don Mahsulotlari". At the same time, the stages of implementation of the investment strategy of the joint-stock company were analyzed, and the criteria for evaluating this strategy were formed. If we analyze the activities of the joint-stock company, there was no significant change in the amount of investment of the joint-stock company during the 5-year period (Figure 1).

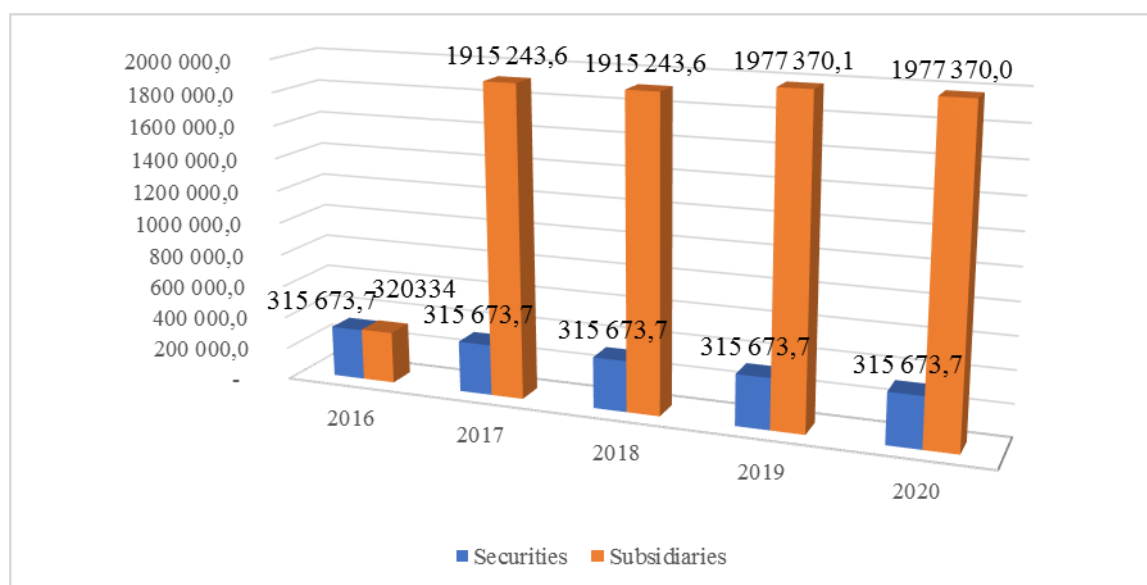


Figure 1: Dynamics of investments of JSC "Taxiatosh Don Mahsulotlari" over the years (in thousands of soums)

Source: Reports of JSC

As can be seen from the data in Figure 1, the amount of investment made by the joint-stock company has not changed significantly over the years. The reason for this is that the joint-stock company has not developed an investment strategy or criteria for evaluating the effectiveness of investment projects. For this reason, we have developed an investment strategy for JSC "Taxiatosh

Don Mahsulotlari" and criteria for assessing its effectiveness by analyzing the current state of the joint-stock company. Figure 2 shows that neither the amount of the joint-stock company's income from investment activities nor the rate of return is high, which once again demonstrates the need for the joint-stock company's investment strategy.

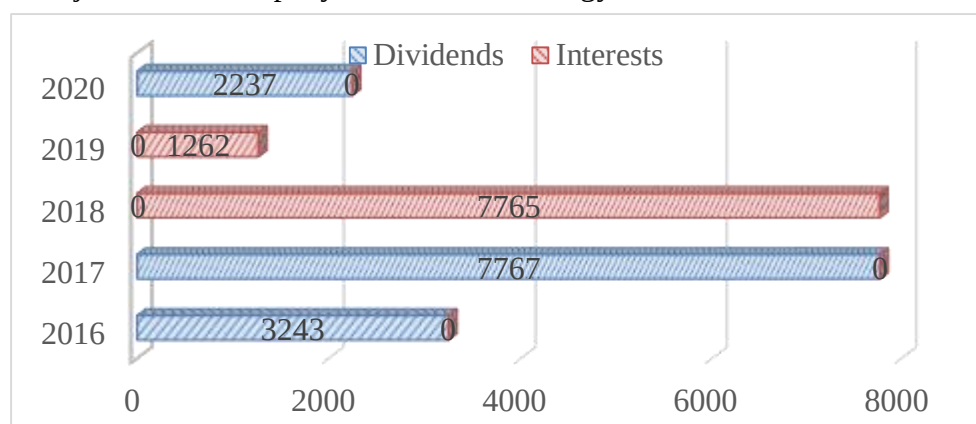


Figure 2: Dynamics of dividends and interest income from investments of Takhiatash Don Mahsulotlari JSC (in thousand soums)

Source: Reports of JSC

Studies show that in the absence of consistency based on the investment strategy in the field of investment, unreasonable investment does not guarantee the success of the enterprise in the market. At the same time, the investment strategy is based on the overall economic development strategy of the enterprise and should be consistent with the development goals and stages. Based on this, we have developed an investment strategy of Takhiatash Don Mahsulotlari JSC and criteria for evaluating its effectiveness. Using the stages of development of the investment strategy shown in Figure 5, we have developed the investment strategy of JSC "Taxiatosh Don Mahsulotlari".

According to him, we consider it expedient to develop the investment strategy of the joint-stock company in the following order.

Conclusion

As a result of our research on improving the efficiency of investment activities of enterprises, the following conclusions were formed:

1. In order to increase the flow of investment in enterprises, it is necessary to use several discount rates when using models for evaluating investment projects. Because in the last 5 years, the interest rate in Uzbekistan has changed 3 times.

2. In order to ensure the efficiency of investment activities of enterprises, it is advisable to first develop an investment strategy of the enterprise and implement the tasks set out in it in stages.

3. Based on our research from international experience, we have concluded that the investment attractiveness of short-term securities is higher than that of long-term securities. The issuance of this type of securities serves to ensure the efficiency of investment activities of enterprises. However, it is advisable to provide such an opportunity only to enterprises with high credit ratings.

4. Information on the investment project that the company plans to finance and its internal rate of return (IRR - internal rate of return), the current weighted average cost of capital (WACC - weighted average cost of capital) and capital structure should be provided to potential investors.

5. In order to reduce the impact of inflation risk, adding the standard deviation of the last 10 years inflation rate as a risk premium to the amount of the discount rate used to determine the net present value (NPV) and discounted payback period (DPP) of projects for which efficiency or profitability is determined increases investment efficiency.

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Rezyume: *Dunyoning turli mintaqalari iqtisodiyoti rivojlanishida investitsiyalar talabi va taklifi o'rtasidagi nomutanosiblik, rivojlangan mamlakatlardan rivojlanayotgan mamlakatlarga sarmoya oqimi kuchayib bormoqda. Ushbu maqolada "Taxiatosh" AJning O'zbekistondagi investitsiya strategiyasi o'rganilib, korxonalarning investitsiya samaradorligini oshirish bo'yicha bir qator tavsiyalar berilgan.*

Резюме: *В развитии экономик разных регионов мира нарастает дисбаланс между спросом и предложением на инвестиции, поток инвестиций из развитых экономик в развивающиеся. В данной статье рассматривается инвестиционная стратегия АО «Таксиаташ» в Узбекистане и даются некоторые рекомендации по повышению инвестиционной эффективности предприятий.*

Kalit so'zlar: *investitsiya, investitsiya strategiyalari, investitsiya loyihalari, Taxiatosh AJ, O'zbekiston*

Ключевые слова: *инвестиции, инвестиционные стратегии, инвестиционные проекты, АО «Таксиаташ», Узбекистан.*

ISSUES OF PROVIDING FINANCIAL-INVESTMENT ACTIVITY AND ECONOMIC SECURITY OF REGIONS

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Summary: *The paper analyzes the actual problems of economic security in detail. The essence of economic security is theoretically detailed and economically based. To implement the economic security strategy, it is necessary to develop a mechanism for its implementation.*

Key words: *economic security, inflation, crisis, national economy, government policy, budget deficit, economic growth, dynamic development, supply and demand, money depreciation, shadow economy, economic relations, information communication.*

Introduction The socio-economic development of any country increases its need for economic security. However, the low satisfaction of the state's need for security has a negative impact on the socio-economic development of society, causes crisis situations in certain economic sectors, and in some cases deepens them.

Economic security in market conditions as a type of current economic theory has its own subject and special research methods. However, despite being independent, it is inextricably linked with traditional concepts such as economic growth and the stability of the socio-economic system. In fact, the country's economy cannot be stable if there is no economic growth, dynamic development in accordance with the economy of other countries. If the economy does not develop, there will be no adequate response to external and internal threats, that is, the economy's ability to survive in difficult situations will be abstract.

One of the undeniable conditions for the effective development of Uzbekistan and its regions is the creation of an effective mechanism for fighting for economic security. In order to determine the positive directions of the processes of combating the hidden economy, control and influence mechanisms of law enforcement agencies are required.

The deepening of economic reforms in our country, in turn, requires the development of an effective strategy of economic security. Problems such as the large weight of the secret economy in our national economy, the existence of cases of non-compliance with the threshold values of economic security indicators indicate the urgency of conducting research in this direction.

Today, the new social, economic, institutional and technological environment in which the executive bodies operate has greatly reduced the effectiveness of the traditional work methods in the field of economic security. Diversity and independence of economic entities, simplification of registration of individuals and legal entities, uncontrolled communications of citizens and organizations, freedom of economic activity, difficulties in controlling migration processes not only made it difficult to get the necessary quick information, but also social and economic also expanded the possibilities of committing illegal actions aimed at violating the official requirements for the validity of relations.

Also, most researches in recent years indicate that today most crimes are related to economic relations in one way or another. In many law enforcement agencies, the use of information technologies, various agencies, regional authorities, corporate and social structures has not yet reached a new level of quality. Information systems and information exchange of large business entities of different departmental affiliations have different formats and protocols, often incompatible with each other, scattered, as well as insurmountable organizational constraints between them. there is.

The lack of research in the field of economic security in our country also hinders the disclosure of the content of this concept to the general public and the adoption of specific strategies.

The purpose of this article is to study the nature of economic security from a theoretical point of view and describe it from the point of view of economic importance, and to develop a mechanism for its implementation in order to implement the strategy of economic security.

Most authors define economic security as the stability of the economic system under the influence of external and internal factors, and stability requires its development. Stability and development require a dynamic approach to the problem of economic security. Also, economic security indicators may change over time.

Existing interpretations of economic security can be combined into several groups. For example, the concept of "Economic crime" is interpreted as a set of conditions that protect the country's economy from external and internal threats (L. Abalkin et al.); this concept is connected with the state of the country's economy that allows protection of its vital interests (V. Senchagov, G. Gutman, etc.); it is assumed that the economy can effectively satisfy social needs at the national and international level (A. Gorodetsky, A. Arkhipov, etc.).

H. Abdulkasimov, one of the scientists of our country, AEIshmuhammedov, D. Artikovalar conducted research on economic security and published their own training manuals. In particular, D. Artikova's "Economic Security" study guide, published in 2010, provides ideas about the country's economic security, threats to it, its indicators, criteria, and lower limit values. The impact of globalization processes on the economic security of countries, increasing the competitiveness of the economy, the place and role of regional organizations in ensuring economic security, terrorism, secret economy, corruption and their impact on economic security are given a special place in it.

In terms of ensuring investment attractiveness, ensuring its continuous supply in each country, comprehensive improvement of the investment climate, raising the activity of investors to the highest possible level, and reforming international investment integration, several scientists has been researching for decades.

Benjamin Graham, Edwin Leferveer, Krugman P., John Ch. Bogle, Khan MS and Villanuyeva D. as well as many other Western scientists are considered to be scientists who conduct effective research in the field of investment, and are conducting extensive research on the impact of investment on the development of the national economy, evaluating its effectiveness, and the importance of investment in scientific development and technological growth. Including Askinadzi B. and Maksimova F., Zimin AI, Igor Klyushnev, Tamara Teplova, Dmitriy Panchenko, Mann, Ivanov, Ferber and many other scientists' researches contain deep knowledge of the scientific theoretical foundations and practical experiences of ways to increase the attractiveness of investment.

It can be observed that the research directions of these scientists include the integration of Eastern and Western experiences in the issue of increasing investment efficiency, an approach from the point of view of national interests, and the analysis of political factors related to investment.

Among the local scientists who conducted scientific research on the regulation of regional development of the economy of Uzbekistan, development of the basis of regional development and creation of methodology: G.K. Saidova, A.M. Sodikov, S.S. G'ulomov, Sh. Imomov, Sh. Mustafaulov, Sh. Nazarov and others can be cited as an example.

Abstraction, deduction, classification, generalization, comparative, dynamic series, theoretical interpretation and analytical methods are used in the methodology of this article. In particular, with the help of abstraction, as a result of studies on economic security and its provision in Uzbekistan, scientific and practical recommendations are developed.) was used to make a conclusion based on the volume of growth and other analyses, as well as the factors of emergence of the concept of "economic security" as a result of the bibliographic study and the necessity were determined.

At the same time, the applied research paradigm is Positivism, qualitative, objective, scientific experiments are used in the research. The process is mainly deductive. A cause-and-

effect statistical design is used. Research involves certain situations. Generalizations of results lead to predictions, explanations, and understanding. The reliability of the results is confirmed by tests.

All the problems and reforms related to investment in the state, the ability of the state to receive investments and, in parallel, to digest them at the required level, to ensure liquidity, stability, any kind of methods are used. The second component of the attractiveness of the investment environment is investment risk. Its level indicates the possibility of losing investments and income from them. In one or another region of the republic, this risk is macroeconomic (tendencies in the economic development of the region), financial and currency (balanced level of the regional budget and enterprise finances), political (mental state, mood of the population based on the results of the presidential and parliamentary elections, compliance of local government bodies with the law).

During our research, we used bivariate analysis, i.e. analysis data involving two variables, proportion, comparison, and distribution methods to describe the collected quantitative data.

A country with a high level of development, a high level of experience and high intellectual capacity among the countries of the world, a country with a small population, but a strong reputation in the field of computer programming and telecommunications Singapore, one of the so-called "Asian Tigers", has the 3rd highest GDP per capita (purchasing power parity) in the reports published by the World Bank. has accumulated rich experience in improving the investment environment and increasing its attractiveness in the country. From this given figure, we can see that Singapore is ranked 5th among the 20 highest ranked countries for 2018-2019 by accumulated TTXI. 92 billion in 2019. accepted foreign direct investments in dollars.

The main reason for achieving the mentioned achievements can be explained as follows: the opinion of all the scientists who dealt with the "economic miracle" of the Singapore state's development path is based on one important point. This is due to the creation of a favorable investment environment in Singapore. It is precisely because of this situation that many projects were implemented by investors in this new country, and the volume of GDP increased sharply from year to year. Even today, capital funds are directed by investors to the state of Singapore without any hesitation. The attractiveness of the investment environment there is the reason for the constant interest of donor countries.

The health and attractiveness of the investment environment can also be determined through macroeconomic indicators that show the state's socio-economic condition. According to the World Bank (WB) classification, Singapore is among the countries with the highest income. One of the important indicators affecting the investment climate is the inflation rate. The lower the inflation rate, the higher the investment attractiveness.

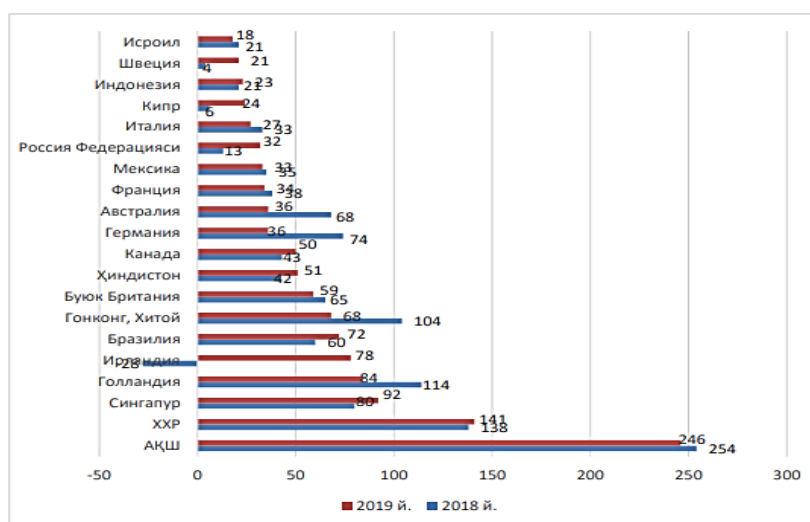


Figure 1. Accumulated TTXI, for 2018-2019 (for the 20 highest-ranked countries), in billions of dollars

"*Economic security*" the term appeared relatively recently. Until the Second World War, the terms "defense" and "defense capability" were mainly used. In 1974, the law "On National Security" was adopted in the USA, and the National Security Council was established under the president of the country. The Council was assigned not only foreign and defense related issues, but also economic policy issues.

One of the most important and main tasks of ensuring the country's economic security is to monitor the state of the economy, identify threats and dangers in economic systems in time. At the same time, it is important to prepare management decisions on security as an organizational information technology system and institution in public administration. Therefore, it is necessary to determine the system of monitoring the state and dynamics of the country's economy and the level of its scientific-practical and methodological support. It is based on indicators in the assessment of a number of indicators and is mainly reflected in scientific periodicals and analytical developments of the government. Through this, the government at all levels: short-term (tactical), medium-term, evaluates the long-term (strategic) situation and begins to prepare rational management decisions. The most common point of view is that the objects of economic security are the individual, society and the economic system of the state or society. With this approach, there is a mixture of economic policy and economic security object.

Based on these positions, it is proposed to consider separately the objects of economic security and the objects of economic security or the objects of protection in order to clearly differentiate between the theoretical and practical aspects of economic security. In my opinion, the first reveals the content of the phenomenon being studied, while the second acts as a form of manifestation and implementation of this content. In this respect, the object of economic security is considered as a symbol of economic relations. The objects of economic security are the carriers of economic relations (material and ideal), in other words, objects that can affect economic interests.

Such a distinction is necessary because economic interests and relationships theoretically reveal the essence of economic security as an object of economic security. But in practical terms, they are implemented in various forms of human and social life. Therefore, the isolation of the objects of economic security (objects of protection) theoretically allows to take into account all the diversity of the activity of economic relations and the realization of economic interests and to translate it into practical terms. analysis of specific forms and manifestations of economic security mechanisms on the plane of study. From the point of view of managing the economic security system,

The reasons for the emergence and development of crisis situations that threaten the economic security of the region are various external and internal factors.

The region cannot be directly affected by environmental factors and therefore must adapt to them. Internal factors can be managed and, by influencing them, there is a possibility of ensuring the security of the regional socio-economic system.

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Figure 2. Economic security objects include:

Economic security has a very complex internal structure. The analysis of the real processes in it and the domestic and foreign experience of solving this problem allows us to distinguish three qualitative characteristics of it:

1) *Economic independence*- in the conditions of the world economy, it does not have an absolute meaning. The international division of labor binds national economies together. In such conditions, economic independence means that the state can control its own national resources, it is competitive in world trade, cooperative relations and exchanges with scientific and technical achievements, and it has reached a level of production where it can participate on an equal basis with others;

2) *Stability and stability of the national economy*- this implies the protection of all forms of ownership, creation of reliable conditions and guarantees for entrepreneurial activity, curbing factors that destabilize the situation (fighting against criminal structures in the economy, preventing serious disruptions in income distribution that cause social chains, etc.) ;

3) *The ability to develop oneself*- this is especially important in the current era of harmonious development. Creating a favorable environment for investments and innovations, constant modernization of production, raising the general professional and cultural level of employees is a necessary and mandatory condition for maintaining the stability of the national economy and its general self.

External and internal threats. Objectively, any economic system is not immune from interrelated external and internal threats. An underdeveloped, uncompetitive domestic market increases imports and, as a result, increases external debt.

External threats include:

- 1) *high external debt*;
- 2) *orientation of exports to raw materials*;
- 3) *the small volume of foreign trade turnover, especially in the field of processing industry products*.

Among the internal threats, trends occurring in the social and scientific and technical spheres, especially the decrease in the population's ability to pay demand, pose the greatest danger. The recovery of economic growth requires the restoration of solvent demand in both the consumption and investment sectors. Here a special "solvency trap" occurs. Low demand for the ability to pay leads to the extinction of many types of production. Excess solvency demand causes prices to rise, putting pressure on money supply and thus increasing inflation.

It is known that 1 bln. The amount of issued money will increase inflation by 1 percent. Therefore, it is necessary to create an optimal structure of the population's ability to pay with the help of state regulation. In the regulation of this problem by the state, first of all, it is necessary to take into account the deep differences in the ability of one or another social group to pay, and there should be enough goods of high, relatively medium and low prices.

Reducing the budget deficit-one of the means of reducing inflation, but without a

structural and effective industrial policy, it is impossible to be completely sure that reducing the budget deficit will lead to positive results (especially in the long term). If the demand exceeds the supply, and the money supply increases at a rate higher than that required for the reproduction of the capital and commodity supply, the conditions for the increase in prices are created, and the economy is in deficit.

Here, one of the important indicators of economic security is the growth rate of the country's gross domestic product (hereinafter referred to as GDP) and its share per capita. If we pay attention to the dynamics of production of GDP by types of economic activity in our country, it is represented by the data presented.

As can be seen from the data presented, the rate of economic growth is related to the positive growth rates observed in the main sectors of the national economy. The volume of gross added value (GVA) created in all sectors of the national economy made up 89.8% of the total volume of GDP and grew by 3% (the impact on the absolute growth of GDP was 2.4% points). The share of net taxes on products in the GDP was 5.2% and grew by 3%, like the GDP (the impact on the absolute growth of GDP was 1.5% points).

Artificially maintaining the growth of the money supply with the help of central bank levers in order to control the rise in prices creates a crisis of defaults.

A more complex and multifactorial method of combating inflation is to stabilize output and prices. After the liberalization of prices, it became clear that it was impossible to stabilize prices without stabilizing production and circulation, as well as increasing labor productivity. It is necessary to point out the shortcomings in one or another part of the decided reproduction model and develop mechanisms for their elimination. The task of state regulation will be to eliminate factors that lead to price increases.

In order to compile a list of enterprises that produce products necessary for the needs of the state, specific enterprises that need state support are determined, and the control package or "golden share" is given to the state in order to influence the decisions made. operating entities are separated.

Economic security strategy. For the normal functioning of the economic system, an economic security strategy for the short and long term is needed. According to some economists, the main thing at the moment is to save the life of the economy, then stabilize it and develop it only in the future. At the heart of this strategy is the idea of the "powerful hand of the market". Such a vision deserves attention, and from the point of view of economics, it is theoretically based. But what will be the expenses of the state and the population when carrying out such an economic policy?

In the words of the American economist, Nobel laureate V. Leontev, the market and entrepreneurship are the "sails of the economy", and attempts to steer the ship without a rudder trace the direction and trajectory of development for a very long time. The economic security strategy of the state should take into account national interests first.

It is crucial to attract foreign investments for the development of the economy of our country, the creation and reconstruction of new enterprises equipped with modern equipment and technologies. First, it creates an opportunity to solve important social problems, such as employment of the population, increasing their income. Therefore, it is a clear way to encourage the enterprises that attract foreign investments to our country from the economic and financial side, to create the necessary conditions for them at the level of state policy.

After all, it is impossible to make structural changes in the economy, to modernize production technically and technologically, as well as to start the production of competitive goods without introducing foreign investments into the leading sectors and branches of the state economy. The importance of foreign investments in the development of the national economy is determined by:

- ▶ application of modern techniques and technologies to local production is ensured;
- ▶ modern professions that are new for the economy of the republic will be created,

additional and new jobs will be created, the number of jobs in the economy will increase, and the income of the population will increase;

► the possibility of ensuring the standard standard of living of the population and meeting their socio-economic needs increases;

► the production of export products will expand. This, in turn, leads to the development of foreign exchange earnings;

► production of import-substituting goods and services will be launched (currency outflow will be prevented);

► morally and physically outdated production capacities of enterprises and organizations are removed from consumption, the material and technical base is renewed, resource productivity increases.

In conclusion, we can say that economic security is an economic category that reflects the state of protection of the economic interests of the population, society and the state against external and internal threats based on the country's economic independence, efficiency and competitiveness.

The efficiency of the economy of our country and its separate regions directly depends on the description and scale of the investment policy. Investments are an important means of reducing regional differences and imbalances in the socio-economic development of our republic, and their appropriate use allows effective use of natural, economic and labor resources available in the regions, thereby improving the regional structure of the economy.

In attracting and regulating foreign investments in Uzbekistan, the Laws of the Republic of Uzbekistan "On Foreign Investments", "On Guarantees of the Rights of Foreign Investors and

Measures to Protect Them", "On Investment Activities" and other legal documents will be its legal basis.

State regulation of the market model of the economy should not violate self-regulation mechanisms from the point of view of security interests, as well as create conditions for the effective functioning of these mechanisms.

The mechanism for ensuring the country's economic security is a system of organizational, economic and legal measures to prevent economic threats. It includes the following elements:

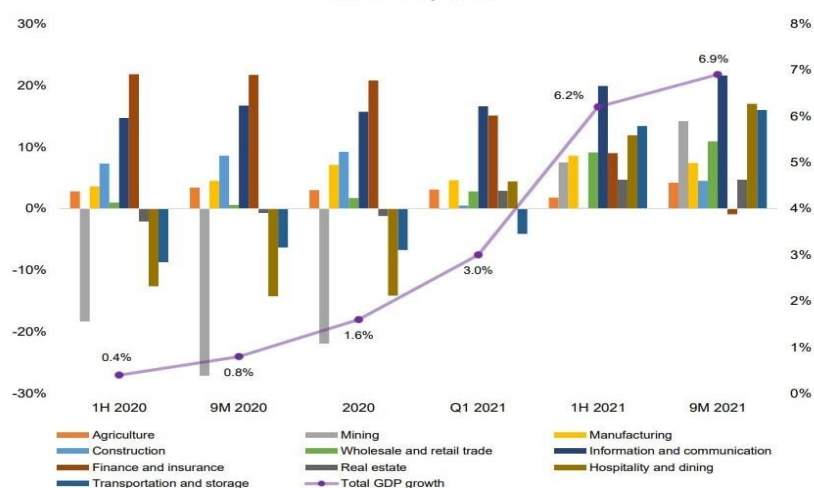


Figure 2. Industry GDP Growth (%)

- 1) monitoring of economy and society;
- 2) socio-economic of indicators the way to be placed development of legal values;
- 3) activities to identify internal and external threats to the security of the state's economy;
- 4) creation of material reserves for production and non-production purposes for use in

emergency situations.

In order to implement the economic security strategy of the state, it is necessary to develop a mechanism for its implementation.

The goal of economic strategy is economic growth. Growth directions are developed within the framework of structural policy as an integral part of macroeconomic management.

The economic security strategy of the state can be effectively implemented if certain conditions are followed. Therefore, in our opinion, it is appropriate to implement the following:

- 1) it is necessary to establish a clear boundary between territorial and executive, as well as local self-government bodies of the republic's regions when setting tasks for state administration;
- 2) reflect the real situation in the economy in the information supply;
- 3) ensuring economic security during the development of socio-economic development forecast and state budget projects;
- 4) clarification of economic security goals.

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Rezyume: *Maqolada iqtisodiy xavfsizlikning dolzarb muammolari batafsil tahlil qilinadi. Iqtisodiy xavfsizlikning mohiyati nazariy jihatdan batafsil va iqtisodiy jihatdan asoslangan. Iqtisodiy xavfsizlik strategiyasini amalga oshirish uchun uni amalga oshirish mexanizmini ishlab chiqish zarur.*

Резюме: *В статье подробно анализируются актуальные проблемы экономической безопасности. Теоретически детализированы и экономически обоснованы сущность обеспечения экономической безопасности. Определено что, для реализации стратегии экономической безопасности необходимо разработать механизм ее реализации.*

Kalit so'zlar: *iqtisodiy xavfsizlik, inflyatsiya, inqiroz, , davlat siyosati, budjet taqchilligi mamlakatlar iqtisodiyoti, iqtisodiy o'sish, dinamik rivojlanish, talab va taklif, pulning qadrsizlanishi, yashirin iqtisodiyot, iqtisodiy munosabatlar, axborot almashinuvi.*

Ключевые слова: *экономическая безопасность, инфляция, кризис, государственная политика, бюджетный дефицит, экономика стран, экономический рост, динамичное развитие, спрос и предложение, девальвация денег, скрытая экономика, экономические отношения, информационный обмен.*

ECONOMIC CLUSTERS: ESSENCE AND PROBLEMS OF FORMATION

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Summary: *In this article, the essence of economic clusters and the issues of their formation are studied in detail. Also, from the point of view of scientists, aspects related to the content of clusters were studied.*

Key words: *Cluster, geographical concentration, competition, integration, infrastructure.*

Economics is faced with the task of knowing, describing and developing the approaches, mechanisms and principles necessary to implement such a policy that would ensure sustainable economic growth and competitiveness at all levels.

These goals are met by the methodology of forming clusters of competitiveness, which, being in their essence intersectoral complexes, are “internal points of growth” of economic sectors. Clusters make it possible to overcome structural limitations and disproportions in the development of the territory of the regions, including the single-industry structure of production that has developed in a number of economic entities. The tasks of increasing the competitiveness of economic sectors, the need to overcome the current state of the economy indicate that the development of the problem of the cotton-textile cluster is very timely and in demand. These provisions determine the choice of the topic of this study and its relevance.

This problem is complex in nature, since it is the object of study of various scientific disciplines (economic geography, world economy, marketing, regional economy, industrial economics, agricultural economics, etc.).

Based on the analysis of the literature on the problems of the formation and development of clusters, scientists have identified several aspects based on theoretical concepts that support the cluster theory. In particular, E. Berg-man and E. Fezer distinguish five main theoretical concepts: external economies of scale; innovative environment; cooperative competition; intercompany competition; path dependency.

T. Anderson identified seven aspects related to the understanding of the cluster: geographical concentration; specialization; many actors; competition and cooperation; critical mass; cluster life cycle; innovation [1].

A full description of these aspects of the cluster is presented in Table 1 [2].

Table 1.

Aspect	Description and possible effects
1	2
Geographic concentration	- specific natural resources or other local assets become more accessible; - geographical proximity helps to reduce transaction costs, especially in organizing access to knowledge and its transfer; - external economies due to economies of scale; - specialization of suppliers in factor markets of labor, capital or technological resources can be facilitated within a particular area; - means for organizing access and sharing information about market or technological changes can become more efficient within a given area; - interaction with local consumers generates a learning process and more sophisticated demand; - social proximity provides easier access to services such as informal exchange of information.
Specialization	- the parties involved are linked together through the main activity; - clusters have a limited number of transactions among firms within a given

	cluster, that is, in the form of seller-buyer relationships; - continuous multidimensional interaction in similar, but complementary activities, explains the process of mutual learning, experimentation and innovation; - the nature of specialization is not necessarily limited to any sector, since clusters can develop in mixed directions when subjected to internal or external influences; - interconnected specialized suppliers and qualified consumers enhance the competitiveness of the cluster in global markets.
cluster executors	-the cluster should include: ■ companies, incl. and infrastructure elements ■ public institutions, ■ public authorities, ■ research institutes, ■ financial institutions..
Competition and cooperation	- intra-industry competition acts here as a tool for self-improvement; - cooperation contributes to a better allocation of resources both within the cluster and outside.
Critical mass	- is a necessary condition for maintaining the internal dynamics; - ensures the stability of the cluster to external influences.
Cluster life cycle	A cluster goes through the following life cycle stages: ■ Agglomeration (geographical proximity); ■ Emerging cluster (cooperation along the technological chain); ■ Developing cluster (development of network interconnections); ■ Mature cluster (the presence of a critical mass and fuzziness of boundaries, tendencies of isolation are weakened); Transformation (as a rule, the collapse of a cluster and the formation of new clusters).
Innovation	- increased opportunities for innovation; - improved business formation; - increased productivity.

In works on this topic, the above aspects are often linked to cluster strategies. Described in the table 1.

“At present,” notes T.B. Tsikhan, - experts described 7 main characteristics of clusters, on the combination of which the choice of a particular cluster strategy is based:

- geographic: building spatial clusters of economic activity, ranging from purely local (eg horticulture in the Netherlands) to truly global (aerospace cluster);
- horizontal: several industries/sectors can be part of a larger cluster (eg the mega-cluster system in the Dutch economy);
- vertical', clusters may contain adjacent stages of the production process. At the same time, it is important which of the network participants is the initiator and final executor of innovations within the cluster;
- lateral: a cluster brings together different sectors that can provide economies of scale, leading to new combinations (eg multimedia cluster);
- technological: a set of industries using the same technology (as, for example, a biotechnology cluster);
- focal: a cluster of firms centered around one center - an enterprise, a research institute or an educational institution;
- Qualitative: here it is not only the question of whether firms actually cooperate, but also how they do it that is significant. The network does not always automatically stimulate the

development of innovation. It happens that in networks, on the contrary, innovation processes are suppressed and protective behavior is encouraged. Relationships with suppliers can stimulate innovation processes, but they can also be used to shift costs to partners and infringe them in financial terms. In the latter case, the networks are neither stable nor stimulating" [3].

Aspects make it possible to highlight the benefits that help to realize the formation of a cluster for the business territory, to understand the nature of the cluster, the essence of the business of the processes occurring in it and characteristic of its functioning, which is very useful when comparing the cluster with other business structures.

Due to the fact that there is no single definition of a cluster, their classification is difficult, but we only indicate this issue. Clusters can be classified according to various features, G.V. Marchenko identifies the following features of cluster classification:

product range (multi-profile, single-profile); the degree of dependence on external resources ("their own" or external resources are used); nature of the final product (raw material, semi-finished product, component, finished product); scale and structure of sales markets; share in the economic base of the region, in the volume of the regional and national market; sales geography (outside the region or in it); the degree of technological, economic and organizational isolation from other clusters in the region; efficiency for the regional budget [4].

Clusters that are oriented to the external market, G.V. Marchenko calls regional clusters of competitiveness. I.S. Ferova proposes to classify clusters: on the basis of localization: geographical and dispersed ("project"); by the form of connections: vertically integrated companies and horizontal or network structures; on a functional basis: technological clusters, innovation and marketing (oriented to the general market of resources or the consumer market).

L.S. Markov describes two main categories of clusters, formed along the spatial and functional axes [5].

Functionally connected systems, which are less limited to strictly defined regions, he refers to industrial clusters, and spatial groupings of similar and related firms and industries to regional clusters. ETHA scientists classify clusters according to the degree of maturity, highlighting strong, stable, potential and latent clusters [6].

Based on the above, let's sum up some results: firstly, the authors determine the cluster based on the goals and objectives set; secondly, among the presented points of view, it is necessary to distinguish between the definitions of the cluster itself and the specific definitions of clusters - regional, industrial, economic and innovative; thirdly, consideration as the central moments in the cluster, necessary for its formation and development, the territorial concentration of participants and their relationship based on the commonality of activities with focus on the core industry, which allows us to put forward a hypothesis about objective nature cluster and the need to interpret it through the prism of the process of territorial socialization of production; fourthly, consideration of various definitions of the phenomenon under study allows us to single out generalized positions and approaches to the interpretation of the cluster and their classification.

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Rezyume: Ushbu maqolada iqtisodiy klasterlar mazmun-mohiyati, ularning shakllanish tartibi masalalari batafsil o'rganilgan. Shuningdek, klasterlarning mazmuniga bog'liq jihatlari olimlar nuqtay-nazaridan tadqiq qilingan.

Резюме: В данной статье подробно изучены сущность экономических кластеров и вопросы их формирования. Также с точки зрения ученых были изучены аспекты, связанные с содержанием кластеров.

Kalit so'zlar: Klaster, geografik kontsentratsiya, raqobat, integrallashuv, infratuzilma.

Ключевые слова: Кластер, географическая концентрация, конкуренция, интеграция, инфраструктура.

TESTING AS AN INNOVATIVE METHOD OF ASSESSMENT

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Summary: *This article analyzes testing as an innovative method to teach students' communicative competence. Testing is one of the important problems that needs for further investigation in methodology of teaching foreign languages. The aim / purpose, object, type, forms of testing have been investigated. As a result we recommend testing as one of the innovative and effective tools in teaching foreign languages.*

Key words: *testing, test, testology, competence, methodology of teaching, innovative method, purpose, object, type, forms of testing.*

The choice of effective methods for monitoring communicative competence of students depends on the aim / purpose, object, type, form, stages of formation of skills and competencies of assessment. -The use of such methods as tests (discrete, integral types, computer tests), role-playing games, portfolios, which are considered as innovative methods for monitoring the results of teaching practical grammar of a foreign language, makes it possible to achieve high efficiency.

The English term "test" means a set of standardized tasks used to analyze the psychophysiological and personal characteristics, the level of intellectual development, abilities, as well as the knowledge.

Since 1992, the admission of students to higher educational institutions of our republic has been carried out through testing. Over the years, the test and its technology have been improved, showing a number of positive aspects. As a result, at all stages of the educational process in educational institutions, the test was used in conjunction with traditional control methods to determine the level of knowledge of students.

According to the content of tests in existing pedagogical and psychological sources, they are divided into the following groups:

1. General tests for determining mental abilities and development.
2. Tests to determine special abilities in various activities (situation, area).
3. Tests to check the development of knowledge and skills.
4. Tests to determine the personal abilities of a person (memory, character, thinking, etc.).
5. Tests for determining human culture (universal, social, and other qualities) [6: 558].

Tests conducted to determine the knowledge, skills and qualifications of students provide reliable information in determining the knowledge of students on educational material. Tests conducted in foreign languages are called linguodidactic tests, in which the level of use of language material and the speech ability of students is clarified by separate criteria specially developed for different stages.

According to the form, tests for controlling knowledge are divided into such types as individual, adapted for group work, oral or written, or using a computer.

In foreign testology, there are mainly two trends in determining the level of students' ability to speak a foreign language effectively. The first includes the actions of students (speech) and directly evaluates their speech. In the second method, their assessment is carried out indirectly, that is, their general behavior is taken into account as an object of control (linguistic richness, ability to use words). For direct assessment of speech behavior, integral tests are used, and for indirect assessment, discrete (object – linguistic richness) and integral (object - speech ability) tests are used [1: 29-30].

Discrete test types are a very common method used alone or as part of a larger test to test the effectiveness of verbal communication. Its positive side lies in the fact that a vocabulary of the same volume and simplicity of structure is chosen, which allows giving an equal assessment to all subjects.

Integral tests are aimed at checking one or another form of a speech act, in which the assessment can be carried out as follows: a) the student's involvement in a certain form of a speech act; b) checking the mastery of special abilities or other types of speech acts.

Integrated test types have the following advantages:

1. As an assessment criterion, the text prepared by its examiner, that is, the elements not contained in it, is taken into account. The task is aimed at creating the text itself.

2. In a controlled test interview, all subjects are given the same volume (number of replicas) and complexity of material.

3. Tests allow you to evaluate the behavior of the subject on the basis of previously developed criteria (norm-referenced measure). This is different from a norm-referenced measure obtained from a specific group of test takers [3: 26-27; 146:8].

In particular, there are the following disadvantages of complex tests:

1. The subjectivity of the examiner is preserved even if the assessment of the examinees is carried out on the basis of pre-prepared criteria.

2. The object presented by the test author and its initial size often do not match, which raises doubts about the competence of this test.

3. Even if the examiner controls the speed of the subject's speech, integration tests take a long time, and from this point of view, such tests are inconvenient. Discrete tests have many advantages in this regard.

This shows that we can creatively approach the experience of testing abroad and apply their positive aspects.

Currently, in the education system of our country, tests are widely used for individual and group work and conducted on a computer.

When using information technology in the educational process, the computer plays a key role and can replace the teacher in a given situation. At the same time, it is shown that the control of students' knowledge, skills and abilities with the help of a computer has a number of advantages in the educational process. According to experts, computer control has the following advantages:

1. Convenient to use.

2. Saves time.

3. Has no disadvantages than "paper test".

4. Compliance with the maximum accuracy of control, due to the fact that all students take the test under the same conditions.

5. Can be used in all kinds of control (including self-control).

6. Suitable for use in printed version.

7. Does not allow the use of cheat sheets.

8. There are conditions for regular improvement of the effectiveness of the testing process [5: 9-10].

The advantages of the computer test mentioned above - the simplicity and convenience of conducting such tests for the teacher and students prove that it is an effective method of pedagogical control.

It should be noted that any test questions created during the educational process are not the basis for an objective assessment of the knowledge of the teacher and students. Because, the very creation of the test: "... this is painstaking work, this is an activity that requires a specialist to know his work and have fundamental knowledge and skills in the field of psychology of students" [4: 188].

When creating a test, first of all, it is necessary to pay attention to the fact that the tasks correspond to the state educational standard for the subject and incorporate competence buildings in this area. Also, when writing tests, you need to pay attention to the following:

- compliance with the requirements for knowledge, skills and qualifications of students and the stages reflected in the State Standard;
- questions and answers should be short, concise and fluent;
- in the tests there should be only one correct answer to the question asked;
- answers must be comprehensive in content;
- the presence of tasks of different levels of complexity according to the material;
- correct performance of control functions (for example, diagnostic, educational, training, etc.) through tests;
- ensuring interdisciplinarity;
- correspondence of the allotted amount of time and the given volume of material in questions;
- taking into account the complexity of tasks in multivariate tests and at different stages;
- providing unique questions and answers in tests conducted with different types of control.

Carefully designed test tasks in compliance with the above general requirements make it possible to determine the real knowledge, thinking, creative abilities of students, as well as, in addition, the activity of the teacher. Thus, the teacher understands what should be given more importance, what material is difficult for language learners, and, of course, creates the basis for achieving the expected results.

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Rezyume: *Ushbu maqola test sinovlarini talabalarining kommunikatsion kompetentsiyasini o'rgatishning innovatsion usuli sifatida tahlil qiladi. Test sinovlari chet tillarini o'qitish metodikasida qo'shimcha tekshirishni talab qiladigan muhim muammolardan biridir. Sinovning maqsadi / maqsadi, ob'ekti, turi, shakllari o'rganildi. Natijada test sinovlarini chet tillarini o'qitishning innovatsion va samarali vositalaridan biri sifatida tavsiya etamiz.*

Резюме: *В данной статье анализируется тестирование как инновационный метод обучения коммуникативной компетентности студентов. Тестирование - одна из важных проблем, требующая дальнейшего изучения в методике преподавания иностранных языков. Были исследованы цель, объект, тип, формы тестирования. В результате мы рекомендуем тестирование как один из инновационных и эффективных инструментов в обучении иностранным языкам.*

Kalit so'zlar: *sinov, test, testologiya, kompetensiya, o'qitish metodikasi, innovatsion usul, test maqsadi, ob'ekti, turi va shakllari*

Ключевые слова: *тестирование, тест, тестология, компетенция, методика преподавания, инновационный способ, цель, объект, тип и виды тестирования.*

TERMS ON ECOLOGY IN CRIMINAL LAW

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Summary: *this article analyzes the terms related to the field of Ecology in criminal law.*

Key words: *Ecology, Environment, Environmental, Criminal Code.*

"Ecology" - Greek "oikos" - means home and "logos" - doctrine. The founder of ecology is the German biologist E. Geckel (1834-1919), who first used the term "ecology" in 1866. He wrote: "by ecology we mean the general science of the relationship between the organism and the environment, where we refer to all the "conditions of existence" in the broad sense of the word. They are partly organic and partly inorganic".

Literally translated, ecology means "home, the doctrine of living". "Ecology" is used to express a special science of the interaction of living organisms, including humans, with each other and with the environment. From inanimate, infinite nature, organic, living nature gradually emerged. Due to the increased influence of man on the natural environment, ecology is gaining importance as a scientific basis for the rational management of nature and Environmental Protection. The term ecology was gradually concretized in relation to nature: a natural home, a place of residence of a person, the doctrine of people. As a diligent, caring landlord, a person not only takes care of him, protects and improves him. Man lives in nature and therefore interacts with it. This interaction is manifested in nature management and conservation.

Nature management and conservation represent social relationships between people in the field of nature management and nature conservation. They are legally regulated by the nature Management Law and the nature, environmental protection legislation, that is, they are two branches of this legislation; together they constitute a complex branch of environmental legislation as two interconnected branches.

In the middle of the 20th century, nature in science began to be called "natural environment", sometimes simply "environment", and often simply "habitat". In such cases, we mean nature, natural environment. All these concepts and terms were subsequently consolidated and reflected in environmental legislation.

Here we want to focus on some of the terms that are found in the structure of the criminal law part of crimes in the field of Ecology. Several terms related to ecology can be found in the Criminal Code of the Republic of Uzbekistan. For example, chapter XIV of the criminal code, known as crimes in the field of ecology, is called, as mentioned above, "crimes in the field of Environmental Protection and the use of nature." Article 2 of the Criminal Code states that one of the tasks of the code is the protection of the natural environment. And in articles 194-204 of Chapter XIV of the Criminal Code, the term "environment-natural environment" is used.

In scientific works related to the protection of Ecology, current laws and practices, several terms can be found in this area, including: "protection of the natural environment", "protection of the environment", "protection of nature", "protection of Natural Resources" and others.

A well-known scientist in the field of Environmental Law O.S.Kolbasov noted, the development of terms on law correlates with its discussion and formation. In fact, the demand for understanding the meaning of legal terms has always been high. Knowing the true meaning of a word has its effect on the correct application of that word.

Analysis of the above terms in terms of content in kilingan, each of them can mean different meanings. These and other environmental terms are well-known scientists (O.S.Kolbasov, M.M.Brinchuk, O.N.Dubovik, A.K.Despite the fact that it was studied by Golichenkov and others), until now there has not been a single opinion on these terms.

The term "environment" is often used as concepts used interchangeably, meaning the same

as the term "environment natural". In our opinion, the concept of "environment" is broader than the concept of "environmental natural environment". By environment we can understand any environment (not only natural) around a person. For example, the environment of the daily, production and others, through which most of a person's life passes, "...the concept of the environment can also be applied to natural objects (since they are around man), only this does not include production, non-natural objects". Hence, by the environment, one can understand the natural and non-natural environment, and this means wider than the "natural environment".

Assuming that these three different terms are used by the legislator as words that mean the same meaning, it is unconditional that the use of three different terms in the same law itself leads to different interpretations of the law. Because to reveal the meaning of these concepts, the meaning of each word in it is investigated. For example, if the word "natural" is given in one concept, then the second does not. Also with the name of the chapter (XIV), it is noticeable that the substances specified in IT (articles 193-196 of the Criminal Code) are incompatible.

If we consider that these three concepts were used in three different meanings, the first, as mentioned above, means wider than the second.

In our opinion, it is more expedient to use the term "environment" instead of the three different terms used in the Criminal Code, considering the concept of "environment" as a broader concept than the concepts of "Environment" and "natural environment".

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Rezyume: maqolada jinoyat qonunchiligida ekologiya sohasiga oid atamalar tahlil qilinadi.

Резюме: в статье анализируются термины присущие экологии в уголовном законодательстве.

Kalit so'zlar: ekologiya, atrof muhit, atrof tabiiy muhit, jinoyat kodeksi.

Ключевые слова: экология, окружающая среда, окружающая природная среда, уголовный кодекс.

THE ROLE OF THE COMPARATIVE METHOD IN THE STUDY OF STYLISTIC ISSUES

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Summary: The given article is about the role of the comparative method in the study of stylistic issues of genetically unrelated languages. The article uses the method of comparative analysis and made it possible to identify both common similar features and distinctive features and inconsistencies in different languages such as English, Russian and Karakalpak. Examples for the article were taken from proverbs, dictionaries and literary works of studied languages.

Key words: compare, stylistics, English language, Russian language, Karakalpak language, stylistic devices.

Problems of stylistics every year attract the attention of an ever wider range of linguists and literary critics. Stylistics exists as an independent discipline, it develops, it becomes more and more differentiated. At the same time, in stylistics, as well as in any other science, integration is taking place, i.e. the strengthening of the mutual influence of different branches of knowledge and the emergence of new synthetic sections that combine and generalize the data of disciplines that were previously considered distant.

Language is one of the amazing tools in the hands of mankind. However, you need to use it skillfully, having studied all its features and secrets. The more we realize the richness and grandeur of our native language, as well as the foreign language being studied, the more demanding we become of our speech, the more acutely we feel the need to improve our style, to fight for the purity of the language. Even if we are fluent in our native literary language, it is always useful to think about how to make our speech richer, more expressive. This is taught by stylistics - one of the important branches of applied linguistics, the science of the skillful use and choice of language means.

The study of the style of the English language has practical value, it is associated with an increase in the general culture. It not only develops the skills of thoughtful reading of fiction, but also provides a basis for the development of artistic taste, it contributes to the normalization of the language and helps its speakers to speak well and expressively. Great aesthetic pleasure from reading can be obtained without knowing the style, since a true work of art always leaves a mark in the mind of a person, but for a reader who has knowledge of style, the understanding of a work of art will be both deeper and more complete.

The linguostylistic analysis of a work of art is a kind of catalyst for the cognitive, ideological, emotional and aesthetic impact of literature. Analysis is inseparable from synthesis, which restores the artistic integrity of the work, showing the place of each element in the structure of the whole. Each linguistic phenomenon, each element in a literary text is considered not in isolation, but in its connections and relations with other elements, with the entire structure of the literary text and language as a whole.

When studying English, that rich world of language is born, about which linguist W. von Humboldt wrote: "Through the diversity of language, the richness of the world and the diversity of what we learn in it open up for us." S.Ya. Marshak rightly noted that there is no object in the universe for which a person would not have invented the word [1, p. 5, 6].

By assimilating a foreign, new language, a person simultaneously assimilates an alien, new world. With new foreign words, the student, as it were, transfers concepts from another world into his consciousness and world. It is this need to restructure thinking, to "reshape" one's own, familiar, native picture of the world according to someone else's unusual pattern, and this is one of the main difficulties in mastering a foreign language [2, p. 107].

One and the same concept, one and the same piece of reality has different forms of linguistic expression in different languages. It is difficult to find multilingual words that “express the same concept and do not differ from each other in emotionally expressive, stylistic or any other kind of constant significant information” [3, p. 56].

In the process of speech, the speaker relies on his social experience and compares words that can be combined in a given society, i.e. social structures are the material basis of linguistic structures. Social differentiation manifests itself especially brightly and directly in the vocabulary of the language.

The use of the method of comparative analysis makes it possible to identify both common similar features, as well as distinctive features and inconsistencies in different languages. The study of interlingual correspondences in the vocabulary of languages belonging to different systems: English (Germanic languages), Karakalpak (Turkic languages) and Russian (Slavic languages) is of considerable interest for research.

For example, even such a concept as the designation of colors white, black, green contains certain connotations in different languages. The phrase green eyes in Russian sounds poetic, romantic, suggestive of magical, mermaid eyes [4, p. 45].

Russian phrases «синие глаза, голубые глаза» also have positive connotations, the blue or blue color of the eyes is conveyed by different epithets in Russian: sky-colored eyes, cornflower blue eyes. In English and Karakalpak languages, the phrases: green eyes, «kózi kók, kózi duzday kók» have negative connotations. In English, the phrase «green eyes» is a metaphor for envy.

The word white (aq in Karakalpak, белый in Russian) denoting color has a positive connotation in all compared languages. White color is the color of the world (white dove – белый голубь - aq kepter) - a symbol of peace, the color of the bride's wedding dress, the color of all that is good and pure.

For example, such phrases as «white man – белый человек, white dress – белое платье, aq keuil, aq kókirek, aq niyet, aq altın» have a positive connotation. The phrase white man means not only «a person with white skin, a representative of the white race», but also means a decent, well-mannered person. For example:

1. The whitest man that ever lived, a man with a cultured mind and with all the courage in the world. (T.Hardy).

2. He really loved to have white men staying on the place. (D.H.Lawrence).

In the phrase white lie, we see a combination of the word white with the noun lie (lie), denoting something bad, but the word white, as it were, “softens”, ennobles the negative meaning of the latter: it means “a lie to the rescue, a justified lie”.

In all compared languages, the correlation of black with something bad is typical, therefore, phrases with an adjective often have negative connotations: a black man is synonymous with the words “devil, evil spirit, satan”, black sheep, black market, black mail, Black Gehenna, black soul in English, «чёрная зависть, чёрный дьявол» in Russian and “qara oy, qara miynet, baxtıń qara bolsın” in Karakalpak language.

The author of the political sociology of the English language, Ali Mazroui, associates the association of black with something bad with the spread of Christianity, which depicted the devil as black and angels as white [5, p. 81]. Consider the use of the word “black” in context:

1. Rich as Croesus and as wicked as the black man below. (G.Meredith.Evan Harrington).

2. Two blacks don't make a white.

3. You cannot wash a charcoal white.

In W. Blake's poem “The little black boy” two colors are contrasted: black and white:

And I am black but

O My soul is white.

In the Karakalpak language, in the following proverbs and poetic lines, we see the use of the word “qara” in a negative sense:

1. Qara qoydin terisin sabınlap juusańda aǵarmas.

2. Aqqa qara joq

Qaraǵa shara joq.

3. Bazda tayıp qara muzǵa

Bazda dár'ya aǵar dizden. (I. Yusupov)

It should be noted that if for the English and Russians black is the color of mourning, then in the Karakalpak language the word “qara” can have positive connotations in combination with some words.

For example, the phrase “qara kózler” is used to describe beautiful girls and women. In the phrase “qara qalpaq (black hat), the word “qara” means not only the color, but also the national hat of the people, the symbol of the nation.

Interest in the comparative study of languages is dictated by life itself, the need for practical study of languages and the use of the native language in order to facilitate the assimilation of the features of the second language being studied [6, p. 34].

To sum up, a comparative study of the same concepts and stylistic devices in genetically unrelated languages, such as English, Russian and Karakalpak, makes it possible to see common features, on the basis of which new ways of rapprochement of language systems are outlined.

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Rezyume: Mazkur maqola stilistik genetik jihatdan qardosh bo'lmagan tillarni o'rganishda qiyosiy metodning o'rni haqida. Maqolada qiyosiy tahlil usuli qo'llanilgan bo'lib, bu turli tillarda, ingliz, rus, qoraqalpoq tillarida umumiy o'xshashlik va o'ziga xos xususiyatlar va nomuvofiqliklarni aniqlash imkonini berdi. Maqolaga misollar o'rganilayotgan tillarning maqollari, lug'atlari va adabiy asarlaridan olindi.

Резюме: В данной статье речь идет о роли сопоставительного метода в изучении вопросов стилистики генетически неродственных языков. В статье использован метод сопоставительного анализа, что позволило выявить как общие сходные черты, так и отличительные черты и несоответствия в разных языках, таких как английский, русский и каракалпакский. Примеры для статьи были взяты из пословиц, словарей и литературных произведений изучаемых языков.

Kalit so'zlar: taqqoslash, stilistika, ingliz tili, rus tili, qoraqalpoq tili, stilistik vositalar.

Ключевые слова: сравнение, стилистика, английский язык, русский язык, каракалпакский язык, стилистические приемы.

**COMPOSITIONAL AND STRUCTURAL PROPERTIES OF DOCUMENTS IN
KARAKALPAK LANGUAGE**

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Summary: *A document, like any other object, has its own purpose. It serves to register and confirm certain facts, events, phenomena, actions by a person, that is, it is a source of information. They differ in importance and character. Documents can have political, historical, legal, economic and other significance.*

Key words: *documents, composition, structure, process.*

Compilation of any document implies compliance with the established rules of data registration for each type of document. Compliance with these rules provides the document with the necessary legal force. Legal force is a property of a formal document established by existing legislation.

The legal force of the document is provided by the use of a certain compositional scheme in the preparation of this type of document. The special feature of this scheme is the mandatory presence of the main semantic sections - requisites (from the Latin requisite - necessary, necessary). A series of details placed in a specified sequence forms a document form. The form is the standardized structure of the documentary text, which determines its compositional and genre modality, semantic properties.

The form is regulated by the national standard. It is documented in one court and throughout the country and ensures the commonality of the document. The most important condition is to correctly prepare this type of document in a single form.

A form intended for one specific type of document is called a standard form and is defined by the specified number of details and their strict placement on the document form.

The model developed according to the established rules is a graphic model of form document creation. It defines the formats, sizes, and placement of fixed and variable props.

Organizational-administrative documents (OAD) must be organized strictly according to the model form adopted in this document system.

The current requirements of the organization for providing documents for management are defined in the national management documentation system (NMDS). It envisages all the principles and rules that define uniform requirements for management activities in national management bodies, enterprises, institutions and public organizations. The adoption of such a unified system is aimed at the development of favorable conditions for the regulation of the organization's document flow, reduction of the number and increase of the quality of documents, collection of information, processing, and effective use of technical tools and advanced technologies. NMDS refers to the existing document systems of state management bodies, courts, prosecutor's office, arbitration, institutions, organizations and enterprises, including documents developed by computer technologies.

No document, as a rule, has a complete set of details. Their composition is related to the purpose and content of the document itself. Regardless of this, it is mandatory to have requisites for each document, regardless of its type. Therefore, for each type of document, there is a set of requirements and a strict and stable arrangement procedure for each requirement. A set of attributes identifies the type of document, helping to identify the information contained therein.

Among the requisites, there are stable requisites that are mandatory for each document type.

They are pre-printed on standard paper using a computer or a special stamp and form an official document.

A blank is a standard sheet of paper on which stable values common to a group of documents are listed and space is allocated for variables specific to each specific document.

The use of forms gives formality to documents, increases work culture, significantly reduces the time spent on document preparation, facilitates its execution and subsequent use.

Forms are usually divided into letter forms and other types of documents.

The special feature of the letterhead is related to the need to show the address information of the company, and therefore the bank account number. In addition, a stable reference to the form requirement - the index and date of the introductory document is included. In other forms, these sections of the page (of paper) are left transparent for filling in the details of this type of document, or are provided with template sections of the text filled with changes when the document is created.

Official documents are mainly issued in two formats: A4 (210 x297 mm) and A5 (148 x210 mm). Including, A3 and A6 formats can be used. In document forms, subject details can be placed in an angle or in a longitudinal direction.

The angular location of the requisites is the most convenient and convenient for coding the requisites covered in the letterhead (especially in letters and documents that require approval, resolutions). The requisites of the document type arranged lengthwise are located in the center of the upper part of the paper. This type of blank is often used in cases where the name of the organization and the name of the higher organizations subordinate to it contain more characters. Two languages, Karakalpak and Uzbek, which act as national languages, on the forms of the bodies of the subjects of the Republic of Uzbeks, requisites 06, 07, 12 are printed in these two languages in longitudinal form at a common level. Document forms must have a common size:

Left - 20 mm;

upper - at least 20 mm;

right and bottom - at least 8-10 mm.

In printing, the established rules are also followed. The text of the document is printed in 1, 5 line spacing. There can be 1, 5-3 line spacing between chunk components. If one prop is set to multiple lines, then its text will be printed after 1 interval.

Contents and details of documents

Most of the documents we are considering are administrative (laws, decrees, orders, etc.), the main purpose of which is to regulate the work, to ensure the solution of the task assigned to the management body, to achieve the maximum fulfillment of the specified tasks. is to get.

Administrative documents ensure the execution of relevant tasks according to the scheme: from the superior body to the subordinate, from the head of the organization to its constituent departments and employees. They implement the principle of vertical management.

Moreover, from the legal point of view, administrative documents belong to normative legal documents. They inform the promotion of subjects of the executive power and create clear administrative-legal interventions.

Normative documents mainly come from the national bodies acting within their own representation and representing the country as a whole. This means that they are bound to be fulfilled, and gives them representativeness and formality.

Normative documents are a type of law that allows us to quickly and efficiently respond to the changing needs of life, that is, they can be issued as soon as possible, changed or canceled when necessary.

Furthermore, the most important condition for their preparation and printing is compliance with the Constitution of the Republic of Karakalpakstan, which ensures the development of the entire society in one direction. In addition, they must not conflict with supporting documents with significant legal force. Supporting documents, which are a written source of law and have the appropriate type of document, give you the opportunity to correctly and clearly define the content of legal norms and help to understand the requirements of legal norms, to accept them as universal and universally binding. It is important to comply with the rules of the composition of regulatory

documents, indicating the relevant mandatory requirements: the type of regulatory documents, their names, the name of the organization that accepted the document, date, place of acceptance, number, signatures of relevant officials. Depending on the type, purpose and content of supporting documents, the section may have additional sections (sources, notes, appendices, date of entry into force, instruction on the cancellation of other regulatory documents, compliance with the requirements of regulatory documents consequences, etc.).

As a rule, the ground of NH is a text with an introductory section - a preamble. There, the purpose, tasks and motives of the NH press are determined (reference, for example: "About the appointment of K.A. Allaniazov to the position of governor of Bozatau district" Decision of the Head of the People's Council of the Republic of Karakalpakstan // Nukus city, March 7, 2022 year). However, showing this section may not be mandatory for any NH. For example, there are no such instructions in the codes, because the publication of the codes confirms the desire of the legislator to generalize and systematize the legislation in this area of law. It makes no sense to indicate the tasks and tasks directly based on the meaning of the text of the normative documents (for example: 1) "About the opening of the thirtieth vote of the Council of the People's Republic of Karakalpakstan" » 17. 06. 2022; 2) "M. About the appointment of Kh. Akhmedova as the Deputy Head of the Council of Ministers of the Republic of Karakalpakstan - Head of the Family and Women's Committee» Decision of the Presiding Committee of the Council of Home Affairs of the Republic of Karakalpakstan // Nukus city, 7 -March, 2022).

Accordingly, in the preamble (introduction) of some regulatory documents, a detailed description of the socio-political situation is given in connection with the regulated problems, which fully reveal the social significance of the regulatory documents (for example:

"Organization of honorary titles of the Republic of Karakalpakstan on the "Law of the Republic of Karakalpakstan // Nukus city, December 14, 1996, No. 231/I). The first article of normative documents may be intended to define the terminology that will be used later (for example: Law of the Republic of Karakalpakstan "On Protection of Atmospheric Air") // City of Nukus, December 15, 1997, No. 291/ I).

Normative documents determine the main content of the decision-making body. It usually begins with the words "THAT THE BODY DECIDES." This is followed by a list of normative clauses to be determined in the imperative form and in the corresponding logic: clauses given by articles or numerical symbols. In addition, the laws follow the procedure of giving in the form of statutes, paragraphs for powers, decisions and business plans are compared with some sub-clauses.

In addition to articles (points), the decision section of large normative documents includes paragraphs, chapters and sections. In this case, the material must be placed in a strict sequence. Sections, chapters, paragraphs and articles (points) should be provided with special topics, which will make working with normative documents much easier. Articles of normative documents can be used to summarize common facts and information or to register specific objects, actions or events. In order to get the two-pronged opinion first, the registration procedure must be as clear and complete as possible. The content of the decision-making body and its presentation are closely related to the preparation of regulatory documents. If a new standard is established in the normative documents, it is suggested to state it according to the "if" scheme, indicating the sanction that ensures this rule. When a norm that changes, complements, or rejects existing norms is drawn up, words such as change, consider, listen to the statement are added to it (reference: "Constitution of the Republic of Karakalpakstan Law of the Republic of Karakalpakstan on amendments and additions // Nukus city, February 13, 2021).

However, in any case, the legal norm must have a three-element structure, which can be given by the "if - there - else" scheme, where each unit of the scheme corresponds to one specific element of the legal norm: "if" - hypothesis, "then"- disposition, "else"- sanction. It provides a clear indication of the legal requirements of mandatory field-starting. The absence of some single

element leads to "failures" in regulation, that is, the logic or verbal construction accepted as the norm may not reflect the legal norm.

Also, all regulatory documents should be published in the Karakalpak and Russian languages and brought to the attention of citizens and organizations. Then they are considered to have entered into force.

Thus, taking into account the legal force of existing normative documents, they can be divided into two large groups: laws and by-laws. Since the laws are normative documents of the higher central authorities of the country, they occupy a central place in this integrated system. Also, regulatory documents acting at the national level on service sectors are distinguished (documents issued by the President of the Republic of Uzbekistan, the government of the Republic of Uzbekistan, etc.); at the level of subjects of the Republic of Uzbekistan (provinces, districts, cities, etc.); issued by branch bodies of the executive power; regulatory documents related to separate organizations, institutions.

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Rezyume: *Hujjat, boshqa ob'ektlar kabi, o'z maqsadiga ega. U ma'lum faktlar, hodisalar, hodisalar, insonlarning harakatlarini qayd etish va tasdiqlashga xizmat qiladi, ya'ni axborot manbai hisoblanadi. Ular ahamiyati va tabiati bilan farqlanadi. Hujjatlar siyosiy, tarixiy, huquqiy, iqtisodiy va boshqa ahamiyatga ega bo'lishi mumkin.*

Резюме: *Документ, как и любой другой объект, имеет свое назначение. Он служит для регистрации и подтверждения определенных фактов, событий, явлений, действий человека, то есть является источником информации. Они различаются по важности и характеру. Документы могут иметь политическое, историческое, юридическое, экономическое и иное значение.*

Kalit so'zlar: *hujjatlar, tarkib, tuzilma, jarayon.*

Ключевые слова: *документы, состав, структура, процесс.*

**THE USE OF THE CATEGORY OF POSSESSIVENESS IN THE ENGLISH AND
KARAKALPAK LANGUAGES**

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Summary: *This article deals with the category of possessive case in English and Karakalpak languages, which is one of the important problems that needs for further investigation. The analysis of the category of possessiveness in above mentioned languages is related to the study typological system of languages. As a result of investigation similarities and differences have been revealed in languages.*

Key words: *possessiveness, grammatical category, English language, Karakalpak language, suffixes, affixes, similarities and differences.*

The category of possessiveness is a complex linguistic phenomenon studied in Linguistics, especially in a comparative way. Only several aspects of this problem have been investigated in the linguistic literature in the English and Karakalpak languages. Possessive affixes of nouns are an obvious example.

The views related to the problems of expressing the sense of possessiveness in the Karakalpak language have been explained in the works of N.A.Baskakov, A.Kydyrbaev, A.Bekbergenov and G.Patullaeva.

In the English language V.Y.Plotkina, G.Vorontsova, I.P.Ivanova, L.S.Barkhudarov, D.A.Shtelling, A.A.Kholodovich and several other scientists dedicated their works to the issues of possessiveness.

The present article is a piece of research determining the use of “the category of possessiveness” in different ways in the English and Karakalpak languages. This is the first step in determining the use of the category of possessiveness in the languages belonging to various systems.

The analysis of the category of possessiveness is related to the study of this categorial meaning in the languages being compared “Possessiveness” has been the object of the study and research of many foreign scientists and linguists.” “Possessiveness” conveys the certain general concept on all research”, however analysing and modelling principles, research methods can be different.

Looking at it from this point of view, the category of possessiveness is of interest not only to linguists but also to general scientific on public scholars.

The term “possessiveness” is derived from the Latin word “possessivus”, which means ownership, possessiveness. “Possessiveness” is one of the categories of the universal concept of the language, the main essence of which is to determine the name of the object in relation to another person or object. In terms of form and content, “possessiveness” is connected with categories such as determination, predicativity, attributive, locativity, semanticity and relativity [1:89].

The category of possessiveness is an interlanguage category, for it can be studied in all language systems being compared with, namely English, Karakalpak, Uzbek, Russian and others.

Why this category is called “interlanguage” is because it relies on the study of linguistic hierarchy of “possessiveness” in morphological, grammatical and lexical aspects. In the English and Karakalpak languages it is represented by morphological and syntactical methods.

The intercategorical feature of “possessiveness” is proved by its collocation with many lexical-grammatical associations of the word, in particular, a characteristic phenomenon for nouns, verbs, pronouns and adjectives. For example, the concept of “possessiveness” can be expressed in several ways – with the help of verbs, such as “have”, “belong”, “own”, “possess”, as well as with nouns “owner”, “possession”.

For example: They have a large garden.

To whom does this land belong?

He owns two motorcars.

The concept of “possessiveness” is also expressed by possessive pronouns: my, mine, our, ours, his, her, hers, its, your, yours, their, theirs.

For example: That is my notebook. That notebook is mine.

The concept of “possessiveness” can also be expressed by prepositional phrases with the preposition “of”: at the end of the page, at the foot of the mountain. Sometimes it is possible to use the attributive noun instead of these phrases: the legs of the table and the table leg, the City of New York and the New York City.

Possessive pronouns, possessive nouns and prepositional nouns with the preposition “of” can also indicate the concept of “possessiveness” with several other meanings.

In each expression of “possessiveness” several signs and indicators can be explained vividly.

Morphological expression of “possessiveness” includes the forms of nouns, verbs, pronouns etc. For instance, the linguist A.A.Kholodovich did research on “expressing possessiveness” in modern Slavic languages by the way of morphological method.

A.A.Kholodovich’s interest in the science of grammar resulted in his research on expressing “possessiveness” in different ways. At the first stage of his activities, he was interested in the aspect of phased semantics of grammatical aspects, and at the second stage of his creative work, he became interested in it as an aspect of grammatical typology. In the study of the category of possessiveness, these two aspects are still relevant today, scientists today use the scientific heritage of this particular scientist in their studies and research. [4:19].

A noted scientist N.S.Trubetskoy mentioned that at one time certain languages had different forms of nouns denoting “possessiveness” [see: 2:78].

The possessive forms of words, in their turn, can be connected with categorical means-concepts; the category of “possessiveness” (In Uzbek, Karakalpak) and the category of number (In Karakalpak and English).

For example:

my book – I person, singular (китаб-ым)

my books – I person, plural (китаплар-ым)

his book – II person, singular (китаб-ы)

her book – II person, singular (китаб-ы)

their books – II person, plural (китаблар-ы)

One can see from the examples above, the particular affix “ым” is added to the root of the word in the first case and expresses first person, singular. In the second case, the affix “лар” which is plural, is added to the root of the word and then another affix “ым” is added to make plural form of possessive noun. The affix “ым” denotes that the object belongs to one person, and the affix “лар” and the affix “ым” together denotes plural noun belonging to one person. The form “their books” is similar to other its analogues, only the noun is in the second person, plural [3: 130].

Each aspect has its own means of expressing “possessiveness”. From the morphological point of view, the concept of “possessiveness” is expressed by suffixes, in the syntactical aspect it is expressed with the expressions, in the lexical aspect it is given with the help of words expressing “possessiveness”.

While studying the possessive category, we considered that the category of case is also important. The reason for this is that one of the main functions of possessive case” is to express possession.

In English, the case category has been studied far less than it was in other languages. This view is proved by the number of cases. There are six cases in the Karakalpak language, while English has only two cases. Linguists state that the reason why there are two cases in English is because the English language has by far the most preposition uses instead of case category.

Some functions of cases are thought to have been transferred to the use of prepositions.

Possessive case is one of the main cases in English. This phenomenon was used in the ancient written sources and today it is still being used and developed.

Possessive case is formed by adding “s” to the end of a noun. In some cases it is formed without suffix, just adding apostrophe that is, the symbol “'”. This depends on the plural form of a noun as well as the words ending in certain sounds: boys [bɔɪz]; Gus [ɡʌs]; Zones [zəʊnz].

In English 's inflexion can be added to the roots of simple nouns, abbreviations, as well as compound nouns.

It is necessary to mention that in the Karakalpak language the suffixes of possessive case are sometimes added to the nouns and sometimes not. This phenomenon is called “izafet” in Turkic languages.

The morphological methods are effective in expressing the category of possessiveness in the Karakalpak language and the syntactical methods are effective in English.

When the category of possessiveness is expressed in the lexical way, it is considered acceptable to express affix and root morphemes, as well as compound nouns. These associations belong to different lexical-grammatical types of words; therefore, this category can also be called “inter” aspect category.

In English, suffixes -ed (black-haired), -y (a windy day), -en (golden medal), -ern (Eastern), -er (a Londoner), -tion (arrogation), -ing (holding), -ment (enjoyment), -or (heritor), in the Karakalpak language these suffixes are the following: -ли/лы (ақыллы, үйли); -лык/лик (ауыллык), -да+ғы/де+ги, -та+ғы/-те+ги (даладағы, үйдеги);

In English, certain verbs convey possessiveness: acquire, have, own, possess, property; in Karakalpak the meaning of possessiveness can be given with these verbs: “ийелеў”, “ийе болыў”, “алыў”, “өзиники етиў”, “өзлестириў”, “хотайын болыў”, “қараслы болыў”.

Roots can convey “possessiveness” implicitly, they take no markers of possessiveness.

The structure of compound words used to convey the meaning of possessiveness is also different. They are lexicological compounds made of different lexico-grammatical groups: ownership, free-tail; уйли-жайлы, баў-бақшалы etc.

It should be noted that the category of possessiveness is defined by the lexical-grammatical types of words such as nouns, adjectives, pronouns, verbs. However, their prevalence is different. This view can be found in the two languages.

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Rezyume: Ushbu maqolada ingliz va qoraqalpoq tillaridagi egalik kategoriyasi ko'rib chiqiladi, bu esa qo'shimcha tadqiq qilish uchun zarur bo'lgan muhim muammolardan biridir. Yuqorida aytib o'tilgan tillarda egalik kategoriyasini tahlil qilish tillarning tipologik tizimini o'rganish bilan bog'liq. Tadqiqot natijasida tillarda o'xshashlik va farqlar aniqlandi.

Резюме: В данной статье рассматривается категория притяжательного надежда в английском и каракалпакском языках, которая является одной из важных проблем, требующих дальнейшего изучения. Анализ категории притяжательности в вышеупомянутых языках связан с изучением типологической системы языков. В результате исследования были выявлены сходства и различия в языках.

Kalit so'zlar: egalik, grammatik kategoriya, ingliz tili, qoraqalpoq tili, qo'shimchalar, affikslar, o'xshashlik va farqlar.

Ключевые слова: притяжательность, грамматическая категория, английский язык, каракалпакский язык, суффиксы, аффиксы, сходства и различия.

**PAREMIA AS ONE OF THE MOST SIGNIFICANT ELEMENTS OF THE CONTENT OF
A LANGUAGE UNIT**

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Summary: The article talks about analysis of the proverbs selected for study, which becomes obvious that the semantic spaces and scope of the content of the concept of “patience, tolerance” are expanding, taking into account the acquisition of new meanings by the designated concept, paremia is indeed a very bright and voluminous element of the content.

Key words: semantic, paremia, content, concept, linguistic, language, proverb, patience, tolerance, ethnic, culture.

The study of the content side of language units, the analysis of the semantic component of a concept or word, and the search for the semantic component of a linguistic sign are always new and interesting due to the fact that the content of almost every concept or word is a multifaceted construct that provides the researcher with an almost infinite number of possible research avenues.

Proverbs and sayings, which along with aphorisms of non-folklore origin form rather independent layer of language expressions, which are conditionally united with phraseology.

From our vantage point, paremia appears to be one of the most prominent and obvious aspects of a linguistic unit's content. A linguistic sign's content can indicate the characteristics of semantic spaces through paremia analysis. The fascination with proverbs stems in large part from the fact that, despite the vast amount of literature devoted to the study of proverbs, scholars continue to make efforts to understand the meaning of a linguistic sign's overall content, the meaning of a word as a linguistic sign, and a concept that occasionally combines the meanings of several linguistic signs.

We decided to portray a paremia as one of the elements of the content of a linguistic sign (as a crucial component of a concept and a word), highlighting the fact that one method to analyze the meaning of a proverb is to explain its significance (concept or word).

It makes sense to establish research questions pertinent to this work in relation to the justification of the study's aims and objectives, such as: How does paremia convey the content and significance of a linguistic sign? The study of the idea of “patience, tolerance” through the examination of proverbs that embody this idea provided the source material for the essay. The material for writing the article was the study of the concept of “patience, tolerance” through the analysis of proverbs, which include this concept. Methodically, the author relied on the widely used method of component-definitional analysis, where for a complete description of the content of a linguistic sign, paremia is necessarily analyzed.

It seems necessary and logical for the study to conduct a brief review of the literature on the problem of describing paremia in order to clarify the issue of the elaboration of this issue in Russian linguistics, given that the main objective of the work is the study and analysis of paremia as a meaningful component of the concept. In regard to our study, a few lines must be devoted to elucidating the following research topic: what is paremia; to ascertain its linguistic nature; and to establish its position within the framework of phraseological knowledge.

It is also crucial to stress that, in light of the goals of our research; we will not concentrate on and examine the various theoretical disagreements among linguists who associate proverbs, sayings, or parables. Paremia, like proverbs and sayings, may be described as stable, multipurpose sayings that reflect a particular reality of folk life and are marked by generality, imagery, and required prescriptive didacticism and moralizing. As the foundation for the development of a specific ethnic group's values, all such mini-texts with a general ideological orientation serve to characterize folk culture, serve as its mark, designate and store ethical norms, and prescribe the guiding principles of people's lives through their content. Proverbs' symbolic or metaphorical

maxims, which are expressed as advice and desires, frequently shed light on their spiritual, moral, and ethical value. Let's go back to the inquiry made at the outset of the paper: how can paremia convey the meaning of a linguistic sign?

It is well known that the meaning of a linguistic sign (concept, word) encompasses all the knowledge about the topic or phenomena of reality that makes up the sign's expression. The significance of a language sign determines how individuals behave in social, historical, and cognitive contexts (concept, word). Therefore, information about the realities' objects and phenomena is conveyed objectively in the meaning.

The author shares A. Vezhbetskaya's view that "linguistic meaning is the interpretation of the world by a person," which further supports the concept that meaning contains socially and culturally processed personal experience [2].

The meaning of a linguistic sign (concept, word) can be represented as a structure that collectively includes the entire volume of different information and data obtained about objects and phenomena of reality, about the world around people in general, and about themselves, in other words, almost all numerous studies of meaning come down to this. Language-based signatures are used to encrypt all of this data and information. It is clear that the meaning of linguistic signs is the consequence of this codification, which consolidates and encodes the outcome of people's cognitive work (word, concept).

We should, in our judgment, go on to defining the issue of the content of a linguistic sign, or more accurately, a concept or a word, after having comprehended in more or less depth the question of what is meant by the meaning of a linguistic sign. Starting with the axiom that "every meaningful word is related with all the sentiments it evokes repeatedly, involuntarily stimulated pictures and ideas," we can observe that each linguistic sign (concept or word) gives rise to new ideas, meanings, connections, and synonyms with each and every repetition.

To put it another way, a "thesaurus presentation" may be used to describe the entire set of alternative representations and meanings connected to a certain linguistic sign (idea or word) in this instance (concept or word). As you are aware, a thesaurus is a compilation of all available knowledge on a subject. If we recall that the idea of the meaning of a linguistic sign in modern linguistics is based on explaining it as a multifaceted and multifaceted structure consisting of different components, then it seems appropriate to designate the content of a linguistic sign as a thesaurus, i.e. a set of all information about a particular linguistic sign (concept or word). Thesaurus therefore, structurally and systematically generalizes all information about a linguistic sign and can be described as the content of a linguistic sign (concept or word).

The idea that the substance of linguistic units is multilayered is where the conventional concept of meaning originates. It also comprises a secondary meaning, or a shade of meaning, as well as aesthetic and emotionally expressive meaning-related components, in addition to meaning in the strict sense of the word [1].

In linguistics, a similar process of actualizing and decoding the meaning of a linguistic sign is also known as connotation, when, depending on the evaluative or emotional shades of the meaning, the semantic and sometimes stylistic function of a linguistic unit can receive different interpretations depending on the cultural and historical traditions of the society.

Strictly speaking, the idea cannot be limited to the field of language alone because it is frequently employed in other fields as well, such as philosophy's theory of knowledge and linguistics. The notion and the linguistic meaning of the language can be separated by an equal sign, however all phenomena and real-world items have a sign language manifestation. The society fixes in the word (in the linguistic symbolic expression) the results of the conceptual knowledge of the surrounding reality. Thus, in concepts (or their linguistic expressions, words) the socio-historical and cultural value practice of people, their knowledge about the world and themselves are concentrated. Only the linguistic meaning of a word cannot represent the completeness of the content of a particular concept, only a part of the content of the concept is represented in the

meaning of the word, therefore, we explain the author's interest in all possible ways of conveying and representing the content of the concept, of which in this article special attention is paid to paremia.

We can now move on to practical examples and results of an experimental analysis of the concept of "patience, tolerance," its content, and the role of proverbs in revealing the semantic content of the con after illuminating the issues associated with the definition of paremia, with definitions, terminological similarities and differences in the linguistic sign, concept, word, and their meaning and content.

For a practical illustration of the theoretical postulates, the concept of "patience, tolerance" was chosen, which is described using a component-definitional analysis, where the content (or meaning) of a linguistic sign, according to I.M. Kobozeva [3], is discretely divided into minimal semantic components. Using this method, you can not only explore, but also systematize the already available information about the concept. Establishing a relationship between definitions and various interpretations, the concept, in the end, takes the form of a verbal generalization of the minimum components of meaning. Having carried out a component-definitional analysis, it is easy to see that the meaning of a word is a set of semantic features.

Proverbs also highlight the age-old contrast between long-suffering and outbursts of passion. When all internal constraints have been lifted from a person, which happens when patience reaches its limit, that person is free to express his sentiments without restraint. After deciphering and analyzing the meanings of the proverbs that describe "patience, tolerance," we can say that the concept of "patience, tolerance" is the same thesaurus constructs that Yu.D. Apresyan created, which encompasses all the concepts in this case of the Russian ethnos about "patience, tolerance."

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Rezyume: *Maqolada o'rganish uchun tanlangan maqollar tahlili haqida so'z boradi, bu esa "sabr-toqat, bag'rikenglik" tushunchasi mazmunining mazmuniy makonlari va ko'lami, belgilangan tushunchaning yangi ma'nolar kasb etishini hisobga olgan holda kengayib borayotgani yaqqol ko'rinib turibdi. Paremiya haqiqatan ham tarkibning juda yorqin va hajmli elementidir.*

Резюме: *В статье идет речь об анализе отобранных для исследования пословиц, из которого становится очевидным, что семантические пространства и объем содержания концепта «терпение, терпимость» расширяются с учетом приобретения обозначенным концептом новых значений. Паремия действительно очень яркий и объемный элемент содержания.*

Kalit so'zlar: *semantik, paremiya, mazmun, tushuncha, lingvistik, til, maqol, sabr, bag'rikenglik, etnik, madaniyat.*

Ключевые слова: *семантика, паремия, содержание, концепт, лингвистический, язык, пословица, терпение, толерантность, этническая, культура.*

**FOREIGN SCIENTIFIC CENTERS FOR STUDYING THE HISTORY OF THE
KHIVA KHANATE IN THE ENGLISH SPEAKING COUNTRIES**

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Summary: *The article touches upon that building research centres to study the history of Khiva Khanate and studying its works in English speaking countries is important nowadays*

Key word: *the Khiva Khanate, Central Asia, English Speaking Countries, research, historiography*

In the resolution of the Cabinet of Ministers of the Republic of Uzbekistan dated July 28, 1998, it is especially appropriate to indicate that one of the priority tasks facing domestic historical science is scientific research “analysis of our research in foreign countries on the history of the Uzbek people, the environment from ancient times to the present time” [1]. On the occasion of the emergence of the work of Russian-speaking historians in Uzbekistan, research began from an objective point of view based on new scientific approaches. For example, D.A. Nishanova analyzed the experience of covering the Anglo-Russian conflict in Central Asia at the end of the 19th century and foreign historiography [2]. In the works of O.M. Masaliyeva partially touched upon the history of the Khiva Khanate in English-language historiography [3].

Thus, a promising historiographic direction begins to take shape in the study of the works of Western scholars on the history of the Khiva Khanate. But it is still in its infancy and therefore an extensive layer of problems related to the coverage of the history of our region in English-language historiography is not considered by us.

English-speaking researchers have a long tradition of studying the history of the Khiva Khanate, based on the principles of world scientific knowledge. The emergence of Western interest in the Khanate of Khiva goes back to the past. The first sources for them were the information of travelers, their diaries and impressions. Later, on their basis, the foundation of the historiography of the Khiva Khanate was laid. At the beginning, scientific research on the history and life of the peoples of the Khiva Khanate abroad was carried out in line with Russian oriental studies and relied mainly on Russian research. Until the middle of the 20th century, there were no separate research centers specializing in the Khiva Khanate in England and the USA. However, the "Royal Asiatic Geographical Society" in Great Britain, the American Society of Orientalists actively worked.

In 1834, the "Journal of the Asiatic Society of the Kingdom of Great Britain and Ireland" appeared, in 1912, the journal "Islamic Reviews". In 1915 “School of Slavonic and East European studies” is organized at the University of London (School of Slavonic and East European Studies), which published the journal “The Slavonic and East European review” In 1921, the “Institute of Historical Research” (Research Institute of History) was opened here , who published "Annual report historical research", "Bulletin", "Historical research for higher degrees in the United Kingdom". In 1924, the “Society for Cultural Relations with the USSR” (“Society for Cultural Relations with the USSR :)” was created in England, which published the “Anglo-Soviet journal” every 3 years.

In 1953, in England, on the basis of the Center for Turkic Studies, the “Central Asian Research Center” (“Centre for Central Asian Studies”) was created. In 1963, the Institute of Soviet and East European Studies was formed at the University of Glasgow. (“Institute for Studies of the Soviet Union and Eastern Europe”).

In the United States of America, the history of the Khiva Khanate began to be studied from 1885. at Oberlin College. In universities, with the help of major organizations and companies, especially at the expense of the Rockefeller and Ford corporations, the Carnegie joint-stock company and the federal government, Centers for the study and research of little-studied sections of

world history were created. After the Second World War, the history, geography, culture, languages, ethnography, life and traditions of the peoples of the Khiva Khanate began to be actively studied at the Indiana, Washington, Columbia universities.

The Center for Central Asian Studies at Indiana University was established in 1949 and published the Journal of Asian History. Now the Center is called "Research Institute for Inner Asian studies-RIFIAS" ("Research Institute for Inner Asian Studies"). In the 1980s such well-known scientists as Y. Bregel, L. Clark, V. Feuerman, M. Shakhroni and others worked here. processing of information and materials about Central Asia. In the 1960s and 1970s, 98 research centers were created in the United States, which undertook the study of almost 80 national language groups in Asia.

A great contribution to the study of Central Asia in general, the Khiva Khanate in particular, was made by the journal of the British Center for the Study of Central Asia "Central Asian review" (began to be published in 1956). The journal "Soviet studies", published since 1959, and in the USA since 1993, is called "Europe-Asia studies".

The collapse of the Soviet state, the orientation of the Central Asian republics to an independent path of development again increased the interest of the Western scientific community in our region. The implementation of the "Central Asia" program of Columbia University should play an important role in a deeper study of the region, in the exchange of information and data.

Thus, in the English-speaking countries, an extensive research structure has developed to study the mod of life of the life of the Central Asian people, the history of the region. At present, the foundations are being laid for close cooperation between domestic and foreign scientists, which has a positive effect on the revival of historical science.

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Rezyume: *Maqolada Xiva xonligi tarixini o'rganish bo'yicha ilmiy-tadqiqot markazlarini barpo etish va uning asarlarini ingliz tilida so'zlashuvchi mamlakatlarda o'rganish bugungi kunda muhim ahamiyat kasb etishi haqida so'z boradi.*

Резюме: *статья затрагивает эти центры по строительству, чтобы изучить историю Хивы Ханата, и изучение его работ в англоязычных странах в настоящее время важно*

Kalit so'zlar: *Xiva xonligi, O'rta Osiyo, ingliz tilida so'zlashuvchi mamlakatlar, tadqiqotlar, tarixshunoslik*

Ключевое слово: *Хива Ханат, Центральная Азия, Английские страны, исследования, историография*

DEVELOPMENT OF STUDENTS' CREATIVE SKILLS THROUGH ENGLISH LITERATURE

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Summary: *The article deals with the problems of organizing practical activities with foreign texts for the development of students' creative abilities. The main attention is paid to the type of work related to the creative use of texts that correspond to the communicative and cognitive interests and needs of students.*

Key words: *personality formation, creative ability, practical activity, practical skills and abilities*

One of the characteristics of a professional is his ability to self-realization and self-development. A creatively active person is able to achieve professional success, is distinguished by high intelligence, the ability to defend his point of view, independently develop and implement new ideas.

The education system in modern conditions should train specialists who can solve non-standard tasks. In addition, the educational program for the development of higher education in our country notes the need to ensure the innovative nature of the education system, the formation of a specialist who is able to independently and creatively solve professional issues.

At present, almost all students understand the importance and necessity of learning foreign languages, however, sometimes there is apathy, indifference. Therefore, one of the tasks of a foreign language teacher is to create conditions for maintaining a sustainable interest in the language. To do this, the teacher must not only know his subject, but also look for new methodological techniques that develop cognitive interest in learning foreign languages. It is necessary, by creating positive motivation, not only to interest students in a foreign language, but also to present it as a professionally significant subject, while resorting to a variety of forms and techniques.

In the modern methodology of teaching foreign languages, the text is the main didactic unit of the bilingual and cultural development of the student's personality. The value of a text as a unit of teaching a foreign language culture is not limited to its sociocultural content, only at the text level one can see the relationship between the content of speech, its semantic centers and their formal linguistic, structural compositional and genre-stylistic design, the functional side of lexical and grammatical structures, so as well as the relationship of all the means of the language involved in the transmission of the content and meaning of the statement.

In the absence of a language environment in which the study of a foreign language culture is carried out, the text is the only way to create the missing linguistic socio-cultural environment, the only way to expand this cultural and linguistic space and ensure an arbitrarily long stay of the student in this space. [6]

Personality develops in activity; therefore, activity is the main means and condition for the formation of personality. This position in domestic pedagogy is leading. In the pedagogical context, activity is "defined as the most important form of manifestation of a person's active attitude to the surrounding reality." [6]

In the process of organizing practical activities with texts, the following creative abilities of students develop more effectively: abilities for creative imitation (according to the model, including the ability to translate literary texts from other languages); to the expression in speech and creativity of a personal position; to the creation of original works: fairy tales, poems, essays, etc. [1]

We dwelled on the problem of organizing practical activities with foreign texts to develop the creative abilities of students, since; unfortunately, such possibilities of texts are little used in

English lessons. Traditionally, in the teaching methodology, it is believed that when working with texts, language and speech skills and abilities are developed, with the help of the text, these skills can be controlled. In our opinion, the text can be used to develop the creative abilities of students in English lessons.

In our opinion, the texts offered in the educational process should correspond to the communicative and cognitive interests and needs of students correspond in terms of complexity to their language and speech experience in their native and foreign languages. In general, the text should be perceived by the students as a “carrier” of not linguistic (linguistic), but meaningful information, since a student of a language university can read a foreign language text and get “pleasure” from the perception of the text of the language form. [4]

The educational process should use different types of texts of different genres and functional styles:

- poems, rhymes, short stories, fairy tales, comics;
- a personal letter from a peer from the country of the language being studied, including to a newspaper or magazine, a postcard;
- a simple culinary recipe, tickets, programs, TV shows, posters;
- a map of the country of the language being studied,
- pointers, signs in shops, at stations, labels for goods, train schedules, city signs, announcements, weather forecast;
- magazine and newspaper articles of a country-specific character, catalogs, guidebooks, excerpts from fiction, etc. [4]

Any text affects the reader in a certain way: either it provides new information (for example, pragmatic texts), or it affects his feelings, opinions (“Do I agree?”), behavior (“What would I do?”). This once again emphasizes the importance of referring to the content aspects of the texts used in the educational process.

The texts offered to students at each stage of learning should reflect their communicative function in communication. With the help of their content, students should create an objective image of the country of the language being studied and form ideas about various aspects of the life of their foreign peers.

In turn, the proposed system of reading exercises is designed to encourage students to compare new facts and phenomena with their own experience. Therefore, on the basis of texts, training in mediated communication in the context of a dialogue of cultures should be carried out.

The text is the basis for developing the ability of students to express their thoughts orally and in writing. Students answer questions to the text, comment on its content, express their point of view on the information received, compose their own written version of their own text, etc. In this sense, the text plays a central role in the educational process.

Among the types of work related to the creative use of texts, the following groups can be distinguished:

1) Types of work of a partially creative nature: make a proposal on key words, on a given topic, of various designs, complete sentences, restore the text, compose answers to questions, title the story, compose an elementary description, conduct an elementary analysis of the composition of the text, a comparative analysis of artistic and scientific texts, etc. [1]

For example, the implementation of such an exercise is partly creative: “Title the text. Write down, replacing the underlined words with synonyms.

Also partly creative is the work of completing guesswork sentences.

2) Types of work with a creative basis: compose an oral story on a topic, from these sentences, according to a picture, a story in connection with what has been read, based on impressions or observations, using language material, a detailed story, a coherent story according to a plan, a story about a hero, a presentation according to the text, concise, detailed with elements of

description, with the replacement of a person, with elements of reasoning, presentation at the beginning and end. [1]

For example, working with the creative basis is to perform the exercise: restore the sequence.

The following task is also an example of working with a creative base. Task: draw up a story plan, title the story, write a first-person narrative.

3) Types of creative work: write an essay based on pictures, an essay with a grammar task, with elements of comparative characteristics, prepare a report, write a fairy tale, write a script, essay - reasoning, essay with elements of description, essay - miniature. [4]

Creative work serves not so much the purpose of mastering educational material as the goal of increasing the activity and independence of students, developing their creative approach to solving specific issues, and forming the cognitive interests of students.

As a result of socio-economic transformations, qualitative changes in the values and needs of modern society, changes in the type of cognitive attitude to the world, the importance of creative activity has sharply increased.

Regarding the problems of a foreign language, this is the task of developing the intellectual and creative abilities of students in the process of learning languages and cultures.

In the absence of a language environment in which the study of a foreign language culture is carried out, the text is the only way to create the missing linguistic socio-cultural environment, the only way to expand this cultural and linguistic space and ensure an arbitrarily long stay of the student in this space.

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Rezyume: *Maqolada talabalarning ijodiy qobiliyatlarini rivojlantirish uchun xorijiy matnlar bilan amaliy faoliyatni tashkil etish muammolari ko'rib chiqiladi.*

Asosiy e'tibor o'quvchilarning kommunikativ va kognitiv qiziqishlari va ehtiyojlariga mos keladigan matnlardan ijodiy foydalanish bilan bog'liq ish turiga qaratiladi.

Резюме: *В статье рассматриваются проблемы организации практической деятельности с иноязычными текстами для развития творческих способностей учащихся. Основное внимание уделено на вид работ, связанных с творческим использованием текстов, которые соответствуют коммуникативно-познавательным интересам и потребностям учащихся.*

Kalit so'zlar: *shaxsni shakllantirish, ijodiy qobiliyat, amaliy faoliyat, amaliy ko'nikma va malakalar*

Ключевые слова: *формирование личности, творческая способность, практическая деятельность, практические навыки и умения*

**ENCOURAGING STUDENTS TO DEVELOP INTERCULTURAL RELATIONSHIPS
WHILE IMMERSED IN THEIR LINGUISTIC ENVIRONMENT**

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Summary: *The article talks about communication between representatives of different demographic groups: religion, gender and age. In this case, communication between people is determined by their belonging to a certain group and specific characteristics of the culture of this group.*

Key words: *process, knowledge, motivation, student, intercultural, environment, condition, dynamic, linguistic, pedagogy, approach, communication, culture.*

The problem of forming the motivational field of language learning for students has been relevant for many years [2]. Often, many teachers are faced with a situation where students are not interested in the learning material and do not feel the need for knowledge. Thus, the teacher faced the difficult task of improving students' positive motivation for the learning process. This, of course, requires a special organization of the educational process, a clear definition of the educational tasks available for students' understanding and implementation. Study materials must be carefully selected to meet the interests of the study group and each student.

Basically, learning motivation is a dynamic process that supports and corrects the student's activity throughout the learning process. The student's needs, goals and attitudes are the basis for the formation of educational motives [4]. In the framework of this work, the motivation of students to form intercultural relations in the environment will directly depend on the pedagogical experience of the teacher and the ability to organize the educational space of the educational process. In this regard, stimulating the formation of intercultural competence in the context of students' immersion in the environment is the first psychological and pedagogical condition for improving intercultural relations among students based on the communicative and ethnographic approach.

Immersion in an authentic cultural and linguistic environment. According to many researchers in the field of English language teaching methodology, often a student who consciously wants to learn the language and regularly attends classes has significant difficulties in expressing his opinion in English and in receiving written and oral speech in a foreign language. The method of total immersion means that for several years all academic time is spent exclusively in English: all instructions, explanations of new material and discussions are conducted in English.

Intercultural communication is a type of conscious acquisition/transmission of information during the interaction of at least two subjects using historically established means of communication (symbols and rules for combining them) [3].

Undoubtedly, the most effective way to learn language and culture together is to organize trips abroad. In such conditions, English serves as a means of communication and teaching with representatives of other linguistic communities. It is worth noting that in a real cultural and linguistic environment, students develop the language skills necessary to solve communication problems and fully understand the speech intentions of native speakers. Thus, immersion in the environment helps to master the characteristics of a certain group (age, gender, social, ethnic, regional, etc.), as well as the sphere of value-motivation that determines their communicative behavior.

From the point of view of the communicative approach to teaching English, the method of immersion in the environment is a unique means of preparation aimed at discovering something new in the student's personality that was not there before. In this regard, students get information

about the country, culture and cultural realities of the language being studied, try to understand unfamiliar phenomena, and also collect knowledge that is necessary for future use.

Using the method of immersion in the environment is a convenient way to implement the communicative-ethnographic approach. A student who feels himself in the environment of the language being studied, in his country, acts as an ethnographer, he tries to learn the English language and its culture by studying the mother tongue and other cultural realities. It is worth noting that, unlike observers who use their own coordinate system from the point of view of cultural perception, students use the method of immersion in the environment and determine the communicative behavior of native speakers and what is happening from the point of view of an active participant in the environment. This means, first of all, a change in the nature of the activity of the subjects of study - from a passive observer to an active participant in the social and cultural life of the foreign language community.

The student analyzes and classifies unfamiliar linguistic and cultural phenomena. In this, the role of the teacher is reduced to the level of a person who provides additional sources of information to students. In particular, students can always turn to a native speaker as a source of information who can answer various questions when interpreting cultural phenomena in a foreign language. It is noteworthy that students can conduct independent research, observe the life of native speakers, compare the characteristics of the culture of the studied language with the culture of their native language, form the ability to perceive their native culture and themselves as a part of their native country.

Communication between representatives of different demographic groups: religion, gender and age. In this case, communication between people is determined by their belonging to a certain group and specific characteristics of the culture of this group [1].

Based on current research in the field of the theory of intercultural communication and the methodology of teaching English language and culture, it is necessary to highlight the features of using the method of immersion in the real cultural and linguistic environment:

- Complete linguistic isolation, which means that students refuse to use their mother tongue during the educational process;
- The communicative direction of the educational process, where the English language works not only as a goal, but also as a teaching tool;
- Careful selection of educational material (newspaper, magazine, video, audio recording, etc.) according to a differentiated approach to each student;
- A combination of various formats of knowledge sources (television, radio broadcasting, etc.) and types of activities (reading, listening, speaking, writing);
- Based on the principle of situational-thematic organization of the educational process, the possibility of modeling communicative situations encountered in everyday life;
- To go beyond the textbook to learn a foreign language in the process of live communication.

The method of immersion in the environment can often be used in extracurricular activities of students: visiting ethnographic exhibitions, museums of national history, correspondence with native speakers, etc. At the same time, the student independently monitors his educational and cognitive activity in the process of communication.

In order to organize a joint study of language and culture with the method of immersion in the environment, they put forward a number of recommendations for the implementation of ethnographic research:

- The study of language and cultural phenomena should begin with the analysis of one's own experience in relation to one's own culture;
- It is preferable to use a comparative comparison of cultural events, bypassing critical assessment;

- It is necessary to pay attention to the practical side of research: to collect and analyze data independently, to improve one's own conclusions;
- Collection of personal information allows supplementing or differentiating them with existing knowledge, to compare them and compare them with the cultural-historical context;
- In order to determine the behavior and values of native speakers, it is necessary to search for different opinions, generalize and abandon stereotypes;
- Conclusions about cultural phenomena and the values of native speakers can always be questioned in order to identify new evidence and form beliefs.

Following these recommendations in practice will allow you to achieve positive results in improving intercultural relations over a period of time. Therefore, immersion in the real cultural and linguistic environment serves as the second psychological and pedagogical condition for improving intercultural relations among students based on the communicative and ethnographic approach.

Using problem-based cultural studies and ethnographic methods in teaching. Over the years, research in the field of pedagogy shows that the greatest efficiency in obtaining educational results can be achieved using problem tasks and the principle of the superiority of problem cultural tasks. Methodology of problem-based learning is based on the hypothesis of increasing their educational and cognitive activity by setting problem-based research tasks to students. According to this hypothesis, a set of tasks of a cultural nature is developed to acquire, analyze, generalize and confront information aimed at acquiring strategies for traveling to an unfamiliar cultural environment, to understand the types of cultures and generally accepted norms of behavior.

One of the important problems of modern methods of teaching English and the culture of the country where the language is taught is insufficiently developed methodological support of the educational process. In this regard, the issue of choosing the educational content in which tasks of a problematic nature are used sharply arises. It is necessary to clarify the typology of tasks in order to develop cultural tasks of a problematic nature, to determine the expediency of using this or that type of tasks in the conditions of immersion in the environment.

The personal culture of a person learning a foreign language serves as a means of knowing not only the foreign culture, but also the culture of his own country.

The use of ethnographic methods to improve intercultural relations together with the problematic tasks of cultural studies opens up the great methodological potential of the foreign language teacher for the development of intercultural relations. At the same time, it is necessary to pay enough attention to preparatory work for the use of some methods, the essence of which should be revealed in seminars and problem lectures for individual and group work of students. Consistent exchange of ethnographic methods with problematic cultural studies allows them to complement each other methodologically, create a powerful set of tools, and at the same time enrich students' linguistic socio-cultural and intercultural practice [5].

In the context of immersion, when the learner is in the country of the language, ethnographic methods are mainly used as a way to study language and culture together. Depending on the actual linguistic and cultural environment, as well as the duration of the curriculum, a teaching strategy is determined that can be implemented in both the home country and the host country. In this case, the role of the teacher in the implementation of all kinds of support for students is extremely reduced, and the role of the teacher is more clearly manifested in the stages of preparation and completion of studies. Educational and cognitive activities of students are carried out in the English language in the audience directly in the presence of the teacher.

At the stage of presenting the cultural project, the teacher's task is to observe the educational and cognitive activity of the students. It is also worth noting that monitoring can be in the form of face-to-face during observation or interview with the participation of the teacher, or remotely - with the help of modern information and communication technologies, in the form of consultation or interim control. At the final stage of the training, regardless of the chosen ethnographic method, students and the teacher must analyze and interpret the data obtained. In particular, it will be

possible to improve communicative and intercultural relations in a foreign language, improve objective ideas about the culture of the country of the studied language, cultural reflection of the native culture.

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Rezyume: *Maqolada turli demografik guruhlar vakillari o'rtasidagi aloqa haqida so'z boradi: din, jins va yosh. Bunday holda, odamlar o'rtasidagi muloqot ularning ma'lum bir guruhga mansubligi va ushbu guruh madaniyatining o'ziga xos xususiyatlari bilan belgilanadi.*

Резюме: *В статье говорится о коммуникации между представителями разных демографических групп: религии, пола и возраста. При этом общение между людьми определяется их принадлежностью к определенной группе и специфическими особенностями культуры этой группы.*

Kalit so'zlar: *jarayon, bilim, motivatsiya, talaba, madaniyatlararo, muhit, holat, dinamik, lingvistik, pedagogika, yondashuv, muloqot, madaniyat.*

Ключевые слова: *процесс, знание, мотивация, студент, интеркультурный, среда, состояние, динамика, лингвистический, педагогика, подход, коммуникация, культура.*

ARTISTIC DEFINITION OF THE SYMBOLS OF REAL IMAGES AND HISTORICAL FIGURES IN LEGENDS (ON THE EXAMPLE OF UZBEK AND KARAKALPAK FOLKLORE MATERIALS)

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Summary: *The article describes the analysis of the problems of the artistic definition of the symbols of real images and historical figures in legends on the example of Uzbek and Karakalpak folklore materials. The issues of typology in them are also determined.*

Key words: *image, historical figure, theory, poetry, folklore, healer, poet, baqsi, genealogy*

In the world of folklore studies, theoretical concepts developed by mythological, Finnish, historical, anthropological, ritual-mythological, schools of the theory of "nomadic plots" on the genesis and classification of epic genres such as myth, legend, legend, fairy tale, their comparative-historical, comparative-typological and others pointed out that the systematic collection of materials characteristic of folk tales and their preparation for publication, as well as the problems of learning them, are of great importance. Therefore, the genre characteristics of legends, similarities and differences of folk prose from epic genres like legends, fairy tales, proverbs, epics, etc., the description of real life events in the plot, creation of poetic composition, creation of motifs, system of images, method of narration, clarity of issues related to language are one of the topical issues facing today's folklore studies and enriching them from the theoretical point of view is of great importance. Therefore, in this article, we will try to compare the problems of artistic interpretation of real images and symbols of historical figures in legends using the example of historical legends of Uzbek and Karakalpak folklore.

In historical legends, there are historical figures, kings, prophets and holy saints, saints and other real images are more accessible and have their own artistic interpretation. One of the most exaggerated images in the historical legends of the world and Turkish folklore is the image of historical figures. In the plot of the legend, historical figures appear as protagonists or episodic characters and perform their own artistic function. In historical legends, the image of a historical figure is portrayed as a brave, manly, hardworking, wise person who protects the people, and by highlighting the humane qualities of the historical figure and artistically portraying his activities for the people, the historical figure rises to the level of an ideal hero. Therefore, people manage to create prototype images of historical figures. As it is known from folklore data, legends involving historical figures are divided into several types: a) legends depicting the image of prophets and holy saints; b) legends with images of judges or military commanders, warriors; c) legends in which the image of popular healers are described; d) different parts of historical legends are related to genealogy - clans, communities, and their origin is connected with a historical person or a person who has made history; e) legends with the image of poets and *baqsi* (a musician who plays traditional Karakalpak instrument *duwtar*); f) legends about the names of places, cities, etc. that appeared in connection with historical persons and historical events.

As it is known from the data, it has its own tradition of glorifying the image of prophets and holy saints and saints in oral and written works. In the works of art, the views of the people about the educated person are described based on the image of the prophets. Therefore, there are several legends about prophets, holy saints among the people and in folklore. In these legends, events related to the deeds of prophets and holy saints and holy things that they consider to be sacred are narrated. It should also be mentioned that the image of prophets and holy saints and saints is different from ordinary people. That is why, in legends, the mythical characteristics of these images are described more often.

In Turkish folk tales, the image of rulers or military commanders and warriors is explained in a particularly loving and noble spirit. For example, in Karakalpak folklore, in the legend "Aidos Biy" Aydos Biy is depicted as a folk hero. According to the information of historical literature, Aidos Biy "... among Karakalpaks was a person who conducted the policy of Khiva khans, he was known as a Biy who collected tributes from the people of Khiva khans. He rendered great service in subduing the Karakalpak villages to Khiya Khan and gained great honor during the reign of Muhammed Rahim Khan (1806-1825) [1; p.201]. However, during the reign Allakuly Khan, Aidos' former honor and influence decreases, and the new Khan limits his former rights and influence. Aidos Biy, who was angry with this situation, led the people's movement in 1827, raising the discontent of the people against the khan. But the uprising was suppressed by the Khan's troops, and Aydos Biy, who led it, was killed [2; pp.218-219].

In this historical legend, the symbols that show the greatness, heroism, power and courage of Aidos are chosen, and it is noticeable that he serves as an example of heroism and sacrifice for the people.

In the Uzbek and Karakalpak folklore, there are also legends in which the image of the well-known Tabip (healer) is depicted. For example, we can see it in the legends Karakalpak folklore like "The wedding of Hakim Ulykpan's son", "About the wisdom of Aplaton and the ingenuity of Alastun" and others. Legends about Luqman Hakim can also be found among people. Luqman Hakim (sage, philosopher), a healer who found a cure for a thousands of ailments, is depicted in them. He is considered to have lived for a thousand years. However, written documents contain all kinds of information about Luqman Hakim. When considering them, it is possible to see three types of Luqman. For example, M. B. Piotrovsky: "In Muslim mythology and Middle Arab mythology, Luqman was wise and pious. In the pre-Islamic Arabs, it is said that this hero lived a long life. Then the last eagle - when Lubad died, Luqman passed away" - he expressed his opinion relying on the Quran [3; p.325].

According to the information written in "Qissasul-anbiya", Luqman was the son of an Ethiopian carpenter, and he himself made it in the time of Prophet David.

Karakalpak scholar S. Bahadyrova, in her article "Myths in Berdak's works", gave a little information about Lukman, noting that he is described as a smart, wise, long-achieving person in the mythology of the Eastern peoples before the arrival of Islam religion, and reminding Lukman's long life in Berdakh's poem, she depicts the poet's love for life, love for the future and his optimistic attitude [4; p.186].

Legends about Luqman Hakim have been preserved in Uzbek folklore. For example, "Lukmon's place was from the heart, he was a slave of a carpenter. He lived for three thousand and five years after doing many services to his mother and father. Luqmon was asked the reason for this:

- Prophethood is a great work, but a person needs knowledge and wisdom. "I will get knowledge and wisdom," answered Lukmon Hakim. Luqmon Hakim was asked:

- Where did you get this knowledge, wisdom and dignity?

- I found it because I walked the right path, - replied he [5; p.40].

In this story, the epic hero lived a long (three thousand five hundred) years of life, and the opinion that if you do good, if your heart is pure, if you are righteous, if you follow the right path, Allah will shine on you, and your life will be long.

The typological motif that stands out in all of the above stories is that Luqman Hakim is a healer of diseases, and secondly, that he lived a long life. In the legends of the world and Turkish folklore, there is a similarity in the stories about the creation of the main character Luqman Hakim, his world-famous character and his business activities, which combine typological motives.

Legends connected with a different part of historical legends like genealogy - clans, communities, and their origin is connected with a historical person or a person who has made

history in history are also widespread in Karakalpak folklore. For example, in Karakalpak folklore, the song "Kipchaklar" is quoted as follows:

"It was the time of Hazrat Ali. Ali started a war to convert the tribes of Kap Mountain to religion, but the military could not defeat them. When he was ready to return after not being able to capture the mountaineers, in the distance he could hear the rustling of grain and the sight of many horses. When he looked, it was the Zhayilkan militiamen with blue flags. When he listened to the cries, it was their motto "Akpyshchak!". When he realized that they were Karakalpak he was very happy. "We have come to help you," they said. Looking at their signs, he understood that they were brave heroes.

Ali chooses a leader among arrived troops and assigns each of them to each group. Kipchak's hand made Tau people one by one submit and convert them to Islam. In that battle, the *jabi* clan walk in the front line and show a lot of bravery. "The real owners of Kypchak tribe were the *jabi* clan." Hazrat Ali tied a white knife to the waist of each of Kypchak warrior and appointed some of them as masters of the occupied the Kap mountain territory for gaining the victory. Prophet Muhammad heard this news and said, "These Turkmen are my ummah." If someone doesn't obey these people, they will suffer. "Karakalpaks are my wings in Mashyrik."

Жабы урыўының атына айтылатуғын:

Әйне жабы – Дәшти Қыпшақлық,

Минген атлары топышақлық,

Кимдур қыпшаққа тил тийгизсе,

Өзи өлтимдар, малы патшалық, "- said Hazrat Ali [6; p.160].

The origin of the Kypchak tribe of the Karakalpak people is also connected with historical figures in the legend "About the Kypchak tribe" in this context. It is said that "during the Oghuz period, all soldiers used to carry their children in carts." The reason is that long drawn-out battles require it. In one of these battles, one of the brave warriors of Oghuz Khan was killed. His wife was pregnant. He found out that her husband had died and went to the war front. The day was cold. Unfortunately the contractions started suddenly and she didn't know what to do. She entered into the hollow of a big rotting tree and gave birth to a child in the bark of a poplar. Oghuz Khan heard this story, named the boy Kypchak and adopted this baby. The reason for calling him Kypchak is that in the old Turkish language, a hollow tree is called *kipchak*. After that, he brought up the boy and made him king of the people of Attil (Edil). It is said that all the Kypchak people descended from him [6; pp.203-204].

Folklorist K. Maksetov based on Sharafuddin Ali Yazdiy's book "Zafarnama" gave the following legend about the origin of such Kypchak tribe.

"During one of the battles, Oghuzkhan fled from the enemy and took refuge on an island between two rivers. One of the soldiers was pregnant and her husband was killed in the battle. When the contractions started, she entered the hollow the tree and gave birth to the child. When Oguzkhan heard this news, he he felt pity for the child. The boy's grandfather was killed because of us and the boy became an orphan, so he adopted him and named the boy "Kipchak". Saying that the word "kipchak" comes from the word "bark", which means a tree with a hollow, he cites the following verse:

Енди қыпшақ қәўими бастан-аяқ,

Усы бир уғылдан аларлар санақ [7; p.209]

A similar legend is mentioned in the work "Oguznama" by Fazlullah Rashid al-Din in this form.

"The Oghuz warrior was pregnant. Her husband died in the war. The time for the birth of the child has arrived, there was a hollow tree in those places, and the she gave birth to a child in that hollow. His son was brought before Oghuz, Oghuz heard about the circumstances of his birth and

named him Kypchak. The word "Kipchak" comes from the word "bark" and in the Turkish language it means "bark" and refers to a hollow tree with a rotten middle [8; pp.24-25].

As you can see, the presented plots are close to each other in content. Even though the origin of the Kypchak tribe is connected with hollow tree, historical events take center stage in them. .

K. Mambetov thinking that the history of the Kypchak tribe was known in ancient times states: "This ancestor appeared in the first years of our era, and Central Asia and the Urals were called the Kypchak state (Dashti Kypchak) in the IX-XII centuries. After all, the majority of modern Turkic-speaking peoples come from the Kipchak tribe. That is, this is the most powerful state before the Mongols. And Karakalpak kipchaks are a part of them"[9; p.31].

In Uzbek and Karakalpak folklore, there are also legends in which the image of a poet and baqsi are depicted: for example, in Uzbek folklore, poets are Alisher Navayi, Babur, in Karakalpak folklore poets Ajiniyaz, Berdakh and others can be given an example.

There is a legend in Karakalpak folklore called "The Tale of Berdakh Shayir and Ajiniyaz Shayir". According to this legend the 19th-century Karakalpak classic poets of Berdakh Gargabay Uli and Ajiniyaz Kosybay Uli were to have some kind contest.

"One day, Ernazar Atalik and Adil Atalik, prominent people of their time, were sitting in the house of Daulet Pushik in Shymbai. Berdakh was also there. One of those sitting there says that Ajiniyaz has come to the city. The men who were sitting heard this:

"Let's have a contest between these two poets," he said, and sent a man to kill Ajiniyaz.

The person he sent soon brought Ajiniyaz there. Ajiniyaz greeted everyone who was there:

- Today I came to Shymbay market and I came as you called me, - he said. Then the men:

- You are a well-known person whose name has spread to many places. "We invited you to introduce to Berdakh and wanted to watch your talent," they said.

- I would also like to hear Berdakh. Which of you is Berdakh? - asked Ajiniyaz.

"This man," they said, pointing to Berdakh Shayir.

Looking at Berdakh Shayir, Ajiniyaz could see that he was very eager to have a contest. Then Ajiniyaz Shayir looked at Berdakh and asked:

- Well, what do you say to these men's offer? Shall we have it? - he asked.

- Well, let's show them our talent, - said Berdakh.

At that time Ajiniyaz stood up and said:

"Well, my dear, they are going to watch us like fighting two dogs," he said.

Berdakh understood the meaning of the words and remained silent.

Ajiniyaz stood up:

"Now, my dears, if you have nothing else to say, we will have to come back," he said.

After going to the country of Ajiniyaz brother-in-law Mullah Ibadullah:

- Why didn't you have a contest with Berdakh? - he asked.

Then Ajiniyaz:

- If I had a contest mixing up Arabic and Persian words, he would not understand. "That's why I didn't do this and I didn't want to make him feel embarrassed," he answered [6; pp.90-91].

As you can see, legends about poets and baqsi are widespread in folklore, and they create their own special theme. Poets and baqsi's biographies, their real life experiences, the historical events, stories are depicted in them. Therefore, in this form of historical legends, the images of poets and baqsi are created.

In folklore, we can find local names and legends about cities that have appeared in connection with historical persons and historical events. For example, in Karakalpak folklore, there is a legend called "Ayazkala":

"It is said that this city was named after a shepherd named Ayaz. "Bahyt kusy" landed on Ayaz's head and he becomes the Khan. He builds these cities. During his time as a khan, in order not to indulge in pride, he hung the clothes he wore when he was a shepherd:

"Ayaz Khan, don't forget who you were, always look at your shepherd's stick," he says, remembering the times when he was a shepherd [6; p.152].

Here, as we have already seen, one of the traditional images, the image of the shepherd and the image of the king, are presented in parallel. This is what made the evolution of the image. That is, the first profession of the person named Ayaz in history was a shepherd, and then he became a king with the help of the bird of fortune. Nevertheless, he is described as a mature person without losing his virtues.

In Uzbek folklore there are legends called "Nurota", "Hazrati Nur". The Uzbek folklorist M. Zhuraev recorded this legend from the people and presented the text of the legend in the book "Kadimiya Karmana legends". According to the legend "Hazrati Noor":

"When God Almighty created Adam and Eve, all living creatures, living beings, the time of several prophets - when the spirit of our prophet Muhammad was created, God and his messenger - Muhammad peace be upon him - will communicate with each other behind the table. From God to our prophet: - I looked at something. The light is shining on that place. He is my light! - he said. "If only I could get a command from you, I would be happy if I put on that blessed ear," our prophet begged. Then God told seventy thousand angels and angels, "Wait for the place where my light has fallen!" - is the order. As they say, Amri is the only duty, the angels took the City of Light to the fourth heaven. Allah said to his servant and prophet: - This is a healing light for your ummah! I will heal anyone who sincerely takes a bath in this pool and burns his head on the grave stone in the middle of the pool! - he promised. After our Prophet was happy and prayed two rakats in thanksgiving, seventy thousand angels and angels took the city back to its place and burned it. At that time, 55 stones fell from the sky. No saint could wait for him and take him into the pool. Then Iskandar Zulkarnayn, who was passing by, shouted "Ya Allah!" - they asked, they took the stone and burned it in the middle of the pool. Under the water, the giants wriggle and run away. Since then, Hazrat Nur has become a place of pilgrimage [10; pp.55-56]. There is a song called "Nur Ata" in Karakalpak folklore, which has a similar plot and motifs:

"Nur Ata is a sacred place." Iyshan Ata says, "The light of God is here." Karakalpaks have been living in Nur for ages. There is a big "Karaqalpak Qorym" on the side. Qorym – means the guarded place. There is a cemetery here. If nowadays the people visit Turkestan as "Second Mecca", Hazrat Sultan himself visited this place as a holy place. Hazrat Sultanny's sheikhs in Turkestan:

- How Nur is important for you? – asked they.

"It is a holy place for all Karakalpaks, Nur is in Karakalpak's bazaar, Nur is Karakalpak's cemetery," - he said.

At that time, Nur Ata's name was simply called "Nur".

Kara mazar - baba mazar, the word that means all holy ancestors were buried there. If the people of steppe buried their holy ancestors to Yassy and Hazrat Sultan, the people of Nur buried their holy ancestors to Nur. Nur became a holy cemetery after Nur Ata was buried there and turned it into a big holy cemetery.

Karaqalpak Qorym in Nur Ata have been there for thousands of years. Then Hojalar took this place. Istam Iyshan was in Nur Ata. His descendants know a lot about the history of Nur Ata [11; p.163]."

Together with the above mentioned holy image of Nur Ata, there are some preserved historical place names connected with the image of this historical figure.

In general, when we analyze comparatively historical legends in the context of Uzbek and Karakalpak folklore, in the system of images of historical legends, we can see that prophets, holy saints, real people, famous historical figures, kings, rulers, generals, soldiers, armies, warriors, famous healers, communities and tribes are connected with a historical person or a person who has passed through history. The image of certain poets and baqsi occupies a special place in the genealogy, historical figures, and it is ensured that they are portrayed as their own epic heroes. In

legends related to historical persons, the historical person's personality qualities are described at a high level, the historical person is idealized and depicted as a holy person. If we compare this problem as an object of folklore, we can have the typology of it.

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Rezyume: *Maqolada o'zbek va qoraqalpoq xalq og'zaki ijodi materiallari misolida rivoyatlardagi real obraz va tarixiy shaxslarning timsollarini badiiy ta'riflash muammolari tahlili yoritilgan. Ulardagi tipologiya masalalari ham belgilanadi.*

Резюме: *В статье представлен анализ проблем художественного определения символов реальных образов и исторических личностей в легендах на примере узбекского и каракалпакского фольклорных материалов. В них также определяются вопросы типологии.*

Kalit so'zlar: *obraz, tarixiy shaxs, nazariya, she'riyat, xalq og'zaki ijodi, tabib, shoir, baqsiy, nasabnoma*

Ключевые слова: *образ, историческая личность, теория, поэзия, фольклор, целитель, поэт, бакси, генеалогия.*

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ABOUT THE CASE CATEGORY IN THE GERMAN AND KARAKALPAK LANGUAGES

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Summary: *In this article, the grammatical cases in the German language are compared with the cases in Karakalpak, and their semantic meanings and syntactic functions are comparatively analyzed. Alternative and opposite forms in the formation and usage of case forms are defined. The similarities and differences between them are shown.*

Key words: *comparative typology, cases, similarities and specific features of cases in German and Karakalpak language.*

The place and importance of foreign languages in countries on all continents of the globe is incomparable. In terms of learning and teaching foreign languages, it is important to study the native language and the languages that being studied in a comparative typological way. Because the results of the comparative typological research are the basis for the development of a scientific theory.

Nouns in the German and Karakalpak languages have commonalities in the case system and specific features of each language. We will consider the ways of translating the meanings of German cases into the Karakalpak language, as well as the ways of giving Karakalpak place cases in German. So, there are four cases in modern German, and six in Karakalpak. They are as follows:

In German language

- 1. Nominativ** - Nominative.
- 2. Genitiv** - Genitive.
- 3. Dativ** - Dative.
- 4. Akkusativ** –Accusative.

In Karakalpak language

I. Grammatical cases.

- 1. Ataw** - (General) case
- 2. Iyelik** - (Possesive) case.
- 3. Tabıs** - (Dative) case.

II. Place cases

- 1. Barıs** - (accusative) case.
- 2. Shıǵıs** - (instrumental) case.
- 3. Orın** - (prepositional) case.

In German and Karakalpak languages, although they belong to different language families, the presence of case in nouns is a similarity between the typologically compared languages, while their difference in terms of number is considered to be a disproportion arising from the unique characteristics of each of them.

Based on the essence of our work, we decided not to change the names of the cases in the German and Karakalpak languages, but to call each of them as they are in their own language, although the names of the cases are considered grammatical terms in each language, as well as in both languages the color is preserved.

If we take into account the questions of the cases that must be answered in the typologically compared languages, the differences and similarities between them become more noticeable.

In German language

Cases Questions

Nominativ *wer? was?*

wessen?

Genitiv *wem?*

Dativ *wen? was?*

Akkusativ

In Karakalpak language

Cases Questions

Ataw *kim? ne? kimler? neler? (who? what?)*

Iyelik *kimniń? neniń? kimlerdiń? nelerdiń? (whose? Which?)*

Barıs *kimge? nege? qayda? kimlerge? nelerge? (to whom? To what? Where to?)*

Tabıs *kimdi? neni? kimlerdi? nelerdi? (whom?*

	What?)
Shıǵıs	kimnen? neden? qaydan? kimlerden? nelerden? (from whom? From what?)
Orın	kimde? nede? qayda? kimlerde? nelerde? (who? what? Where?)

It should also be mentioned that in the Karakalpak language, nouns take the case suffixes after receiving the possessive affixes. This is also reflected in the questions put on the cases. We see this clearly in some sources. This is not the case in German.

Table of questions asked the case agreements after using the possessive affixes.

Case	Questions
Ataw	<i>kimim? kimiń? kimińiz? neńiz? neń? kimi? nesi? (who? what?)</i>
Iyelik	<i>kiminiń? kimińniń? kimimniń? kimimizdiń? kimińizdiń? nemniń? nesiniń? nemimizdiń? neńizdiń? (whose? which?)</i>
Barıs	<i>kimime? kimińe? kimine? neme? neńe? nesine? nemizge? neńizge? (to whom? to what?)</i>
Tabıs	<i>kimimdi? kimińdi? kimin? nesin? neńdi? neńizdi? (whom? what?)</i>
Shıǵıs	<i>kimimnen? kimińnen? kiminen? kimimizden? kimińizden? kimnen? nesinen? neńizden? (from whom? from what?)</i>
Orın	<i>kimimde? kimińde? kiminde? kimińizde? nemde? neńde? nesinde? neńizde? (who? what?)</i>

Looking at the questions asked of the cases, it is noteworthy that there are more differences than similarities.

In German, the same question is asked of the singular and plural nouns in the nominative case. In the Karakalpak language, in general, in all Turkic languages, the questions asked also accept the plural affix.

The difference between the iyelik and barıs cases questions in the Karakalpak language, which are the analogues of genitive and dative, is more clearly felt, in German the singular and plural are given to animate and inanimate objects, and it is typological special linguistic phenomena between them that they don't differ in the number categories.

If we express our opinion according to the second table, the lack of possessive category in German nouns is proved by that it's characteristic of the second language.

The scientific research conducted on the case forms in the languages being compared shows that there is a commonality in their morphological constructions, as well as in the internal elements of the case forms. The following example can prove it:

<i>Genitiv</i>	<i>Singular</i>	1	2	3
		Arbeit	+ er	+ s
<i>Iyelik (Possessive)</i>	<i>Singular</i>	1	2	3
		Jumis (Work	+ shı + er	+ nıń + 's)
<i>Dativ</i>	<i>Plural</i>	1	2	3
		Bild	+ er	+ n
Barıs	<i>Plural</i>	1	2	3
		Suwret	+ ler	+ ge

However, it should be noted that in modern literary German, nouns do not have certain morphological indications in number and case. German case forms with an antique suffix have their own specific characteristics [1:60].

It is clear that in the German language, the leading place in the expression of noun case forms is occupied by words that act as articles and attributive. They are mainly: possessive,

demonstrative and interrogative pronouns, adjectives in attributive functions, ordinal numbers, participle in attributive functions, etc. They agree with the nouns after them not only in gender and number, but also in cases. Examples: **nominative**-der (dieser, junger, schöner, gebildeter) Lehrer; die (meine, diese, junge, schöne, gebildete) Lehrerin; das (dieses, schönes, junges, gebildetes) Mädchen; **dative**-dem (diesem, schönem, jungem, gebildetem) Lehrer; der (meiner, dieser, schöner, junger, gebildeter) Lehrerin; dem (diesem, schönem, jungem, gebildetem) Mädchen; **accusative**-den (diesen, jungen, schönen, gebildeten) Lehrer; die (meine, diese, junge, gebildete) Lehrerin; das (dieses, schönes, junges, gebildetes) Mädchen.

As it can be seen from the examples, the case suffixes are almost not used in nouns. Their functions are performed by articles and other words as mentioned above [2:65].

In Karakalpak language, in general, in all Turkic languages, there is no article. The function of articles in German is performed by case affixes. All cases except Ataw have their own affixes. They can be added to nouns both in the singular and in the plural. So, the combination of article+noun in German corresponds to the synthetic form –noun+affix in Karakalpak language. Words that come before nouns in the Karakalpak language and act as attributive (adjectives, participle, demonstrative pronouns, ordinal number, etc.) cannot show the meaning of case, do not affect the declension of nouns, as in German, they are incompatible with attribute nouns that come after them. By this feature, they differ from the language being compared. We can clearly see this from the following example.

Nominativ	<i>schönes Mädchen, großer Tisch, schöne Frau</i>
Genitiv	<i>schönen Mädchens, großen Tisches, schöner Frau</i>
Dativ	<i>schönem Mädchen, großem Tisch, schöner Frau</i>
Akkuzativ	<i>schönes Mädchen, großer Tisch, schöne Frau</i>

Ataw	<i>sulıw qız, úlken stol, sulıw hayal (beautiful girl, big table, pretty woman)</i>
Iyelik	<i>sulıw qızdıń, úlken stoldıń, sulıw hayaldıń (beautiful girl's, big table's, pretty woman's)</i>
Baris	<i>sulıw qızǵa, úlken stolǵa, sulıw hayalǵa (to beautiful girl, to big table, to pretty woman)</i>
Tabis	<i>sulıw qızdı, úlken stoldı, sulıw hayaldı (beautiful girl, big table, pretty woman)</i>
Shıǵıs	<i>sulıw qızdan, úlken stoldan, sulıw hayaldan (from beautiful girl, from big table, from pretty woman)</i>
Orın	<i>sulıw qızda, úlken stolda, sulıw hayalda ((at, on) beautiful girl, on big table, (at, on) pretty woman)</i>

Grammatical morphemes in German are polysemantic, and their original meaning can be distinguished only in the context, in specific word combinations or syntagms in a sentence. This means that several grammatical meanings are expressed by one element, one morpheme. For example, we can clarify the idea if we refer to: -e morpheme is used to form the plural form of nouns (der Tag-die Tage, der Tisch-die Tische), the first person singular of the present tense form of verbs (ich lerne, arbeite, höre), the present conjunctive form of the verb (ich gebe, nehme, schlafe, du gebest, nimmst, schlafest, er gebe, schlafe, etc.), also in declension of the adjectives (*der schwarze Tisch, das schöne Mädchen*), in formation of nouns from other words (krank-der Kranke, alt-die Alte, jung-der Junge, süß-der Süße, gemacht-das Gemachte, vorsitzende-der Vorsitzende), to indicate the gender of the nouns (mein Buch-meine Mappe, meine Mutter, unsere Fabrik, unsere Schwester). Also, the morpheme -(e)n expresses several meanings.

The form of the Karakalpak language case structure differs from the form of the German language in that each case has its own affix, and it is not difficult to distinguish them not only in the context, in phrases, but also in the derived word. According to the meaning of the case affix, it means this case. Affixes of case in the Karakalpak language are added after plurals and after possessive affixes without any change: úy, úydiń, úyge, úydi, úyde, úyden, úyler, úylerdiń, úylerge, úylerdi, úylerde, úylerden; úyim, úyimniń, úyime, úyimdi, úyimde, úyimnen, (house, of house, to

house, house, at house, from house, houses, of houses, to houses, houses, at houses, from houses, my house, of my house, to my house, my house, at my house, from my house), etc.

In the German language, in the nominative and accusative cases in the gender of neuter and feminine, the article and the noun have the same meaning, and the expression of their signs is very close. The nouns of the feminine gender are completely similar in the genitive and dative cases, and in the plural, the nominative and accusative forms of the nouns in all three gender are the same. In such cases, the main role in differentiating the meanings of the cases in the language is played by intonation, stress and context in the sentence, as well as with the word order of the noun (position, i.e., the morphological difference between the nominative and accusative cases) in the sentences, subject+verb predicative – direct object is defined.

Großvater (Nom) wickelt die Uhrkette (Akk) um seinen Zeigefinger (Akk) und reckt die Brust (Akk) heraus. (S.E. Schrittmatter/Tinko). - *Atam saat shunjirın kórsetkish barmagına oraydı da kósholegin aldına shıgaradı* (Akk). Grandfather wraps the watch chain around his index finger and stretches out the chest (Acc). Das Kind (Name) nimmt die Brust seiner Mutter (Gen). - *Bala apasın emip atır*. The baby sucks his mother. Die Schwester (Nom) begleitet ihre Tochter (Akk) in den Kindergarten - *Anası qızın baqshağa alıp bardı*. The mother took her daughter to the Kindergarten. Die Jungen (Nom) begrüßen die Mädchen (Akk) und reichen ihnen die Blumen (Akk) – *Jigitler qızlar menen sálemlesip, olargá gúl berdi*. The boys greeted with the girls and gave flowers to them. Mein Leid (Nom) bat kein Ende (Akk) - *Ğam qayğımnuń sońı joq*. My sorrow is endless. Auch die dunkelbraune Hans (Nom) sah Snowfall (Akk) – *Qońır ğaz Qarlıǵashtı kórdi de*. The brown goose saw swallow. (K. Reichl. Das uzbekische Heldenepos Alpomish). Das Tuch (Nom) der Frau (Gen) war noch nicht alt. Der Mann (Nom) schenkte der Frau (Dat) dieses Tuch (Akk) vor viel Jahren - *Hayaldıń oramalı ele gónermegen edi, kúyewi onı hayalına tórt jıl burın sawǵa etken edi*. The woman's kerchief was not old yet, her husband gifted it to his wife 4 years ago.

In inverted simple sentences, the noun in the ataw case usually comes after the verb, and the noun in the accusative case is either in the first place or in the fourth place after the noun in the ataw case.

Tante Trix (Akk) mag ich (Nom) am wenigsten- *Triksi apaydı men onshama jaqtırmaytuǵın edim*. -I didn't even like Aunt Trixie. Da hörte das Mädchen (Nom) seine helle Stimme (Akk)- *Sol waqıtta qız onıń ashıq dawısın esitip qaldı*. –At that time the girl heard his high voice.

If the sentence contains the nouns in both dative and accusative cases, then the verb is followed by the dative noun and then the accusative noun:

Der Vater kauft dem Sohn eine Schultasche-Ákesi ulına papka satıp alıp atır. The father buys a schoolbag for his son.

If instead of nouns, the case pronouns come in one row, the accusative personal pronoun is placed before the dative.

Ich kann ihn Ihnen zuerst zeigen - *Men aldın onı Sizge kórsetemen*. I will show it to you before.

If the subject and object are used together in the sentence, the noun in the genitive case always comes after the noun in the nominative case.

Die Straße (Nom.) der Stadt (Gen.) sind neu und asphaltiert- *Qalanıń kósheleri taza hám asfaltlangan*. The city streets are clean and paved.

In the Karakalpak language, as well as in all Turkic languages, the placement of the subject and the accusative in a sentence is usually considered the correct word order [3:183]. As we can see from the example, it is the opposite in German.

If the referring word is a proper noun, the proper noun in the genitive case is placed first in the nominative case, and the noun comes second. This order of words in the form of the attributive + attribute corresponds to the arrangement of words in Karakalpak as well as in all Turkic languages.

Das war Allas Absicht (V. Q).- *Bul Allaniń niyeti edi*. It was Alla's intention. Bonegs Kopf hatte keine Erinnerung mehr an diesem comfort (V.Q). *Bunday qolaylıqlar Bonegtiń esine de kirip shıqpaǵan edi*. Such comforts did not come to Bonegti's mind.

The attributive words are nominative and are used mainly before the attribute.

Als er kam, war Frau Dukhart zu Hause (E. P.). - *Ol kelgende Dukkart xanım úyinde edi*. When he arrived, Mrs. Dukart was at her house.

When a noun-attributive in the nominative form is in separate application, it comes after the attribute:

In den Hörsaal trat Karl, der neue Lektor ein. – *Karl, Taza oqıtıwshı auditoriyaǵa kirip keldi*. Karl, the new lecturer, entered the lecture hall.

This arrangement of the attributive noun in relation to the noun is also a characteristic of the Karakalpak language.

Ibrayım Yusupov ta, Ózbekstan qaharmanı ushırıwda qatnastı. Ibrayim Yusupov, the Hero of Uzbekistan participated in the meeting.

Shayır Ibrayım Yusupov penen studentlerdiń ushırıwı bolıp ótti. The poet Ibrayim Yusupov had a meeting with the students.

In the Karakalpak language, in general, in all Turkic languages, the place of words in a sentence is freer than in German. Of course, it is appropriate to take into account the fact that it depends on the types of sentences, as well as on the logical stress. Whichever part of the sentence the logical stress falls on, that word moves to the end of the sentence regardless of the noun in the ataw case and the object in the tabis case. It is placed before the verb, sometimes after it.

In indirect speech sentences, the author's speech begins with a verb, and the subject – word in the ataw case is placed after it. This arrangement of words is a grammatical phenomenon common to both languages under comparison.

There is a peculiarity in the arrangement of German words in a sentence, which cannot be found in other languages. This case is explained by the independent use of the noun in the genitive case and often standing at the beginning of the sentence.

It should also be noted that such nouns are mostly words that express the meaning of time and place.

Eines Tages stand vor mir mein Vater, ... (K. Voken und K. Kammer) - *Bir kúni ákemdi kórip qaldı*. - One day I saw my father. *Des Abends kamen sie zum Vater heim, ...* (der Koran) - *Keshte olar atasınıń aldına keldi....* In the evening they came to their father...

In German, in some cases, the nominative noun is not found in the first or third position, but also in the fourth position.

Plözlich stand vor mir mein Schulfreund Klaus.-Tosınnan meniń aldında mektepte birge oqıǵan dostım Klaus payda bolıp qaldı. - Suddenly my school friend Klaus was standing in front of me. *Kurz nach meiner Rückkehr wurde in Berlin der Schutzwall errichtet*. (K.V,K.K.)- *Men qayıp kelgensoń kóp ótpey-aq Berlin qáwipsizlik (qorǵanıw) diywalı tiklendi*. Shortly after my return, the protective wall was erected in Berlin.

When the noun in the nominative case is an invariant part of the noun predicative, it is placed at the end of the sentence.

Ich werde nie ein anderer Mensch (Nom). *Ich will kein anderer Mensch* (Nom) werden. (K.V, K.K.) *Men hesh waqıtta da basqa adam bolmayman. Men basqasha adam bolıwdı da qálemeymen*. I will never be a different person. I don't want to become another person.

If the prepositional words *als, wie* stay before the nominative nouns, the word can express profession, kinship, closeness, as well as comparative meanings. In such cases, another word in the sentence takes its place in the subject function in the nominative case.

The noun in nominative in the above-mentioned comes later, to be more precise, at the end of the sentence.

Ich (Nom) werde alles, meine ganze Kraft (Akk) und mein Recht (Akk) als Vater (Nom) gebrauchen. (K.V, K.K.) - Áke retinde barlıgın, kúshimdi de, huqıqımdı da jumsayman. I will use everything, all my strength and my right as a father. Das sind unsere, lief ich wie ein Verrückter auf sie zu, ... (K.V, K.K.) -Usılar ózimizdiki, dep jillidey olargá juwırıp ketti. - These are ours, I ran like a madman towards them ... Du bist mir Vater, Mutter, Sohn und Tochter, du mein einziges Pferd. (K.R.Alpamys) - Ata-anam, ul –qızım – bir atım. You are my father, mother, son and daughter, you are my only horse.

In some cases, the noun representing the thing being compared, mainly in the genre of poetry, can be used not only at the end of the nominative sentence, but also at the beginning.

Gleich wie der Vögel eines unsichtbaren heiligen flog Boychibor dahin (K. R. Alp). Bayshubar Ğayıptıń qusınday ushtı. Like the birds of an invisible saint, Boychibor flew there.

One of the distinctive features of the German language is the independent use of nouns denoting direction and place in the genitive case. In this case, the noun in the genitive case comes at the end of the sentence, not at the beginning of the sentence, like nouns meaning place.

Neun Nächte und neun Tage zog er seines Weges, ... (K.R. Alp). Toğız tın, toğız kún jol júrdi, ... Nine nights and nine days he went his way,... Jeder ging seines Weges -hár kim óz jolına ketti; hár kim óz jolı menen ketti. Everyone went his own way

In conclusion, it should be said that there are similarities and differences in terms of the position of the cases in the languages being compared. In the Karakalpak language, nouns are freely placed in sentences, but in German, this is not the case. A visible difference in the case system is felt in their number. There are six cases in the Karakalpak language, but only four in German. There are more differences than similarities in the questions of the cases. If in German the questions “wer? was?” are given to singular and plural nouns, it is the opposite in Karakalpak language. Just as nouns take plural suffixes, interrogative words also differ in number. Such a typological difference is definitely explained by the characteristics of each language.

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Rezyume: *Ushbu maqolada nemis tilidagi grammatik kelishiklarning qoraqalpoq tilidagi kelishiklar bilan solishtirilib, semantik ma'nolari va sintaktik vazifalari bilan qiyosiy taqlil qilinga. Kelishik shakllarining yasalişi va qo'llanishlardagi o'zaro muqobil va namuqobil ko'rinishlari aniqlangan. Ular orasidagi o'zaro o'xshashliklar va farqlarni ko'rsatib berilgan.*

Резюме: *В данной статье грамматические падежи в немецком языке сравниваются с падежами в каракалпакском, а также сравнительно анализируются их семантические значения и синтаксические функции. Определены альтернативные и противоположные формы в образовании и употреблении падежных форм. Показаны сходства и различия между ними.*

Kalit so'zlar: *qiyosiy tipologiya, kelishiklar, nemis va qoraqalpoq tilidagi kelishuklarning uqshash va o'ziga xos xususiyatlari.*

Ключевые слова: *сравнительная типология, падежи, сходства и специфические особенности падежей в немецком и каракалпакском языках.*

ANALYSIS OF POSSIBILITIES AND PROSPECTS FOR DEVELOPMENT OF CLOUD COMPUTING

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Summary: *This article provides an in-depth look at the current state and future development of cloud computing technology. The authors discuss such benefits of cloud computing as scalability, flexibility and cost-effectiveness. In the article the challenges that come with the integration of cloud computing, such as dependence on internet connectivity and the potential for vendor lock-in are also examined and specific examples of using AI in areas of the Internet of Things and Data Analysis are given.*

Key words: *Cloud computing, scalability, flexibility, cost-effectiveness, security, serverless computing, Internet of things, data processing, real-time analysis.*

Cloud computing as a new technology. Cloud computing is a technology that has revolutionized the way we access, store, and process data and software. By delivering computing services over the internet, it has opened up new possibilities for individuals and organizations. From the ability to access data and applications from anywhere to the scalability of resources, cloud computing has transformed the way we work and interact with technology. In this article, we will delve into the current state of cloud computing and its future possibilities. We will examine the latest developments in the field and explore the potential for new innovations to shape the way we use technology in the coming years. This article will provide a comprehensive overview of the current state and future possibilities of cloud computing, making it a valuable resource for anyone interested in the technology. Cloud computing technology (CCT) is a true breakthrough in the way data is accessed, stored and processed, and software. By providing computing services over the Internet, it has opened up new opportunities for both individuals and organizations. The advantages of cloud technologies are their flexibility, scalability, elasticity, budget savings, cost reduction, stability, manageability, security.



Advantages of CCT. By enabling access to data and applications from anywhere and scalability of resources, cloud computing has changed the way we interact with technology. Cloud computing forms a new paradigm for the use of information and communication technologies, which helps to increase the productivity and economic efficiency of enterprises in various industries. Clouds are critical components of today's industrial revolution, in which ICTs provide the opportunity to transform the global manufacturing economy by enabling the digitization of virtually all modern manufacturing processes. The result of this revolution was the transition to a new production environment, which in Europe is called "Industry 4.0" (Industry 4.0), and in the USA - "smart production" (Smart Factory).

A new type of manufacturing is being shaped by foundational products and technologies, including advanced sensors and the Internet of Things (IoT), next-generation machine-to-machine and wireless communications, computer-aided design and manufacturing (CAD/CAE/CAM)

software solutions, automation and robotics, and high-performance computing, data analytics and artificial intelligence.

Use of CCT. Such industries use industrial clouds (Industrial Cloud), which allows you to connect enterprises and industrial assets to networks, securely exchange confidential data, unite users and equipment of all supply chains, and provide the necessary resources for analyzing processes and products in real time.

Cloud computing opens new ways of working with information. By leveraging the power of the internet, cloud computing allows for the delivery of computing services such as storage, processing, and applications on-demand. This has led to an explosion of innovation and growth in the field, with new possibilities emerging every day.

One of the main benefits of cloud computing is its scalability. With cloud computing, users can easily scale up or down their computing resources as needed, without having to invest in expensive hardware. This allows for greater flexibility and adaptability, especially in fields such as big data and analytics where the need for computing power can fluctuate.

Another benefit of cloud computing is its cost-effectiveness. By utilizing cloud computing services, organizations can reduce their IT costs by only paying for the resources they use, rather than having to invest in expensive hardware and software. This can be especially beneficial for small and medium-sized businesses that may not have the resources to invest in expensive IT infrastructure.

Cloud computing also enables organizations to access cutting-edge technology without having to invest in it themselves. For example, with cloud computing, organizations can access advanced analytics tools, machine learning, and artificial intelligence (AI) without having to invest in the expensive hardware and software required to run these technologies. This can help organizations to stay competitive in today's fast-paced business environment.

One of the most exciting areas of cloud computing is the emergence of serverless computing. Serverless computing is a new approach to cloud computing that allows organizations to run their applications and services without having to manage the underlying infrastructure. This can help organizations to save time and money, as they no longer need to manage and maintain servers.

Another area of cloud computing that is rapidly evolving is the Internet of Things (IoT). With IoT, devices such as smartphones, appliances, and even vehicles can be connected to the internet, collect and transmit data. The use of cloud computing in IoT allows processing and analysis of data in real-time, which can lead to new insights and opportunities for business. For example, a manufacturing company may use IoT devices to monitor the performance of their machines and equipment, and then use cloud computing to analyze the data and identify patterns and trends. This can help the company to improve efficiency and reduce downtime.

Area in which AI is having a significant impact now is the development of smart cities. AI is being used to optimize various aspects of urban life, such as traffic management, energy usage, and waste management, leading to increased efficiency and sustainability. For example, AI is being used to monitor traffic patterns and to adjust traffic signals in real-time, reducing traffic congestion and improving safety. At the same time, the widespread deployment of AI in cities raises important questions about privacy, security, and accountability, and it is important that these concerns are addressed as the development of smart cities continues.

In the realm of finance, AI is being used to automate investment decisions, and to analyze financial data to identify market trends and investment opportunities. This has the potential to increase efficiency and reduce the cost of investing, but it also raises important questions about the reliability of AI systems, and the potential for bias in decision-making. It is important that AI is developed and used in a transparent and explainable manner, and that it is subject to robust regulatory oversight to ensure that it is used in a responsible and ethical manner.

IoT can be used in the development of autonomous vehicles. Such data like weather, traffic and road conditions can be analyzed using cloud computing to improve the performance of autonomous vehicles and make them safer.

The possibilities of cloud computing are not limited to just these examples. The technology is expected to continue to evolve and be used in new and innovative ways in the future. The use of cloud computing can also help in the development of new technologies such as artificial intelligence and quantum computing. The integration of cloud computing with other technologies such as IoT, AI and edge computing is expected to lead to the emergence of new hybrid models of computing. These models will combine the benefits of cloud computing, such as scalability and security, with the benefits of other technologies, such as low latency and high processing power.

Prospects for development of CCT. As it was shown, cloud computing is a rapidly evolving technology that is having a significant impact on various industries and aspects of our daily lives. Its ability to provide on-demand access to computing resources and services has led to greater scalability, flexibility and cost-efficiency. AI has the potential to drive economic growth by increasing efficiency and productivity, and by creating new and innovative products and services. It is important that the benefits of AI are shared equitably across society, and that policies are put in place to support workers who are displaced by automation, such as retraining programs, unemployment benefits, and social safety nets. Additionally, the emergence of new technologies such as IoT and serverless computing are further expanding the capabilities and possibilities of cloud computing. However, it is important to consider the potential challenges and security risks when implementing cloud computing solutions.

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Rezyume: Maqolada bulutli hisoblashlar texnologiyasining hozirgi holati va rivojlanish istiqbollari tahlil qilingan. Mualliflar bulutli texnologiyalarning masshablanuvchanligi, moslashuvchanligi va sarflangan harajatlar asoslanganligi kabi afzalliklari muhokama qilinadi. Bulutli hisoblashlar texnologiyalarining muammo tug'diradigan tomonlari, ya'ni internetga bog'lanish va sotuvchini blokirovka qilish imkoniyatlari o'rganilgan va sun'iy intellektning narsalar internetida qo'llanishi bo'yicha misollar keltirilgan.

Резюме: Статья содержит глубокий анализ нынешнего состояния и будущего развития технологии облачных вычислений. Авторы обсуждают такие преимущества облачных технологий как масштабируемость, гибкость и окупаемость. Исследуются проблемы интеграции облачных вычислений, такие как зависимость от подключения к интернету и потенциал для привязки к поставщику, даются примеры использования искусственного интеллекта в Интернете вещей и Дата аналитике.

Kalit so'zlar. Bulutli hisoblashlar, masshtablanuvchanlik, moslashubchanlik, harajatlar samaradorligi, xavfsizlik, serversiz hisoblashlar, narsalar internet, ma'lumotlarga ishlov berish, real vaqt tahlili.

Ключевые слова. Облачные вычисления, масштабируемость, гибкость, эффективность вложений, безопасность, бессерверные вычисления, Интернет вещей, обработка данных, анализ в режиме реального времени.

**THE THEORIES OF MANAGING DEVELOPMENT OF THE INDUSTRIAL COMPLEX
OF THE REGION IN THE CONDITIONS OF INNOVATIVE ECONOMY**

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Summary: *This article deals with the theory of management of development of the industrial complex. Moreover, the opinions of the world-class scientists in area of management of regional development of the industrial complex are studied. Creation and improvement of the regional innovative system and formation of innovative type of regional economy is offered.*

Key words: *region, industrial complex, regional economy, regional scientific and technical complex, innovative approach.*

Introduction. Currently, in the scientific literature there is a fairly large number of the scientific theories, models, methods and recommendations for improving management of development of industrial enterprises and regulation of this process at the national, regional, local and corporate levels. And at the first glance, it seems that this topic has been studied enough and many materials confirming this opinion have been published. However, we have to say that implementation of many theories in practice in terms of effectiveness is ambiguous what requires continuous refinement when evaluating certain events.

The theoretical basis for managing the regional development of the industrial complex is the theory of location, the theory of regional development and the theory of interregional economic relations.

Scientific Literature Review

The main science schools have developed in a number of countries such as Germany, Sweden, France, Great Britain, and the USA. A significant contribution to the formation of certain areas of regional theory was made by J.Thünen (agricultural standard theory), L.Walras and V.Pareto (general economic equilibrium model), K. Launhardt (regional standard of industrial enterprise), A. Weber (pure standard theory of industrial enterprise), H. Hotteling (the beginnings of the dynamic theory of location), T. Palander ("general" and "special" theories of standard), A.Lösch (theory of spatial economic equilibrium), W.Izard and T. Reiner (generalization of regional science), V. Kristaller (the theory of central places), T. Hegerstrandt (theory of "diffusion of innovations"), F. Perrox, J.-R. Boudville, H. Lasuen (the theory of "development poles" and "growth centers"), P.Potier (theory of "development axes"), M. Strait, K. Richter, S. Tsamansky (theory of industrial complexes), M. Porter (theory of industrial clusters) and others [2].

A significant contribution to the fundamental theory of the regional economy was made by the domestic scientists V.I. Vernadsky (noosphere), L.N. Gumilyov (cycles of ethnogenesis), N.D. Kondratiev (the theory of large cycles), N.N. Kolosovsky (the theory of economic zoning), Yu.G. Saushkin (large natural and social cycles of metabolism and energy), N.N. Baransky, I.M. Mayergoyz (theory of economic and geographical location, theory of cities), I.V.), V.M. Chetyrkin (the concept of the key economic problem of the region), N.N. Nekrasov (activities of SOPS-“Council for study of productive forces”), E.B. Alaev (system economic-geographical terminology), M.K. Bandman (TPK theory), etc.

Let us consider the main theories in which the aspects of managing the development of industrial enterprises have taken a special place.

Analysis and results

[Johann Heinrich von Thünen](#) is considered to be the founder of the theory of production location. In his work “Isolated State”, Thünen created an abstract geographical model based on such characteristics as distance from the center and area. In this model, transport costs as a linear function are separated from distance and from other factors affecting the location of agricultural

production and land use. He believed that the price of each product at any point in space differs from its price in the city by the amount of transportation costs, which are directly proportional to the weight of the cargo and the distance of transportation.

The next follower of the theory of placement was K. Launhardt, whose research concerned transport and engineering economics, the theory of prices and market space. J. Schumpeter acknowledged that K. Launhardt was one of the first to apply mathematics in the study of the market space, at the same time he undeservedly belittled his role in the development of the local theory. K. Launhardt was looking for a solution to the problem of determining the optimal sales areas for manufacturers competing with each other, concentrated at one point and serving consumers, evenly dispersed in the economic space. This problem is opposite to that formulated by J.H.von Thünen, who determines the optimal supply areas for competing consumers concentrated at one point but buying goods from producers dispersed in the economic space.

A.Weber in the book "The Theory of Production Location" continued to deepen the analysis in the field of location theory as a specific branch of economic theory. The scientist set himself the task of creating a general "pure" theory of the location of production based on the consideration of an isolated enterprise. He made a significant step forward in comparison with J.Thünen and W.Launhardt, introducing into the theoretical analysis the new factors of production location in addition to transportation costs and setting a more general optimization problem: minimizing the total production costs, and not just transportation.

However, the lack of analysis of the areas of sales and purchases in A.Weber's book did not allow it to become the first complete and comprehensive treatise on the classical theory of placement. Only T.Palander connected the theory of location of enterprises and the spatial analysis of markets consolidating half a century of research on the location of industrial enterprises in space. T.Palander put forward a "general" and "special" theory of standard: the first one is for the region and the country; the second one is for enterprises in industry or group of industries.

The creator of the first theory of model of spatial economic equilibrium - the theory of economic landscape is August Lösch. In his doctrine, A.Lösch significantly expands the range of factors and conditions considered in the placement of enterprises and their combination (taxes, duties, effects of monopolies and oligopolies, etc.) saturating the theory of placement with the whole variety of macroeconomic tools.

A.Weber managed to solve the problem of optimal placement of only one producer under other given conditions, and this achievement remained unsurpassed for more than a quarter of a century. Lösch solved the problem of simultaneous placement of several manufacturers, who, moreover, have different specializations. Whereas before Lösch the optimal point for locating production was considered to be the one that provides the minimum costs, then Lösch showed that the location that provides the maximum profit is preferable.

A. Lösch proved impossibility of creating a general theory of location, which would ensure the optimal location of production. One of the main merits of Lösch's theory lies in consideration of the economic space not at the level of individual enterprises and settlements, but at the level of economic regions. He analyzes the location of producers in a competitive environment and puts forward a position on the tendency to fill the economic space of the region with economic agents to the fullest. The boundaries of the economic space of the region pass along the lines of indifference, and this ensures the state of stability and balance of the space, which, according to A. Lösch, is influenced by the tax system, technological progress, and proximity to state borders. The regional economic space is considered as a market with boundaries determined by interregional competition.

A. Lösch also strengthens the theory of interregional trade (in particular, B. Ohlin) under assumptions about the mobility of goods and services in the short term and factors of production in the long term. A. Losh gave a detailed mathematical description of the market functioning of the system of producers and consumers, where each economic variable is tied to a certain point in

space. The main elements of the equations of the equilibrium model are the functions of demand and costs.

Lösch's theory made it possible much later to see how the distribution of cities changed as the share of the urban population increased.

W. Izard, in his book "Location of Production and the Economics of Efficient Use of Space", written in 1956, eliminates deep discrepancies that existed for a century between the classical theory of production location and the mainstream of economic theory. W. Izard notes that on the basis of the profit maximization condition, all private placement theories can be derived - the theories of J.H. von Thünen, K. Launhardt and A. Weber. W. Izard, on the basis of macroeconomic approaches, develops a method for analyzing the industrial complex, analyzes regional production systems and inter-regional relations.

A. Smith and D. Ricardo in their theories of absolute and comparative advantages believed that it is expedient to carry out international division of labor taking into account the advantages that this or that country (region) has. A. Smith believed that each country (region) should specialize in the production and sale of the product for which it has absolute advantages, because this will lead to an increase in the production and consumption of goods in the cooperating countries (regions). And D. Ricardo, advancing the theory of A. Smith further, proved that absolute advantages are a special case of the general principle of the division of labor, and most importantly - relative (comparative) advantages [3].

In the theories of A. Smith and D. Ricardo, the main factor determining the structure of production and exchange is labor costs. E. Heckscher and B. Olin further developed theoretical provisions of the international (interregional) division of labor, introducing into consideration the ratio of the main interchangeable factors of production (labor, capital, land, etc.). The scientists have proved that backward or developing countries (regions), which, as a rule, have a strong shortage of capital and an excess of labor, should specialize in the production and export of labor-intensive products. Developed countries (regions), which have accumulated large masses of functioning capital (including scientific and technical), should strive to export capital-intensive products. Countries (regions) with large areas of agricultural land and relatively low population density are interested in expanding the export of agricultural products.

The first theory about the functions of locating the system of settlements (central places) in the market space was put forward by W. Christaller in his work "Central Places in Southern Germany", published in 1933. W. Christaller calls economic centers that serve goods and services not only themselves, but also the population of their district (sales zone). According to W. Christaller, over time, service and sales areas tend to take shape in regular hexagons (honeycombs), and the entire populated area is covered with hexagons without gaps (Christaller lattice). This minimizes the average distance for product distribution or travel to shopping and service centers.

The theory of W. Christaller explains why some goods and services should be produced (provided) in each settlement (essential products), others - in medium-sized settlements (ordinary clothing, basic household services, etc.), others - only in large cities (luxury goods, theatres, museums, etc.)

The theory of central places by W. Christaller allows us to formulate general ideas about the expedient resettlement in a particular territory. It can be viewed as a theory that provides an ideal standard of the settlement system, with which one should compare the existing settlement systems in order to identify areas for their improvement [4].

The widely accepted theory of growth poles reinforces W. Christaller's theory of central places, using more modern achievements in economics (in particular, V. Leontyev's input-output method). At the same time, in many respects it is in contact with the theory of production-territorial complexes of N.N. Kolosovsky.

The theory of growth poles, put forward by the French economist F.Perroux, is based on the idea of the leading role of the sectoral structure of the economy, and first of all, the leading industries that create new goods and services. Those centers and areas of the economic space, where the enterprises of the leading industries are located, become the poles of attraction for factors of production, since they ensure their most efficient use. This leads to the concentration of enterprises, the formation of poles of economic growth.

The essence of the theory by F.Perroux is the consideration of inequality as a fundamental principle of economic development. Inequality stems from differences in the size of production and capital, from the different degree of awareness of partners, from belonging to different areas of the economy. The main result of inequality is the existence of dominant and subordinate economic units, the inequality of which results in the deformation of the economic space. One of the types of deformation is the polarization of the space around the leading industry ("growth poles"). F.Perroux calls such industry "propulsive". Enterprises entering polarized spaces establish unequal relations with its poles, experience its captivating or inhibiting influence. The drag effect is based on the interdependence of all economic units. The deformation of the economic space around the dominant unit means, according to F.Perroux, a change in the form and content of relations between economic units included in the space. If earlier it was believed that each firm acts independently, guided only by the level of a single price in the market of its products and the height of its costs, now (according to F.Perroux), having got into a polarized space, the firm must take into account direct and indirect coercion emanating from out of the pole from the dominant unit. In a polarized space, economic units no longer behave as interdependent partners, but as parts of a single system. The main contribution of F.Perroux to the theory of economic space can be considered the representation of the latter through force fields, the consideration of space as an object of planning [5].

Regional scientific and technical complexes were considered as components of a single national economic complex of the country and were accepted only as a resource for accelerating scientific and technological progress. The economic policy of the state in relation to the regions, carried out at that time, was predominantly sectoral in nature and was aimed at providing the country's leading industries with material and labor resources, and production space. As a result, regional scientific and technical complexes were territorial and sectoral in nature and did not take into account the interests of the regions themselves. The landslide reduction in public funding and other consequences of the transition period led to a significant loss of the potential of regional scientific and technical complexes in most regions of the Republic of Uzbekistan and a revision of the paradigm of socio-economic development of the regions[1].

At present, the main direction of regional research is the idea of self-development of regions on an innovative basis. The search for an external solution to regional problems has shifted to the search for internal solutions in the region itself. The region is considered as a specialized reproductive system, as an organizer of economic processes, forming integral complexes equipped for the activities of industrial enterprises. The basis for the functioning and development of the region is an innovative approach. Competitive advantages are acquired by those regions that provide optimal conditions for the diffusion of innovations, creating and developing regional innovation systems. The creation and development of regional innovation systems makes it possible to create real prerequisites for the formation of a regional innovation-type economy.

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Rezyume: Ushbu maqolada sanoat majmuasining rivojlanishini boshqarish nazariyalari muhokama qilinadi. Shuningdek, sanoat majmuasining hududiy rivojlanishini boshqarish bo'yicha jahon miqyosidagi olimlarning fikri o'rganilmoqda. Mintaqaviy innovatsion tizimlarni yaratish va rivojlantirish hamda innovatsion tipdagi hududiy iqtisodiyotni shakllantirish taklif etiladi.

Резюме: В данной статье рассматривается, теорий управления развитием промышленного комплекса. А также изучается мнение ученых мирового масштаба в области управления региональным развитием промышленного комплекса. Предложено создание и развитие региональных инновационных систем и формирования региональной экономики инновационного типа.

Kalit so'zlar: mintaqa, sanoat majmuasi, hududiy iqtisodiyot, hududiy ilmiy-texnika majmuasi, innovatsion yondashuv.

Ключевые слова: регион. промышленный комплекс, региональная экономика, региональный научно – технический комплекс, инновационный подход.

**EFFECTIVE FORMS OF ASSESSING STUDENTS' COMMUNICATIVE COMPETENCE
(ON THE MATERIAL OF ROLE-PLAYS AND EUROPEAN LANGUAGE PORTFOLIO)**

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Summary: *This article is about the effectiveness of using games, namely role-plays and language portfolio in the process of control / assessment of students' communicative competence. The role-plays and language portfolios are considered effective and productive ways of assessment. The requirements, objectives, forms of assessment have been investigated. As a result, we recommend role-plays and portfolio as innovative and effective forms in teaching foreign languages.*

Key words: *foreign language teaching, assessment, competence, methodology of teaching, forms of assessment, role-plays, language portfolio.*

Role-plays

It is known that various games are organized in foreign language education in order to control the oral-speech activity of students. In order to control the grammatical mechanisms of oral speech and the professional and pedagogical skills of students, various games can be used as an effective method of control in practical grammar lessons. These are discussions, presentations, role-playing games, speaking (verbal description) on a topic, situation or picture, retelling of the material read.

Such an organization of control / assessment, firstly, increases students' interest in science and motivation, and secondly, reduces the level of observation from the psychological side, being only a means of "error checking" of students, i.e. identifying shortcomings, thirdly, the full implementation of practical all control functions, fourthly, the group work of students allows you to control them all at the same time and most importantly, it serves to form the speech factor of language learners.

It is important to take into account the conditions of professional activity of students in working games. This type of game, first of all, determines the main aspects of the professional activity of the future specialist [3: 257].

Each game can include different roles related to a specific theme.

For example, such roles as teacher, students, parents, expert methodologist, expert teacher, head of department, deputy. dean to work with teachers and students in a certain situation in the classroom, such as teaching, organizing independent work, searching for materials on the Internet; when organizing a meeting with famous people (an experienced professor of an educational institution, a teacher-methodologist), students are assigned the role of invited students and experts.

In such games, the knowledge, skills and qualifications of students should be assessed in a group and individual, stage-by-stage and final assessment system [3: 258].

The main criteria for evaluating game actions can be defined as follows:

- professional effectiveness of the participants;
- the effectiveness of joint activities and communication in the corresponding foreign language;
- practical knowledge, skills and professional skills, formed in a foreign language in the game;
- the ability of game participants to solve various professional and speech tasks;
- full and high-quality performance of the role;
- creative approach to problem solving;
- formation of professional thinking;
- an experience;

- level of self-education;
- professional discipline and communication culture.

We gave each of these criteria a maximum of 1.5 points, and the following indicator came out of the sum of 15 points:

- 12.9 - 15 - excellent,
- 10.6 - 12.8 - good,
- 8.3 - 10.5 - satisfactory,
- 0 - 8.2 - unsatisfactory.

It seems that the skills of speaking, reading, listening and writing (writing thoughts, formulating questions) are formed with this method of control at the same time and it is possible to control them in a short period of time.

After the end of the game, its results are discussed by the teacher and all participants. Such discussions help to analyze not only the mistakes made by students, but also to solve communication problems.

Portfolio evaluation system

It is known that in the second half of the twentieth century, with the advent of the concept of "Europe without borders", the importance of foreign languages in human life began to be clearly felt. On the basis of this concept, specialists developed the project "European Assessment System for Foreign Language Proficiency", which was successfully tested in the education system of most European countries. In the project, a system for assessing the level of foreign language proficiency, criteria for listening, reading, oral communication (dialogue), monologue and writing were developed separately for each stage and level. The English version of the project was published in Strasbourg in 1996 under the title "Common European Framework of Reference for Languages: Learning, Teaching, Assessment".

In the project, the communicative factor is considered as the goal of learning, and parameters and criteria for the level of language proficiency are developed.

This document of the Council of Europe includes standards for systematizing approaches to teaching foreign languages and assessing levels of language proficiency. The main content of the project is the development of a subject that is understandable to everyone, as well as a special standard for describing and assessing the level of knowledge, regardless of the country in which a foreign language is studied in a higher or secondary school or in private courses using various methods.

As a result of many years of experience in educational institutions where languages are taught, including foreign ones, the main issue of distinguishing between levels of language proficiency has been resolved. There are 3 main levels: A - Basic User, B - Independent User, C - Proficient User.

This standard describes the general and communicative factors, situations and communicative frameworks necessary for communication. One positive aspect of the standard is that the descriptors described for levels A-C can be independently evaluated by language learners themselves. In addition, the teacher can also assess the level of the language learner's performance. This process is carried out objectively. Both the student and the teacher will have a clear idea of the level of knowledge and will try to eliminate shortcomings in time.

Based on the common European assessment system, it is recommended to use a portfolio (European Language Portfolio) as a new way to control the communicative effectiveness of foreign language learners [6].

The portfolio is now widely implemented in the system of higher and secondary schools in most European countries and is a set that reflects the results of the work done by language learners over a certain period of time, whether it is classroom or self-study. The portfolio complements the traditional forms of control, serves to form the knowledge, skills and abilities of students.

The portfolio has benefits for both language learners, teachers and employers. Its advantage for language learners is that it allows the student to regularly monitor their own learning, independently assess the acquired knowledge, skills and abilities and plan future work. For teachers, it can be used as a type of current control in order to save time and increase the effectiveness of control. For employers, viewing a portfolio helps to get an idea of what a student is capable of and make a decision whether to hire him or not [2: 5-6].

One of the advantages of a portfolio is that it can be in electronic form. Unlike a traditional paper collection, an electronic portfolio can express not only information, but also sound, movement (animation), color [4: 17].

The portfolio is not only an assessment method; it also helps to fulfill several important pedagogical tasks:

- support the desire to learn;
- to stimulate the activity and independence of students, the expansion of learning opportunities and self-study;
- formation of reflective and evaluative (self-assessment) skills of students;
- setting the goals of students' learning activities, their planning and organization - the formation of learning skills;
- assistance in the individualization of student learning;
- collection of additional grounds and opportunities for generalizing the effectiveness of education [5: 54].

Based on common European assessment criteria, educators in a number of countries have developed assessment systems based on their circumstances. Russian methodologists N.D. Galskova, K.M. Iriskhanova and G.V. Strelkova presented their project to the general public. [See: 1]

In our republic, the British Council in Uzbekistan is currently working on this issue together with expert teachers of the Republic of Uzbekistan, and it is expected that in the near future it will achieve results in teaching EAP and ESP students.

It is safe to say that the use of a portfolio as a control method is convenient for a rating system. However, it must be emphasized that in order to obtain effective results in increasing the level of control and assessment of knowledge, skills and competencies of foreign language learners using the portfolio method based on the common European assessment system, it is necessary to develop a system of assessment criteria based on our conditions for the common European assessment system.

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Rezyume: *Mazkur maqolada talabalarning kommunikativ kompetentsiyasini nazorat qilish / baholash jarayonida o'yinlardan, ya'ni rolli o'yinlar va til portfoliosidan foydalanish samaradorligi haqida fikr yuritiladi. Rolli o'yinlar va til portfolioisi baholashning samarali va*

samarali usullari hisoblanadi. Nazoratning talablari, maqsadlari, shakllari o'rganildi. Natijada biz chet tillarini o'qitishda innovatsion va samarali shakllar sifatida rolli o'yinlar va til portfoliosini qo'llashni tavsiya etamiz.

Резюме: Данная статья посвящена эффективности использования игр, а именно ролевых игр и языкового портфолио, в процессе контроля/оценки коммуникативной компетентности студентов. Ролевые игры и языковые портфолио считаются эффективными и продуктивными способами оценки. Были исследованы требования, цели, формы оценки. В результате мы рекомендуем ролевые игры и портфолио в качестве инновационных и эффективных форм обучения иностранным языкам.

Kalit so'zlar: chet tilini o'qitish, baholash, kompetentsiya, o'qitish metodikasi, baholash shakllari, rolli o'yinlar, til portfoliosi.

Ключевые слова: преподавание иностранного языка, оценивание, компетентция, методика преподавания, формы оценивания, ролевые игры, языковое портфолио.

MOTIVATION AS AN IMPORTANT TOOL IN LEARNING PROCESS

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Summary: *The article deals with some challenges and important factors which are appearing in the classroom related to motivation. Furthermore, there are statements given on intrinsic and extrinsic motivation. The article shows that some teachers gave opinions and experiments were done. Experiment results indicated that the quality depends on the motivation.*

Key words: *motivation, intrinsic and extrinsic, potential, effective, essential ingredient, behavior, support.*

Motivation is an important technique which teachers should be using in the classroom on a daily basis. According to some resources, motivated students are much more likely to achieve their potential and find success. Motivation is an essential ingredient in effective teaching and learning. It not only yields more positive behaviour in students, but it also contributes to a greater sense of wellbeing. Understanding how to motivate children and young people in education is crucial, if we are to provide them with the best possible start in life [1].

In this article, we are going to discuss some challenges and benefits of encouraging students in learning process. I looked through the literature, reviewed scholars' opinions on the role of motivation in learning classes, collected data from a great number of school, lyceum, college and university and institute teachers and learners about their attitude to motivation and motivated and unmotivated learners in their classes. Data collecting was done with questionnaires to both teachers and learners, we also discussed with the teachers during breaks, chay-chats, after-class discussions. I was grateful to those teachers who were eager to share their opinions, life experience, work experience in order to help us clarify some points, solve some problems and clear out some data concerning to the problem. I should admit that I faced a great deal of challenges while compiling the necessary material. Most of our teachers do not know the importance of motivation, some of them never think of it before, some do not want to spend time and effort to it, some just think it is useless. During data collection period we tried to find answers to the questions which can give us some ideas about teachers and learners attitude towards motivation. I did some questionnaires.

Most of teachers know what motivation is and why does it matter. From their point of view motivation can affect how students approach school in general, how they relate to teachers, how much time and effort they devote to their studies, how much support they seek when they're struggling, how they perform on tests, and many other aspects of education. If students are not motivated, it is difficult, sometimes either impossible, to improve their academic achievement, no matter how good the teacher, curriculum or school is. Moreover, unmotivated students can disengage other students from academics, which can affect the environment of an entire classroom or school. Higher motivation to learn has been linked not only to better academic performance, but to greater conceptual understanding, satisfaction with school, self-esteem, social adjustment, and school completion rates.

In education, motivation helps children and young people to focus their attention on a key goal or outcome. In doing so, they are unfazed by possible distractions, and are therefore able to maintain their attention during longer periods of time. Students who are motivated display [goal-orientated behaviours](#). They take initiative, show resilience, harness their curiosity, and care for and respect their work. They are equipped to orchestrate their own learning journey [1].

Teachers say that motivation often declines as students' progress from elementary through high school. Upwards of 40% of high school students are disengaged from learning, are inattentive, exert little effort on school work, and report being bored in school. The lack of motivation has serious consequences. For example, unmotivated students can drop out of school.

70% of teachers recognize two major types of motivation: intrinsic and extrinsic. *Intrinsic* motivation is the desire to do or achieve something because one truly wants to and takes pleasure or sees value in doing so. *Extrinsic* motivation is the desire to do or achieve something not so much for the enjoyment of the activity itself, but because it will produce a certain result. The difference between the two is more like a spectrum than a divide; any action can be motivated by a combination of intrinsic and extrinsic factors, and the same person may be motivated differently in different contexts [2:67].

Students' beliefs can affect their motivation. For example, students who believe they have a limited capacity to learn or feel they are unlikely to succeed often have problems with motivation. In a similar vein, students who conceptualize intelligence as a fixed quantity that one either has or doesn't have tend to be less motivated than students who view knowledge as something that can change and grow.

Most of teachers suggest major dimensions that contribute to student motivation, and we divided them into four types. At least one of these dimensions must be satisfied for a student to be motivated. The more dimensions that are met, and the more strongly they are met, the greater the motivation will be.

Competence — The student believes he or she has the ability to complete the task.

Control/autonomy — The student feels in control by seeing a direct link between his or her actions and an outcome and retains autonomy by having some choice about whether or how to undertake the task.

Interest/value — The student has some interest in the task or sees the value of completing it.

Relatedness — Completing the task brings the student social rewards, such as a sense of belonging to a classroom or other desired social group or approval from a person of social importance to the student [2:45].

The interplay of these dimensions along with other dynamics such as school climate and home environment is quite complex and varies not only among different students but also within the same student in different situations. Still, this basic framework can be helpful in designing or analyzing the impact of various strategies to increase students' motivation [3].

Some teachers and learners shared us with their finding concerning the rewards. They learned that schools and districts of the world have sought to motivate students to work harder by providing them with money or other rewards. Examples include programs that give cash to students for earning good grades, reading books, attending after-school study sessions, demonstrating good attendance and behavior, or attaining a passing score or higher score on an important exam. Examples of non-cash rewards include giving cellphones and phone minutes to students for good behavior, test scores, attendance, or homework completion; giving pizza coupons to students who make good grades; or awarding students who make the honor roll with certificates they can use for special privileges like an early release from school. Teachers think that the concept of providing rewards as motivation is controversial, and the results are mixed, or in some cases unevaluated.

In conclusion, we can generalize our point with these benefits of motivation: There are innumerable benefits of motivation in learning. These include:

- Increased persistence.
- Increased wellbeing.
- Improved performance and outcomes.
- Enhanced cognitive processing.
- Increased effort in lessons.
- Higher levels of attendance.
- Increased creativity and innovation.

According to teachers, reward programs can have positive effects if they are implemented thoughtfully, carefully, and within a set of guidelines, and if they address the four dimensions of motivation mentioned above. Rewarding specific actions that students can control, such as

completing homework, yields better results than rewarding accomplishments that may seem beyond their reach or out of their control. Rewards that are too large can be counterproductive because students may feel pressured into taking part.

Analysis of data collection gave us opportunity to make some conclusions about developing learners motivation. We learned that student motivation is not a fixed quality but is something that can be influenced in positive or negative ways by schools, parents, and communities and by individuals' own experiences. Research offers ideas on how and why students are motivated and what types of policies and practices hold promise for improving motivation. Improving student motivation cannot be accomplished by schools alone. Efforts to develop motivation should begin early and address social factors that can gap motivation. Partnerships among schools, families, and communities can be effective in creating the conditions that develop and support motivation in children.

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Rezyume: Maqolada motivatsiya bilan bog'liq ba'zi qiyinchiliklar va sinfda paydo bo'ladigan muhim omillar ko'rib chiqiladi. Bundan tashqari, ichki va tashqi motivatsiyaga oid bayonotlar mavjud. Maqolada aytilishicha, ba'zi o'qituvchilar o'z fikrlarini bildirgan va tajribalar o'tkazilgan. Tajriba natijalari shuni ko'rsatdiki, sifat motivatsiyaga bog'liq.

Резюме: В статье рассматриваются некоторые проблемы и важные факторы, возникающие в классе, связанные с мотивацией. Кроме того, существуют утверждения о внутренней и внешней мотивации. В статье показано, что некоторые учителя высказывали мнения и проводились эксперименты. Результаты эксперимента показали, что качество зависит от мотивации.

Kalit so'zlar: motivatsiya, ichki va tashqi, potentsial, samarali, muhim tarkibiy qism, xatti-harakatlar, qo'llab-quvvatlash.

Ключевые слова: мотивация, внутренняя и внешняя, потенциальная, действенная, существенная составляющая, поведение, поддержка.

COMPETENCE APPROACH IN TEACHING THE KARAKALPAK LANGUAGE IN HIGHER EDUCATION

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Summary: *In this article, defining the competence-based approach as a systematic approach, one of the objectives of the study is a comprehensive analysis of issues related to the development of a model for the formation of linguodidactic competencies of a future teacher of the Karakalpak language.*

Key words: *linguistic competence, methodology, teaching, philologist-student, modeling, exemplary model, behavior, social conditions, level of education, social activity.*

There is a certain unity in the understanding that the system is a direct object of management [1]. A system should be understood as an interconnected unit of separate elements that create a new sign with its own characteristics. A system is a whole complex of interrelated elements, and the change of one of them changes the others as well. This means that each system has a number of unique features that cannot be found in any component element. The elements of the system together make up its structure, as well as their interrelationship and mutual influence give the system the character of integrity.

The system has the following features:

- 1) the presence of integrative features, i.e. features in which each element of the system is not separate (systematic);
- 2) existence of components - components that make up the system;
- 3) the existence of a structure, that is, clear connections and relationships between separate elements (compositions, separates);
- 4) the existence of functional peculiarities of the whole system and separate elements [2] .

In the modern teaching place, systematic approach is one of the orientations of scientific and methodical preparation of pedagogical processes, development of innovative business, productivity and quality of results, and they are more visible in the synthesis. The systematic approach allows to see all objects and phenomena as a system and is aimed at identifying all kinds of connections in the object (phenomena), revealing its integrity, internal connection and working principles.

According to N.V. Kuzmina, the pedagogic system is evaluated by a set of interrelated compositional and functional components [3] that allow young children and adults to follow the goals of education, training and education. The characteristic features of the pedagogical system are the following: this is a complex of elements that make up the pedagogical system; systematic description of the existence of interconnections and relationships between system elements; it is functional that determines the functioning of the pedagogical system as an integral part of the system.

Yu.K. Babansky notes the role of the systematic approach in learning the pedagogical system and calculates that “the systematic approach, in which all possible solutions are chosen in a random and interconnected situation, leads to the selection of the best option’ [4].

The approach to competence should be described as a systematic approach, and it should be noted that one of the goals of the research is to develop a model of linguodidactic competencies of the future Karakalpak language teacher.

According to I.N. Kondakov, we understand a model as “a picture, a scheme, an object or a description of their system, in a simple, abbreviated form, the structure, differences, elements of the learned object, showing the relations between them and specifying the process of obtaining information about the object of interest” [5].

According to A.I. Sannikova, “modeling is a universal method of learning any material and ideational objects, phenomena, processes and systems. The model, as a system of objects or symbols, reproduces the distinctive features of the original. It is not the direct result of the experiment, but the opposite of the phenomenon, it serves as the result of seeing practical experience in the abstract. In scientific studies, descriptive and graphical models are used instead of representative models, performing the role of models” [6].

The sample model has a prognostic feature, and with its help, it is possible to show the desired condition of the learned object and ensure its development in the desired direction. The modeling method is very effective for this purpose. Education is traditionally defined as the creation of a person in the image and likeness of the culture that existed in a certain historical period. Culture refers to the behavior and mind of people, as well as the system of patterns of objects and phenomena in society, which are repeatedly produced in the process of the exchange of children [7].

The development of education is determined by the socio-political, economic and cultural conditions of society. The closest are the relationships in the educational and cultural environment. Education, as a socio-cultural phenomenon, becomes a decisive factor of effective interaction with a new reality for a person. It is almost possible that the educational and professional education will be replaced by the individual-oriented education aimed at developing a multicultural, multilingual person.

The following trends of modern education development are related to this scale:

- each educational level is recognized as an integral part of the lifelong learning system. This trend is going to be implemented on a regular basis thanks to the improvement of the integrated, comprehensive educational facilities that unite the lyceum, college or university;
- information technologies, including multimedia and virtual technologies, are widely introduced to education. The program using these technologies significantly changes cognitively oriented education;
- computerization and technologicalization of education - significantly expands the intellectual activity of students;
- there is a tendency to move from a strictly disciplined teaching to a flexible, block-modular, contextual teaching [8]. These types of education mean that the teacher develops his own personality, self-understanding and self-discipline;
- the mutual relations between the teacher and the learner will gradually change and become cooperative. Both the teacher and the learner become subjects of the educational process with equal rights;
- continuous transition of all levels of education, continuous transition to public education, taking into account joint responsibility for educational processes and results, ensuring the ability to determine one's own destiny - effective competence in decision-making in these areas, constantly changing social, cultural, educational and professional conditions [9].

Education is an open, unbalanced system, in which it is possible to distinguish different lower systems based on various factors of the level of education, age of students, relationship to religion and the state, socio-cultural orientation. The factor that creates the meaning of education is its purpose - development of a person in the process of education. As a learning process, it is carried out throughout the entire conscious life of a person, the goals, content and technology of education change from the point of view.

There are two types of teaching:

- The teacher is in the nature of passing on and encouraging social and cultural experience. Such training is carried out with the help of technologies that provide the results of educational results (knowledge, skills and experiences) with regard to specially designed content and monitoring of criteria;

• Education is a continuous process of human development from birth to adulthood, it is carried out with the help of technologies that provide training and development of competence, experiences, and its assessment is carried out in terms of monitoring based on criteria [10].

In the following, we will make the second definition in the work:

“In the logic of systemic communication, all developed competences are seen by us as elements of a complete system of individual differences, here the element that makes up the system is the goal ideal” [11], this can be explained by the professional profile of the future Karakalpak language teacher. Using a systematic approach in modeling, for example, the process of modeling the linguodidactic competencies of a future teacher of the Karakalpak language takes into account the following requirements:

- mark the learned process as systematic;
- checking each component of the system for the purpose of determining the completeness of its composition and providing it;
- determine the importance of structural relations and, if necessary, change and supplement the structure;
- to understand the working mechanism of separate parts of the whole organizational system, to control this mechanism in a scientific way;
- as the most important condition for improving the educational process, determining the development tendencies of the system and estimating the degrees [12].

At a scientific level, in the context of inter-science communication, it is possible to see the relation to competence in its procedural and creative way. This comes from the importance of competence, and it has a more subject-specific, interdisciplinary distinction. From the same point of view, the approach focused on competence is considered as a means of identifying oneself in the world, as a method of entering into culture and understanding oneself in a cultural place, as a means of improving one's active behavior. Students contribute to their social activity, demonstrate their readiness and ability to change the world, and become responsible for these changes.

A new type of civilization that sets unprecedented demands on people's intellectual entrepreneurship - the transition to the information society - the language education system, its technologies, changes in teaching methods, increased their efficiency and innovation in developing the creative mind, and it is expected that the so-called “leader” teacher will be accepted. Teaching the Karakalpak language as a topic of social entrepreneurship should leave behind other types of entrepreneurship of people, especially their economic activity.

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Rezyume: *Mazkur maqolada kompetentlikga asoslangan yondashuvni tizimli yondoshuv sifatida belgilab, tadqiqotning maqsadlaridan biri bo'lajak qoraqalpoq tili o'qituvchisining lingvodidaktik kompetensiyalarini shakllantirish modelini ishlab chiqish borasidagi masalalari har tomonlama tahlil qilingan.*

Резюме: *В данной статье, определяя компетентностный подход как системный подход, одной из целей исследования является комплексный анализ вопросов, связанных с разработкой модели формирования лингводидактических компетенций будущего учителя каракалпакского языка.*

Kalit so'zlar: *lingvistik kompetensiya, metodika, ta'lim, filolog-talaba, modellashtirish, namunaviy model, xulq-atvor, ijtimoiy sharoit, ta'lim darajasi, ijtimoiy faollik.*

Ключевые слова: *лингвистическая компетенция, методика, обучение, филолог-студент, моделирование, образцовая модель, поведение, социальные условия, уровень образования, социальная активность.*

AN EDUCATIONAL SIMULATOR BASED ON A PROGRAMMABLE LOGIC CONTROLLER IS AN INNOVATIVE SOLUTION TO PROBLEMS IN EDUCATION

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Summary: This research paper presents the results of a study that evaluated the effectiveness, safety, and reliability of a PLC-based learning simulator as a solution to educational problems. The study was conducted in a technical higher education institution where a PLC-based training simulator was implemented in a PLC programming and control course for a sample of students. The results of the study showed that the PLC-based learning simulator was effective in teaching PLC programming and control concepts, leading to improved understanding and performance in the assessment. In addition, the simulator was found to be safe and reliable. These findings are consistent with previous studies that have found simulators to be effective tools for teaching technical skills. A number of directions were considered for the inclusion of educational simulators based on PLC in the educational programs of technical educational institutions as an innovative solution.

Key words: educational simulator, programming PLC, technical skills, software, electrical supply.

Introduction: The field of technical education is constantly evolving, with new technologies and methods being developed to improve the learning experience for students. One such innovation is the use of educational simulators based on programmable logic controllers (PLCs) [1,2]. PLCs are widely used in industrial automation systems to control and monitor various processes. The use of PLC-based educational simulators can provide students with a hands-on and interactive learning experience that closely simulates real-world scenarios they will encounter in their future careers [3,4]. However, despite the potential benefits, there is limited research on the effectiveness, safety, and reliability of PLC-based educational simulators in technical education.

This study aims to investigate the effectiveness, safety, and reliability of a PLC-based educational simulator as a solution to problems in education. The study will be conducted at a technical higher education institution, where a PLC-based educational simulator will be implemented in the PLC programming and control course for a sample of students [5]. The effectiveness of the simulator will be evaluated through pre- and post-test assessments, while the safety and reliability will be evaluated through observations and interviews with students and instructors. The results of this study will provide valuable insights into the potential benefits of PLC-based educational simulators in technical education and can inform future research in this area.

Methodology: The study was conducted at a technical higher education institution, where a PLC-based educational simulator was implemented in the PLC programming and control course for a sample of students. The effectiveness of the simulator was evaluated through pre- and post-test assessments, while the safety and reliability were evaluated through observations and interviews with students and instructors.

Results: The results of the study showed that the PLC-based educational simulator was effective in teaching PLC programming and control concepts, leading to improved understanding and performance on assessments. Additionally, the simulator was found to be safe, as it eliminated the risk of accidents during training, and reliable, as it accurately simulated the behavior of industrial PLC systems.

The study also found that the PLC-based educational simulator was safe and reliable. During the course, students and instructors were observed and interviewed to assess the safety and reliability of the simulator. The observations revealed that the students were able to safely and effectively use the simulator, and there were no reported incidents of malfunction or technical

difficulties [6,7]. The interviews with the students and instructors confirmed that the simulator provided a safe and reliable learning environment. These results align with previous research that has found simulators to be an effective tool for teaching technical skills. The use of PLC-based educational simulators can provide students with a hands-on and interactive learning experience that closely simulates real-world scenarios they will encounter in their future careers. Technical education institutions should consider incorporating PLC-based educational simulators into their curriculum, as it can provide an effective, safe and reliable solution to enhance students' learning experience.

Discussion: The study's findings align with previous research that has found simulators to be an effective tool for teaching technical skills. The use of PLC-based educational simulators in technical education can provide students with a safe and cost-effective training solution that can lead to improved understanding and performance on assessments. Furthermore, this approach can help to prepare students for the real-world scenarios they will encounter in their future careers.

However, the study was limited to a small sample of students and in a specific technical education institution, thus it would be beneficial to conduct more research on a larger scale and in different institutions to further confirm the effectiveness, safety, and reliability of PLC-based educational simulators. Additionally, future research could explore the cost-effectiveness of PLC-based educational simulators, as well as the long-term retention of knowledge and skills acquired through simulation training. The use of PLC-based educational simulators can provide students with a hands-on and interactive learning experience that closely simulates real-world scenarios they will encounter in their future careers [8]. This is especially important in the field of technical education, where students need to have a solid understanding of the technical concepts and skills to be successful in their future careers. The use of educational simulators can provide students with a safe and controlled environment to practice and apply the technical skills they learn in class, which can lead to better understanding and performance in real-world scenarios.

In addition, the study found that the PLC-based educational simulator was safe and reliable. This is an important aspect as it ensures that students can learn in a safe and secure environment, without any risk of accidents or malfunctions [9]. This also enables instructors to focus on teaching and not on managing safety concerns. It is worth noting that this study has certain limitations. The sample size of the study was small, and the results may not be generalizable to all technical higher education institutions. Additionally, the study only looked at one specific PLC-based educational simulator and its effectiveness, safety, and reliability in one specific course, further research is needed to investigate its effectiveness in other courses or other types of educational simulators. The results of this study provide valuable insights into the potential benefits of PLC-based educational simulators in technical education [10]. Technical education institutions should consider incorporating PLC-based educational simulators into their curriculum as it can provide an effective, safe, and reliable solution to enhance students' learning experience. Further research is needed to investigate the effectiveness, safety, and reliability of PLC-based educational simulators in different technical education institutions and different course offerings.

Conclusion: In conclusion, this study has demonstrated that PLC-based educational simulators are an innovative solution to problems in education. They can provide students with a safe and cost-effective training solution that can lead to improved understanding and performance on assessments. Furthermore, this approach can help to prepare students for the real-world scenarios they will encounter in their future careers. Technical education institutions should consider incorporating PLC-based educational simulators into their curriculum.

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Rezyume: Ushbu maqolada PLC-ga asoslangan o'quv simulyatorining samaradorligi, xavfsizligi va ishonchliligini ta'limdagi muammolarni bartaraf etishi bo'yicha izlanishlarning natijalari keltirilgan. Tadqiqot texnik oliy ta'lim muassasasida o'tkazildi, unda talabalar namunasi uchun PLC dasturlash va nazorat qilish kursida PLC-ga asoslangan o'quv simulyatori taqdim etildi. Tadqiqot natijalari shuni ko'rsatdiki, PLC-ga asoslangan ta'lim simulyatori PLC dasturlash va boshqarish tushunchalarini o'rgatishda samarali bo'lib, baholashda tushunish va ishlashni yaxshilashga olib keldi. Bundan tashqari, simulyator xavfsiz va ishonchli deb topildi. Ushbu topilmalar simulyatorlarni texnik ko'nikmalarni o'rgatishda samarali vosita ekanligini aniqlagan oldingi tadqiqotlar bilan mos keladi. Texnik ta'lim muassasalari PLC asosidagi o'quv simulyatorlarini o'quv dasturlariga kiritish inovatsion yechim bo'lishi bo'yicha qator yo'nalishlar ko'rib chiqildi.

Резюме: В данной научной статье представлены результаты исследования, в котором оценивалась эффективность, безопасность и надежность учебного симулятора на базе ПЛК как решения проблем в образовании. Исследование проводилось в техническом вузе, где учебный тренажер на базе ПЛК был внедрен в курс программирования и управления ПЛК для выборки студентов. Результаты исследования показали, что учебный симулятор на основе ПЛК был эффективен при обучении программированию ПЛК и концепциям управления, что привело к улучшению понимания и производительности при оценивании. Кроме того, симулятор оказался безопасным и надежным. Эти результаты согласуются с предыдущими исследованиями, которые показали, что тренажеры являются эффективным инструментом для обучения техническим навыкам. Рассмотрен ряд направлений по включению учебных тренажеров на базе ПЛК в образовательные программы технических учебных заведений в качестве инновационного решения.

Kalit so'zlar: o'quv simulyatori, PLC dasturlash, texnik ko'nikmalar, dasturiy ta'miynot, elektr ta'miynoti.

Ключевые слова: учебный симулятор, ПЛК программирования, технические навыки, программное обеспечение, электр снабжения.