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Content

Architecture

Arts

Biological sciences

Economic sciences

Geographical sciences

Geological and mineralogical sciences

Pedagogical sciences

Philological sciences

Technical sciences

Architecture

PEDESTRIAN AND WALKING SPACES AND THEIR FORMATION IN THE EXISTING STRUCTURE OF THE CITY

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Abstract

In this article, pedestrian spaces of embankments, boulevards, streets of the central part of the city are considered from the perspective of architectural and planning principles and compositional techniques used in their formation. Variants of the organization of pedestrian streets in residential buildings have been studied. The reasons for the design that negatively and positively affect the creation of pedestrian spaces have been identified.

Keywords: pedestrian spaces, pedestrian streets, traffic, transport, pedestrian networks

The main part

One of the incentives for the organization of a pedestrian street is the assumption that its arrangement will contribute to solving transport problems. Practice shows that this happens in the following cases: either when the timetable for the passage of transport along a pedestrian street is strictly observed, or when transport and pedestrian flows move without intersecting at different levels or in parallel. Devices for spatial regulation can be mobile, transformable and stationary fences (gates, barriers, bollards, chains, etc.).

If a pedestrian street is organized in a residential building, local residents will have to put up with crowds of tourists walking under their windows almost around the clock, and develop a system for protecting private spaces. Entrepreneurs will have to reorient their services from motorist buyers to pedestrian buyers, change the assortment and terms of delivery of goods after the construction of a pedestrian street. Motorists will have to develop new routes, look for other parking places for their vehicles[1,2].

The creation of pedestrian streets can simultaneously reduce the number of conflict situations between traffic and pedestrian flows and contribute to environmental measures, such as landscaping, reduce noise and air pollution. When a street acquires pedestrian status, there is a significant (about 75%) decrease in the "concentration of carbon dioxide and other gases. However, the organization of pedestrian streets entails an increase in traffic intensity on adjacent streets and deterioration of road conditions on them. Accordingly, the level of traffic noise and gas pollution on adjacent streets increases without taking special measures.

Therefore, when a street turns into a pedestrian one, it is important to provide a solution in which the nearby territories would not have inherited its problems.

It is not always advisable to convert streets into pedestrian ones. There are situations when, taking into account the requirements of business activity, it is wiser to maintain high automobile accessibility to individual objects (office buildings, banks, shops selling large-sized goods, etc.). In the city center, there is a need to re-equip parallel streets on both sides to accept additional load. For example, despite the ardent desire of the city authorities of the city of Herzliya to make one of the central streets pedestrian, the site commissioned this year still includes a small fountain pen in the middle - neighboring streets were unable to absorb the fully increased traffic flow and provide reliable infrastructure connection for the new project[1,2].

The costs of converting a street into a pedestrian one depend on local conditions and must be carefully calculated. The main financial expenses are related to the installation of new paving, installation of road signs, plastic. Processing of the relief and works on landscaping, lighting and decorative design.

Pedestrian streets are usually paved with stone or materials replacing it. The coating must be durable, environmentally and functionally safe, comfortable, resistant to mechanical and atmospheric influences, aesthetically attractive.

Decorative elements of landscaping are used to enhance the artistic expressiveness of pedestrian streets. The introduction of urban furniture and equipment, objects of monumental and decorative art, decorative landscaping, water devices and decorative lighting allows you to aesthetically enrich the space, create compositional accents, give individuality to the street appearance [3].

The creation of a pedestrian street requires a thoughtful approach from the authorities and designers, a search for options taking into account the requirements of all stakeholders, a very careful attitude to historical truth, a competition with careful expertise and economic calculation of the proposed design solutions [2].

Materials and methods

The methodology for obtaining high-quality pedestrian spaces is unique and consists of three consecutive stages:

The first stage is a comprehensive analysis of the current state of pedestrian spaces. At this stage, a group of surveys is conducted and the parameters and characteristics of all components of the environment are determined, among the identified parameters, "conflict points of transition spaces" are determined (discrepancy: improvement systems - ongoing social processes; main pedestrian flows - the purpose of the communication element; network components - the purpose and scale of the element);

At the second stage, methods (design, reconstruction, and optimization) and direction (landscape framework, network components) of project activity are determined. In accordance with the architectural and planning principles of pedestrian space design (the principle of "complexity", the principle of "multifunctionality" and the principle of "sustainability"), a complex transformation of a specific element of the network is carried out;

The third stage - in accordance with the identified principles (the "network" principle, the "living environment" principle), after the implementation of the main measures to transform pedestrian spaces, an obligatory stage of analysis of the operation of this element by residents follows, on the basis of which new "conflict points of pedestrian spaces are determined and the design cycle repeats[4].

In a city with an already existing history, there is inevitably a need to update significant areas of the territory of the existing development [5]. This is due to the moral and physical deterioration of buildings, changes in urban planning tasks and requires, as a rule, significant investments. Their sizes depend on the correct definition of new functional, planning and architectural solutions for future development, which is important both from the point of view of the quality of the urban environment and increasing the economic potential of the city. Thus, conceptual projects for the prospective use of the territory can be considered as a tool for architectural and urban-construction forecasting, analysis of problem areas of the city and identification of relevant areas for investment. The main task of the conceptual project is to find an original solution that can bring a new quality to the formation of the urban environment and guarantee the high efficiency of the investment project[5].

Results

Being a multifunctional environment, the city promotes a closer and more concentrated process of communication between people and various systems. Walking is often the simplest and most natural means of transportation in the center of the cities considered for a person, since the structure of the center is more compact, and all its objects are "within walking distance. The pedestrian framework of the city center is a system of mostly linear or branched pedestrian spaces, less often compact. The analysis of pedestrian spaces of the city today should be given special attention for a number of reasons [6,7].

Firstly, it is the process of spontaneous motorization, which has a negative impact on open pedestrian spaces and entailed the problem of antagonism between transport and pedestrians. A negative factor is also the deterioration of the environmental situation, which has a direct impact on pedestrians, since most of the pedestrian path in the city center runs along transport systems [8]. Due to the high level of motorization, the concept of, for example, an open linear pedestrian space in most cases today has been reduced to the concept of a sidewalk, which has become perceived as an appendix to the highway. Priorities in cities have shifted in the wrong direction, since the formation of the existing environment takes into account the interests of a secondary participant (car) of the communication process, and not the main one (pedestrian).

Recently, the question of the safety of pedestrian spaces has been increasingly raised, since with an increase in the level of motorization, the risk to the lives of pedestrians has increased, which indicates the absence of necessary landscaping of pedestrian spaces that can ensure safe human movement [9].

Secondly, the growth and development of cities require a more responsible approach to the formation of pedestrian spaces, as the needs of its population grow along with the city. Of course, in the centers of the cities considered today there is a tendency to create and reconstruct pedestrian spaces, however, not all examples can be called successful. Most pedestrian spaces of cities remain unattractive and are often unable to meet the needs of residents of a modern metropolis. Often, pedestrians on a whim can only be guided by the criterion of "pass ability" and elementary convenience.

Thirdly, the question of the development of the sports function of open urban pedestrian spaces has long been raised, in particular, the development of cycling, for which a separate territory must be allocated in open pedestrian spaces. It follows from this that the existing communication system needs to be reviewed.

Fourth, open pedestrian spaces, in addition to connecting important urban sites, are themselves objects of historical and cultural heritage and should be adapted for a tourist function. As you know, pedestrian spaces play an important role in shaping the "face" and image of the city.

Conclusion

These and other factors confirm the need for the most thorough study of pedestrian spaces in the centers of large cities and their problems, reassessment of their importance taking into account the past experience, which shows that the potential of pedestrian spaces can be used many times more effectively, simultaneously solving transport and environmental problems of the city[10].

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Arts

PRACTICAL METHOD - AS A MEANS OF REALIZING THE CREATIVE POTENTIAL OF THE STUDENT

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ПРАКТИЧЕСКИЙ МЕТОД – КАК СРЕДСТВО РЕАЛИЗАЦИИ ТВОРЧЕСКОГО ПОТЕНЦИАЛА ОБУЧАЮЩЕГОСЯ

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Abstract

This article is generalized in nature, most likely, it will be a starting point for further research on the way of formation and development of such qualities in trained musicians as: mobility, sense of musical taste, intonation, musical punctuation, expanded horizons. An important feature is the disclosure of the concept of "Public speaking", the identification of the accompanying qualities of the teacher and the student, as well as an algorithm and a clear vision of the final goals in working on a creative project.

Аннотация

Данная статья несёт обобщенный характер, скорее всего, явится отправной точкой для дальнейших исследований на пути формирования и развития у обучающихся музыкантов таких качеств как: мобильность, чувство музыкального вкуса, интонация, музыкальная пунктуация, расширенный кругозор. Важной особенностью служит раскрытие понятия «Публичное выступление», выявление сопутствующих качеств преподавателя и обучающегося, а также, алгоритм и четкое видение конечных целей в работе над творческим проектом.

Keywords: methodology, public speaking, teacher, personality.
Ключевые слова: методология, публичное выступление, педагог, личность.

Тенденции современного музыкального мира, впрочем, как и всего в целом, имеют стремительное развитие. В период глобализации и развития новых информационных, технических, политических сфер деятельности, музыкальный прогресс параллельно двигается вперёд.

Что такое сфера музыкального прогресса? Своеобразное направление каждого десятилетия, которое двигается и развивается, так или иначе, приходит как минимум к одной из выбранных целей. Очень часто это выражение у многих ассоциируется с уже известным термином как модерн или модернизм. Модернизация прочно устоявшихся норм, сводов и канонов, либо создание новой, инновационной базы.

По мнению одного известного американского дирижера, музыковеда и музыкально-общественного деятеля, Леона Ботштейна (англ. Leon Botstein), можно отметить следующее: «Модернизм в музыке характеризуется повышенной восприимчивостью к прогрессу в области современной культуры, науки, и техники, а также позитивистскими взглядами на урбанизацию и многие явления массовой культуры» [1].

Сфера музыкального прогресса представляет собой не только созидание нового инвентаря для солиста-исполнителя, она так же представляет собой концептуально новые сочинения зачастую не известные и не исполняемые, что в свою очередь требует совершенно иного осмысления и нового подхода, как на стадии изучения музыкального материала, так и при его воспроизведении. Важно учитывать, что для изучения чего-то нового, нужно иметь прочную базу знаний.

Развитие у обучающегося (ученика, студента) интереса к своему ремеслу, к поиску «новых звучаний», выбору современных произведений и преодолению представляемых сложностей в выбранной специальности зачастую зависит от профессиональных навыков и компетенций педагога.

Педагогический оптимизм – одно из необходимых качеств успешного учителя, потому как благодаря мотивации педагога, обучающийся, находит интерес в изучении «нового». Существует один известный афоризм, который, по мнению многих педагогов-мастеров должен стать девизом каждого учителя: «Ученик – не сосуд, который надо заполнить, а факел, который нужно зажечь». Учитывая это, следует сказать, что для обучающегося отправной точкой послужат: личный пример, знания и психоэмоциональное наполнение преподавателя. В свою очередь, у педагога в арсенале должно быть немало методов, для того что бы взрастить из студента – «личность».

В сложившейся практике числа многих стран СНГ, методы в обучении принято делить в трех направлениях:

- Метод организации. (Осуществление учебно-познавательной деятельности);
- Метод контроля. (Эффективность учебно-познавательной деятельности);
- Метод стимулирования;

Стоить отметить то, что каждый из методов дополняет друг друга, т.к. последствия одного метода зачастую находятся в основании другого (следующего) метода.

Метод организации направленный на развитие профессиональных качеств у обучающегося, можно разделить на три подкатегории:

- Словесный – (беседа, лекция, объяснение и т.д.);
- Наглядный – (проект, схема, показ, демонстрация);
- Практический – (упражнение, решение поставленных задач, практика).

Применяя данный метод как показательный, стоит отметить, что чаще всего именно он является наиболее востребованным в творческой среде, в процессе развития и формирования навыков, например у дирижера-хоровика.

Публичное выступление – как один из видов практического метода и его кульминационная «вершина», оно не только организует самостоятельную работу обучающегося, но и является самой действенной мотивацией для развития музыканта как исполнителя, и именно отсюда возникает и взаимосвязь всех трех методов.

Приоритетом для педагога служит подготовка творческой и культурно-просветительской работы с каждым обучающимся так, чтобы у второго сформировалось желание, стимул для занятий, а конечной точкой следования стала «сцена», подготовка к всевозможным выступлениям, конкурсам как международным, так и локально-организованным.

Публичное выступление и его масштабы, как правило, не ограничены. Сюда можно отнести: открытый урок, мастер-класс, отчетный концерт, конкурс. Наблюдая и анализируя за становлением образования и формированием музыкантов как личностей, можно отметить то, что 80% задействованных учеников впоследствии становятся более успешными. Как и в любом другом творческом процессе, главное, чтобы обучающиеся получали удовольствие и результативность от своего труда и исполнения.

Одним из практических приемов для достижения наилучшего качества и сценической стабильности в каждом учащемся служит совместное подготовка и их участие в концертах со старшими студентами, магистрантами или же самим педагогом.

Концерт – это в первую очередь праздник. Почему праздник? Потому что в центре всего события внимание сосредотачивается на обучающемся. Это совокупность разнообразных чувств и эмоций, своего рода «вызов» для обучающегося; это публика, которая оценит, которая повлечет своей реакцией либо критику, либо восторг, а следовательно некий контроль. Но, главным и кульминационным событием являются – аплодисменты, это «награда», и именно эти положительные эмоции укрепляют фундамент успешности будущего исполнителя, они являются стимуляцией для последующих действий.

Приведенные мотивационные перспективы тесно связаны между собой и призваны воспитывать, и формировать у обучающегося понятие «предназначение музыканта», «предназначение исполнителя», или же понятие о «музыканте-личности». Это значит что помимо личностного роста в музыкальном развитии, обучающийся обязан развиваться всесторонне, так как современные тенденции требуют большего рвения и отдачи. Культура несется в массы, следовательно, искусство важно для зрителя. Учитывая данный факт, каждый исполнитель будет ощущать себя частью большого механизма, будет развиваться чувство «локтя», а также чувство подлинной радости и выполненного долга в совместном действии с товарищами по сцене.

Перспективы данного развития несут собой следующие качества: поднятая самооценка, инициативность из которой вытекает мобильность, эстетические взгляды, формирующие музыкальные предпочтения, общий кругозор, интерес к познанию своевременных тенденций в обучении и созидании концептуально новых идей.

Подводя итоги, следует в очередной раз подчеркнуть – роль педагога в формировании личности будущего музыканта-исполнителя – велика. Посредством навыков и методов, которыми руководствуется педагог, напрямую будет зависеть будущее студента и то, кем он захочет и может стать впоследствии, а это значит, что и сам педагог обязан обладать этими качествами и быть в постоянном поиске абсолютно новых реалий.

Мастерство педагога будет заключаться в следующем: максимально развить потенциал «новоиспеченного» студента не утратив индивидуальности второго.

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Biological sciences

RESPIRATORY REACTIONS DURING ACTIVATION AND BLOCKADE OF $GABA_B$-RECEPTORS IN THE RETROTRAPEZOID NUCLEUS OF RATS

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Introduction

The central mechanism of respiratory regulation is represented by a complex system of local respiratory neural networks, among which several populations of brainstem respiratory neurons play the main role. In recent years, the physiologists and clinicians' attention has been attracted to the local respiratory neural network of the retrotrapezoid nucleus (RTN). RTN is considered to be the main chemosensitive zone of the ventrolateral region of the brainstem, which determines the parameters of inspiration and active exhalation [1]. In addition, RTN has a modulating effect on the respiratory rhythm generator [2]. RTN neurons are identified by a unique set of markers, such as glutamate transporter VGLUT2, transcription factor Phox2b, receptors to substance P and potassium channel TASK-2 [3], which determine the physiological role of this nucleus in respiratory control. In RTN lesions, severe and even fatal respiratory disorders are possible. For example, Phox2b gene mutation of RTN neurons causes hypoventilation and weakens the body's ventilatory response to hypercapnia [4].

The important role of the RTN in respiratory regulation is explained not only by the neurochemical profile of its neurons, but also by multiple connections with other parts of the respiratory neural network. It was found that RTN neurons have excitatory projections to the rostral and caudal parts of the ventral respiratory group, the pontine respiratory group, and the Botzinger and pre-Botzinger complexes [5], which are responsible for respiratory rhythmogenesis. RTN synaptic contacts mediate its effects on rhythm and respiratory pattern regulation processes through a variety of multiple neurotransmitters, including GABA [6], glutamate [7], serotonin [8], ATP [1], etc. Currently, the receptor mechanisms of the involvement of inhibitory neuroactive amino acids, in particular GABA, in the formation of respiratory responses at the RTN level remain insufficiently understood. In the previous works devoted to this problem, the interest of researchers was focused on the participation of ionotropic $GABA_A$-receptors RTN in respiratory control, and in conditions of hypercapnia [6, 9]. The contribution of metabotropic $GABA_A$-receptors was not studied.

The purpose of this study is to investigate the role of $GABA_B$-receptors of the RTN region in the regulation of respiration in rats breathing atmospheric air of normal composition.

Materials and Methods

Acute experiments were performed on adult non-pedigreed rats weighing 180-250 g anesthetized with urethane (1.6 mg/kg, intraperitoneally). The study was conducted in compliance with the rules of bioethics in accordance with the Community Council Directive 2010/63/EEC and the recommendations of the Samara University Ethics Committee. In the experimental series, external respiration was recorded in rats before and after microinjections into RTN of 200 nl solution of the $GABA_B$-receptor agonist baclofen (n=8) and the $GABA_B$-receptor antagonist 2-hydroxysaclofen (n=7). Injections were made with solutions of 10^{-4} M concentration through a glass microcannula (tip

diameter 50 μm) inserted into the RTN through a trepanation hole in the skull according to stereotactic coordinates [10]. In the control group (n=6), artificial cerebrospinal fluid was injected into the RTN.

Respiratory reactions were assessed by the pattern of external respiration, which was recorded using a miniature spirograph connected to the animal through a tracheostomy tube. Spirograms were used to determine duration of inspiration (Ti, s) and expiration (Te, s), tidal volume (Vt, ml). Respiratory frequency (f, min^{-1}), volumetric inspiratory rate (Vi, ml/s), and minute lung ventilation (V, ml/min) were calculated. The spirogram was recorded continuously at baseline and for 60 minutes after microinjection.

Statistical analysis of the results was performed using Shapiro-Wilk test, paired t-test, and One Way ANOVA. Experimental data were compared with controls and/or with baseline. Results were presented as M ± SEM. Changes at $p<0.05$ were considered statistically significant.

Results and Discussion

Activation of metabotropic GABA receptor RTN caused a slight depression of respiration in rats. At the same time, less consistent regular effects were noted in the dynamics of spirogram frequency parameters. Thus, an increase in Ti and Te was observed at different times after microinjection of the $GABA_B$-receptor agonist baclofen into RTN. The respiratory frequency decreased insignificantly between 1 and 60 minutes of spirogram recording (Fig. 1 A).

Volumetric respiratory parameters, in contrast to frequency parameters, more consistently reflected the inhibitory effect of baclofen on RTN respiratory activity. Thus, a decrease in Vt was observed throughout the entire exposure, but more pronounced (by 12.9 %; $p<0.05$ of the baseline value at 1-2 minutes after injection (Fig. 1 B). Vi decreased at the same time. This reaction was formed immediately after baclofen injection, but the changes reached a statistically significant level by 40 minutes and amounted to 20.7 % ($p<0.05$) of the initial value. A decrease in Vt and f provided a decrease in lung ventilation (V), with the greatest inhibitory effect (18.7 %; $p<0.05$) observed at minute 3 (Fig. 1 C). A significant decrease in the level of V in the early terms of exposure was also observed when comparing the experimental data with the control values ($p<0.05$).

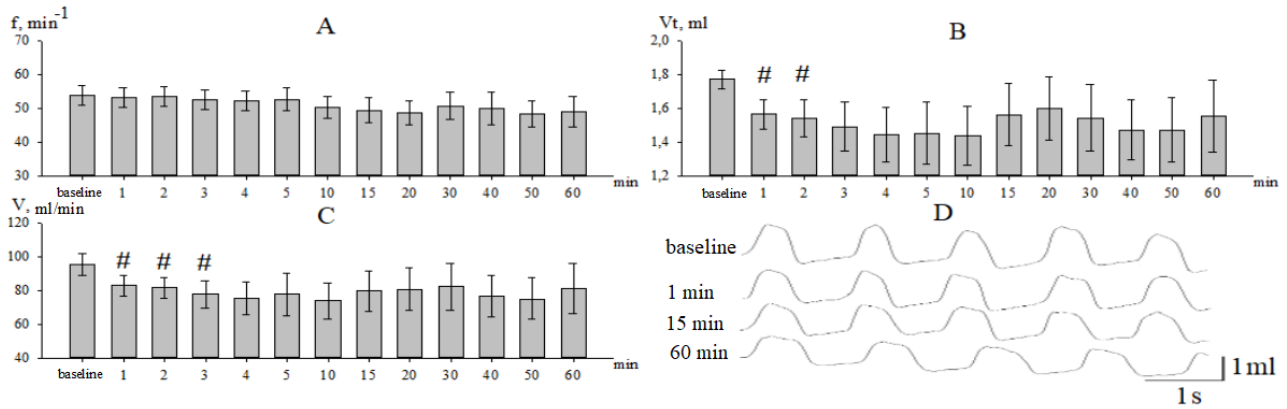

Fig. 1. Changes in the parameters of external respiration pattern during baclofen microinjection into RTN rats. # ($p<0.05$) - statistically significant differences with baseline. A - respiratory frequency, B - tidal volume, C - minute lung ventilation, D - spirograms.

Blockade of $GABA_B$-receptors RTN with 2-hydroxysaclofen resulted in stimulation of external respiration, while contribution of the temporal parameters to this response was not very significant. Thus, Te showed a weak tendency to shortening throughout the recording, but most noticeably at minute 60 (12.0 %). In contrast, Ti increased after blocker administration (by 11.4 %; $p<0.05$). Respiratory frequency after 2-hydroxysaclofen administration in RTN showed an upward trend (Fig. 2 A).

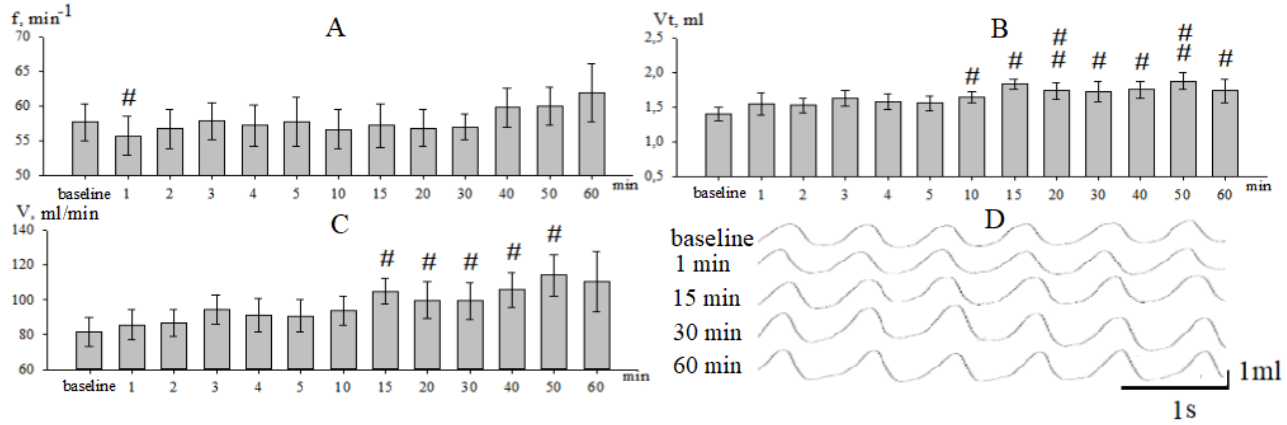

Fig. 2. Changes in the parameters of external respiration pattern during 2-hydroxysaclofen microinjection into RTN rats. # ($p<0.05$) - statistically significant differences with baseline. A - respiratory frequency, B - tidal volume, C - minute lung ventilation, D - spirograms.

Reactions of volumetric parameters of breathing when 2-hydroxysaclofen was administered in RTN were characterised by greater severity. For example, Vt increased already from the first minutes of exposure, that increase reached a statistically significant level (35.2 % on average) between 15 and 50 minutes (Fig. 2 B). This effect was confirmed by comparing the experimental results with the control group ($p<0.05$). The increase of Vt was combined with an increase in Vi. Statistically significant maximum increase of Vi was observed at 40 minutes of antagonist action and was 20.2 % ($p<0.05$) of baseline. As a result, there was increased lung ventilation throughout the spirogram recording. Which was indicated by the dynamics of V, whose maximum statistically significant increase (by 40.0 %; $p<0.05$) was observed at 50 minutes after the microinjection of 2-hydroxysaclofen (Fig. 2 C).

Thus, microinjections of baclofen and 2-hydroxysaclofen into the RTN caused respectively suppression and stimulation of external respiration. The obtained data indicate the involvement of the GABAergic system in the regulation of breathing by RTN structures. The inhibition of respiration observed with the activation of metabotropic $GABA_B$-receptors by baclofen is consistent with the results of studies analyzing respiratory responses to activation of ionotropic $GABA_A$-receptors of RTN by muscimol, which in general indicates the importance of GABAergic inhibition in the RTN region for the regulation of respiration. For instance, Takakura et al show that bilateral injection of muscimol at a concentration of 2 mM in RTN eliminates diaphragmatic nerve excitation in response to hypercapnic stimulation. [6]. Nattie & Li [9] in their study found that microdialysis of a $GABA_A$ receptor agonist in RTN in rats breathing normal atmospheric air resulted in decreased lung ventilation and tidal volume and showed a dose-dependent effect of $GABA_A$ ionotropic receptor activation on respiratory frequency. In our previous study the injection of muscimol solution (10^{-7} M) was administered into the RTN in rats, we observed a decrease in minute respiratory volume [11], which coincided with changes in lung ventilation when the GABA receptors of the indicated nucleus were activated by baclofen in the present work.

Blockade of $GABA_B$-receptors of RTN in experiments with microinjections of 2-hydroxysaclofen resulted in respiratory reactions increased respiration similar to the effects recorded when $GABA_A$-receptor were blocked by bicuculline. Microinjection of 2-hydroxysaclofen into RTN caused an increase in tidal volume and lung ventilation, which is similar to the effects observed by other authors during microdialysis of bicuculline solutions [12]. Noting a significant expression of changes in respiratory volume, inspiratory flow rate and minute lung ventilation under the action of 2-hydroxysaclofen, it is acceptable to suggest the involvement of GABAergic receptor RTN in bulbar mechanisms of regulation of volumetric parameters of the pattern of external respiration.

According to our results and the data mentioned above, it is reasonable to assume that the inhibitory effect of GABA in the RTN region is mediated not only by $GABA_A$- but also by $GABA_B$-receptors, although, perhaps, the metabotropic GABA receptors are not as widely represented as the ionotropic ones. GABAergic inhibition involves GABAergic receptors in pre- and postsynaptic

localisation. Presynaptic receptors can inhibit potential-activated Ca^{2+} ion channels, thereby inhibiting neurotransmitter release [13]. Due to this mechanism, signal delivery to RTN neurons can be terminated. Activation of the postsynaptic $GABA_B$-receptor population is able to induce hyperpolarisation of neuronal membranes by enhancing the flow of K^+ ions out of the cell through G-protein-activated potassium channels [14]. This inhibition may underlie the cessation of impulse transmission from the RTN to other parts of the central respiratory neural network.

The data obtained in this work indicate that in rats GABAergic receptors RTN are an important link in the central mechanisms of respiratory control, including the realization of the inhibitory effects of GABA on neurons involved in the regulation of respiratory patterns. The involvement of this type of receptor in the inhibitory modulation of external respiration is uneven. It can be assumed that a change in the activity level of $GABA_B$-receptors RTN has a greater effect on the activity of local respiratory networks controlling the value of volumetric measures of respiratory pattern.

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Economic sciences

EMPOWERING WOMEN THROUGH REDUCING UNPAID WORK

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Abstract

Unpaid work is recognized as a critical barrier to gender equality and women's economic and social empowerment. Formally categorized as non-market work, unpaid work is not included in gross domestic product (GDP) calculations and remains invisible to decision- and policymakers. Social and cultural gendered norms related to unpaid care work remain stubbornly entrenched. While the 'men as breadwinners' and 'women as caregivers' model may not be universal, it is still the normative construct for gender relations in the Republic of Moldova. Similar to other countries across the world, women in the Republic of Moldova undertake the majority of unpaid work; in the country the unpaid work is not equally shared by women and men. On average, women devote five hours per day to unpaid work. In contrast, men devote an average of two hours per day on unpaid work. Women spend from 1.5 to 4 times as much time as men do on unpaid work. Moreover, while men work longer hours in paid employment, women continue to work longer total hours than men do overall, bearing a 'double burden' or 'second shift'.

Keywords: unpaid work, gender equality, economic development, women's empowerment.

Introduction

This article examines four pathways that influence and shape women's disproportionate responsibility for unpaid work and that affect women's empowerment. These pathways are: access to, and opportunities in, the labor market; social and cultural norms; social care infrastructure; and the legal and institutional environment (including social protection and employment rights). These pathways intersect with the social, political and economic context of the country, which shapes — and is shaped by — country-specific characteristics. Such characteristics include the importance of urban-rural differences, the extent of migration, the informal economy, youth unemployment, the heterogeneity of women's experiences, ethnicity and socioeconomic group. Participation in the labor market is a key source of economic empowerment. Male labor force participation rates in the Republic of Moldova are similar to global rates. In contrast, there is considerable variation for women, even though historically their participation in paid employment has been high. Eastern Europe has an average of 84 per cent, with the lowest level in the Republic of Moldova at 54 percent. Industrial and occupational segregation by gender is a typical feature of labor markets, and the national labor markets are no exception. Despite increases in women's workforce participation, women are more likely to be employed in casual, poorly paid/undervalued and insecure work. Part-time employment among women remains low, which leads to many women turning to the informal sector to seek shorter employment hours. All countries have made progress in adopting gender equality mechanisms, including legislation and policies aimed at advancing women's empowerment and achieving greater gender equality in different spheres of social life. Particular attention has been paid to legislation and the elimination of discriminatory practices to address specific problems, such as gender-based violence and sexual harassment in the workplace. Despite this progress, some women continue to face high levels of discrimination in social norms, and there remains a substantial gap between changing attitudes and gender roles in practice. In 2018, survey [1] research from Armenia, Azerbaijan, Bosnia and Herzegovina and Georgia found that a majority of participants agreed that it "is a mother's responsibility to change diapers, feed and bathe children."

The gendered impact of the COVID-19 pandemic is clear both in terms of women's employment as well as in the intensification of unpaid care. Women have been affected more than

men by pandemic-related unemployment, reduced working hours and the loss of wages. Similarly, the incomes of women working in the informal sector having declined dramatically. Analysis on COVID-19 [2] and informal workers' lost income estimates that they lost an average of 70 per cent of their income. Further, as the crisis unfolded, millions of people left cities and returned to rural areas. This had two consequences: it intensified rural women's unpaid care and domestic work burden and it exposed the reliance of wealthier countries and families on migrant women workers for social and care services. In relation to the intensification of unpaid care work, much greater numbers of women than men have reported doing more household chores and spending more time on unpaid care work since the start of the pandemic. In the Republic of Moldova, 70 per cent of women spent more time on at least one unpaid domestic work activity, compared to 59 per cent of men.

The article concludes with policy recommendations that prioritize the importance of unpaid work as a barrier to women's economic empowerment. Removing or ameliorating this barrier will require specific interventions in three key areas: the labor market, the social care infrastructure and gender-specific social norms. While significant progress is required across all these fronts, the most effective policy intervention to empower women through reducing unpaid work is the provision of institutionalized, high-quality, affordable childcare, especially for young children. This reduction in women's unpaid care work responsibilities will facilitate their labor force participation and will help create job opportunities. In the labor market, greater flexibility in work patterns (e.g. part-time/reduced hours, flexible scheduling, shorter work weeks) is necessary to encourage a more equal distribution of unpaid work at the family level and to help women and men find a better work-life balance. This can be supported with paid parental leave for both women and men accompanied by non-transferable paternity leave.

There also needs to be wider investment to address labor-intensive aspects of unpaid work that thwart women's empowerment and impact on their time. For example, investing in sustainable agriculture and rural development will reduce rural-urban inequalities, rural poverty, food insecurity and will reduce the ongoing depopulation of rural areas. Although deep-seated social and cultural norms related to gender roles are slow to change, they are not intractable. Progress towards gender equality through the redistribution of unpaid work would allow men to benefit from new employment and family responsibility arrangements. Essential to this is revaluing and destigmatizing unpaid work, which will disrupt the current gender, racialized and class underpinnings of household and care work. Achieving these long-overdue changes will unlock the potential of women's economic empowerment.

Methodology

An in-depth desk review of the available studies [1-65] in the Republic of Moldova and worldwide was conducted in order to analyze the empowering women through reducing unpaid work. For the Republic of Moldova, in 2021 it was conducted a Survey [3] on the impact of COVID-19 on SME of Moldova, and the results of the survey were further analyzed to conclude the results of the presented work. Indeed, unpaid care work tends to remain largely taken for granted and overlooked by policy- and decision makers, as has been the case during the COVID-19 pandemic and the response and recovery measures pursued by governments. The Figure 1 bellow shows the four pathway methodology influencing women's responsibility for unpaid work.

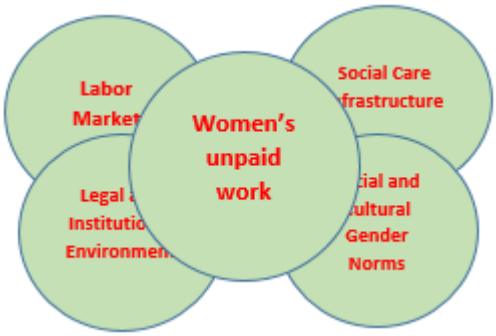

Figure 1. Four Pathways Influencing Women's Responsibility for Unpaid Work

Time use surveys are the principal method for collecting data on unpaid work. They have become an important tool for shining a light on gender-based inequalities, for recognizing and estimating the contributions of women's unpaid work to national well-being and for designing policies for women's empowerment. Regularly collected time-use data disaggregated by sex, age group and locations are necessary for reporting on SDG Target 5.4. However, huge gaps remain in the collection and use of sex-disaggregated data.

Results

In the Republic of Moldova mothers of infants (0 to 2 years old) and mothers of three and more children under 15 years of age are more likely to pursue work in the informal sector, which is typically informal own-account or unpaid family work. In Moldova, working mothers of three or more children under 15 years old are also more likely to live in rural areas and thus have limited choices, with informal work in (subsistence) agriculture often the only option to sustain their young children. Each of the SDGs under the 2030 Agenda for Sustainable Development has been impacted by the Covid-19 pandemic, including Goal 5 on achieving gender equality and empowering all women and girls, and gender equality as a cross-cutting prerequisite for sustainable development. In order to continue to make progress towards meeting SDG targets and ensure that no one is left behind in the wake of the pandemic, every COVID-19 response plan, and every recovery package and budgeting of resources, needs to address the gender impacts of this pandemic.

Policy recommendations

Unpaid work impacts on women's empowerment regardless of their level of education, income or the level of country development. Although the country have made advances in line with the 5R framework (recognizing, reducing and redistributing, reward and representation) , and although women's paid employment participation has increased, the largest share of unpaid work continues to fall on women — particularly vulnerable women from lower socioeconomic groups, rural areas and women from ethnic minority groups.

The COVID-19 pandemic has brought the importance of unpaid work to social and economic life into sharp relief. It has also brought greater recognition of who undertakes most of this work. This momentum must now be harnessed to prioritize unpaid work and care on the long-term political agenda (EIGE, 2020) and to push to revalue such work as crucial rather than burdensome work that must be fairly rewarded and equally shared between women and men.

Achieving these ends requires progress in at least five general areas:

1. Recognizing and representing unpaid work in policies and decision-making;
2. Strengthening employment rights and workplace policies;
3. Challenging social and cultural norms;
4. Investing and prioritizing social care infrastructure; and
5. Improving the legal and institutional infrastructure of social protection systems.

<u>Recognizing and Representing Unpaid Work in Policies and Decision-making</u>

- Recognize unpaid (and paid) care work at the national policy level and in decision-making.
- Improve data collection on unpaid work in order to help inform and shape policy and decision-making.

- Conduct ongoing monitoring and evaluation to better understand the social and economic impacts of women's unpaid care work and to support women's empowerment.
- Ensure evaluations are country- and context-appropriate in order to recognize the multiple circumstances underpinning women's unpaid work and to facilitate comparability across countries.
- Undertake gender analysis and assessments that consider the impacts of infrastructure, social protection and public service investments on women and girls' unpaid work and whether they lead to unpaid work responsibilities being transferred to other women in the household, particularly older women and girls.
- Involve a variety of actors in programme design and implementation in order to understand the local context and to create fit-for-purpose policy and programme solutions.

Strengthening Employment Rights and Workplace Policies

- Formalize paid parental leave for both women and men.
- Introduce incentives to encourage men's take-up of non-transferable paternity leave."
- Encourage men to take on a greater share of unpaid care work.
- Advocate for employment policies that support employees sharing caregiving responsibilities.
- Incentivize the uptake of paternity leave by ensuring that it covers a high percentage — or 100 per cent — of pre-leave income.
- Improve awareness of the benefits of flexible work schedules and different types of working arrangements (e.g. part-time, reduced hours, flexible schedules, shorter working weeks) that will facilitate more equal distribution of unpaid work and that will help women and men find a better work-life balance.
- Encourage long-term monitoring of these options to ensure that men and women access them equally.
- Ensure that flexible scheduling and work arrangements do not factor into performance reviews or other employment-related decisions.
- Raise and strengthen employers' awareness of their responsibilities to help challenge gendered cultural norms and expectations of ideal workers and ideal careers.

Challenging Social and Cultural Norms

- Use outreach campaigns to facilitate changes in sociocultural gender norms and attitudes.
- Address sociocultural factors that unduly affect people's choice to avail themselves of flexible scheduling and work arrangements in support of their family responsibilities.
- Promote men's involvement in unpaid work by addressing gender segregation in the home and workplace.
- Normalize cultural expectations of fathers' equal involvement in unpaid work.
- Transform negative masculinities at the societal, community, family and individual levels.
- Create spaces for men and boys to discuss gender stereotypes.
- Initiate media campaigns to destigmatize and disrupt gendered notions of women's and men's work, norms and roles.
- Engage more men in paid childcare positions in order to advance cultural norms of men's roles in care taking.

Investing and Prioritizing Social Care Infrastructure

- Revalue domestic and care work's worth to both society and the economy.
- Formally recognize the skills gained through paid and unpaid care work.
- Support unpaid and informal careers' transition to the formal labor market.
- Ensure accessible and affordable child- and elder care public services in order to reduce women's unpaid work responsibilities and to enable their labor force participation.
- Invest in measures to mitigate labor-intensive aspects of unpaid work that thwart women's empowerment and that impacts on their time (e.g. include gender analysis in locating new water sources).

Improving the Legal and Institutional Infrastructure of Social Protection Systems

- Design and implement social protection programmes to address legal and institutional constraints on women's access to and utilization of social protection resources.
- Expand unpaid workers' economic and social rights in social protection programmes and schemes.
- Universalize pension entitlements rather than basing them on working life and earned salaries.
- Introduce entitlements to compensate leaving employment in order to undertake unpaid care work.
- Strengthen social assistance and social insurance programmes and schemes to ensure that they enable a decent standard of living.
- Emphasize the need for social protection floors to guarantee services and transfers throughout the life cycle
- Expand social protection programmes to include for children, the economically active with insufficient income, older persons and other vulnerable groups.
- Develop social protection programmes that support unpaid caregivers and that avoid penalizing women as caregivers.
- Design unconditional cash transfer systems that minimize gender stereotypes and that avoid unintentionally creating additional care-related burdens for women.
- Expand contributory credits linked to pensions and other social protection programmes to account and compensate for time spent providing unpaid care (and therefore time spent out of the labor force)

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DIGITAL TRANSFORMATION OF THE NATIONAL BUSINESS STRUCTURES

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In the current environment, there is the rapid development of a new digital technological revolution, associated with fundamental changes in all areas of the national economic system. The constant process of information, technical and technological breakthroughs create new challenges for innovative socio-economic development, while the previous theoretical and methodological concepts formed in the pre-digital era are losing their relevance. These challenges in the context of dynamic information development have also emerged in the modern business environment, including important issues of anti-crisis support for the stable economic development of business structures for the long term.

In the classical sense, the concept of a digital economy means an activity in which the main factors of production are digital (electronic, virtual) data, both numerical and textual. The basis of the digital economy is the information economy, based on information and telecommunications infrastructure and provides access and implementation of digital and information skills in all spheres of life (economy, production, education, trade, management, etc.) [5, p.213].

It should be noted that from the standpoint of economic theory, there are a number of unresolved methodological problems, in particular, the lack of established terminology in the field of digital economy and approaches to periodization and definition of the essence of technological revolutions. At present, there is no complete perception and understanding of the fact whether the current wave of digitalization of the economy is a new technological revolution or the "golden age" of the development of the latest information and telecommunications technological revolution. At the same time, the development of the digital economy is already a reality, and for the successful functioning and survival of business under the new conditions, it is necessary to reconfigure the theoretical concepts of strategic management, its theoretical basis and tools.

Thus, there is a need to identify and analyze the main challenges and directions of digital transformations in the modern business environment, including important issues of anti-crisis support for the stable economic development of business structures for the long term in the era of informatization of society.

As a theoretical basis of the study, we will use the well-known theory of technological revolutions and technical and economic waves [3]. According to this theory, the universe is constantly under the influence of a constant sequential change in information and technological revolutions, which, in turn, are characterized by certain periods and phases of development. In this case, the periods of formation and deployment of the technological revolution (the so-called "Great Wave") are accompanied by a change of the old technical and economic paradigm of the previous technological revolution to a new one [4].

Since the beginning of the XXI century, state regulators began to play an important role in the introduction of information technologies into the national economy. State structures were the largest customer in the hardware and software market. Over the past few years, a new stage of information technology development has begun, called the "digital economy". The key features of this stage are the massive introduction of such breakthrough technologies as big databases (Big Data), Internet of Things, blockchain.

The basic factor is the rapid spread of the Internet (Fig. 1), including through mobile communication, as well as an increase in the level of connection to it (today the level of Internet penetration in the whole world has exceeded 70%, and in developed countries has reached almost 90%) [5]. In Ukraine, the number of Internet users in 2021 increased by 11%. Thus, today 24.15 million Ukrainians, or 81%, regularly use the worldwide web, compared to 63% at the end of 2018 [4]. This provided an exponential growth in the amount of information collected and processed by national organizations and business structures, which, in turn, is positioned as a key asset of the digital economy. All other factors of digitalization are somehow related to the formation and processing of data about consumers and business processes.

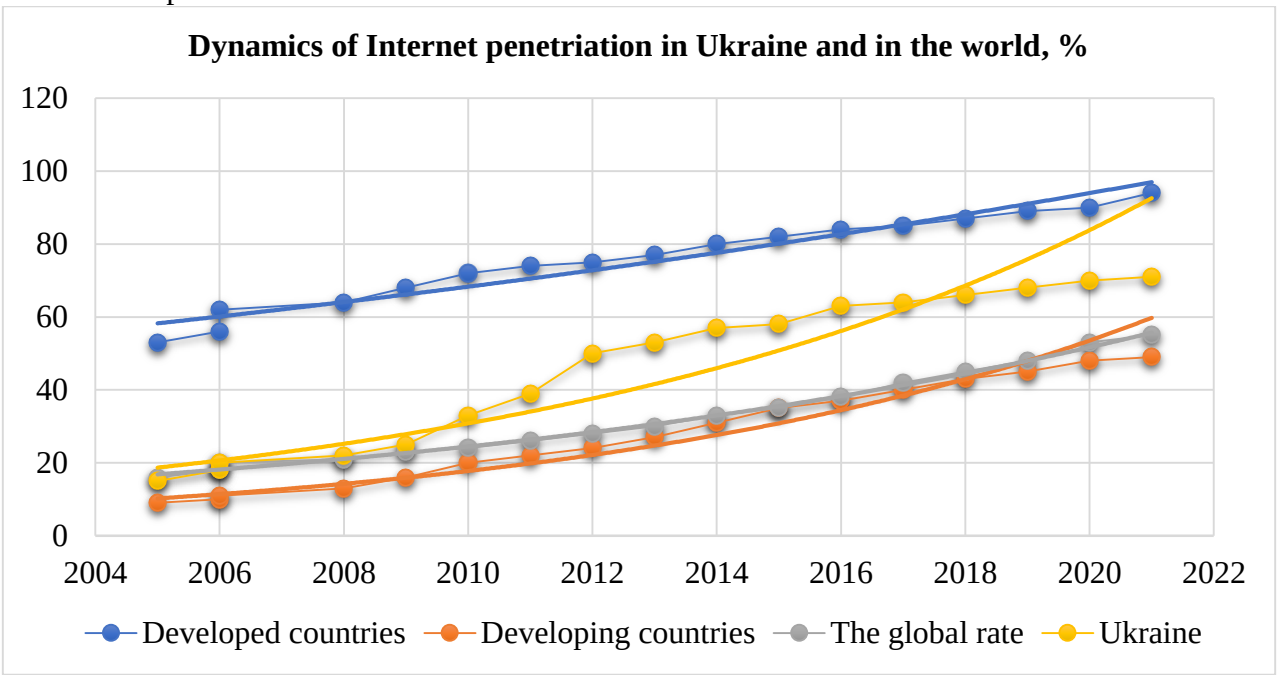

Fig. 1. Dynamics of Internet penetration in Ukraine and in the world, %.

Source: built by the author based on sources [3-5].

The rapid development of the mobile Internet at an accelerated pace has led to irreversible key changes that directly or indirectly affected the change in the business strategy of business enterprises, namely in such aspects as:

- the availability of computing technologies and capacities, cloud services, which led to the formation of the information infrastructure necessary for development in the context of the spread of digitalization and penetration into all business processes;
- reduction in the cost of transmission, analysis, systematization and storage of information and, as a result, a reduction in the cost of data storage and transmission, development of network effects;
- the growth of economies of scale in data processing, which led to an increase in the potential level of profit by accelerating the process of data analysis and making appropriate organizational and managerial decisions.

As can be seen from Figure 1, digital technologies are already actively used in developed countries - companies collect data on all links of the value chain, integrate and analyze them, which allows to identify patterns, reduce risks, restructure business processes and adequately respond to dynamic

market changes. In 2021, investments in the implementation of digital technologies in the world exceeded US$ 4.8 billion [10]. Much of this money was invested in financing high-tech start-ups.

The digital transformation of economic development and business structures, in particular, has led to new challenges in the context of business management, which can be divided into the following groups:

- changing the economic mechanism of business development;
- changing the business management model;
- change the business value priorities.

As a result, the theoretical concepts that determine the development of companies in the pre-digital era have ceased to work for the new digital business. Let us consider in more detail the impact of each of the challenges (Fig. 2).

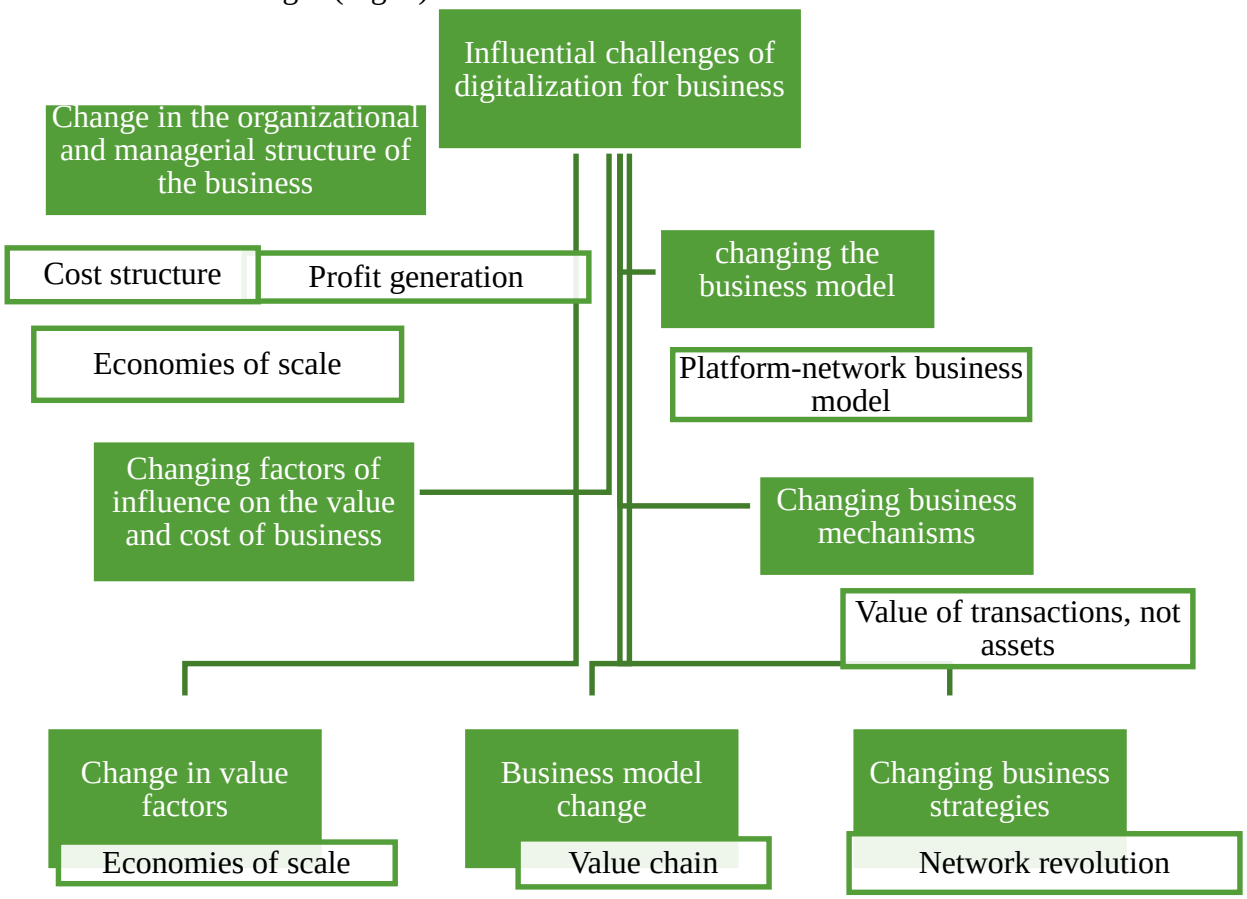

Fig. 2. New challenges of digitalization in the context of business process management
Source: built by the author

One of the key challenges of digitalization of socio-economic processes for business is to change all the mechanisms of the management system and the development of the business structure. The network revolution has radically changed the structure of business costs and, consequently, the mechanism for generating profits. It is also worth noting that the spread of the Internet and the use of digital technologies have led to a significant reduction in transaction costs for searching for information, concluding transactions, selling goods and services. Additionally, it also provided zero marginal transformation costs for the business, since the creation of copies of digital goods, their distribution on the Internet is almost free [9-10].

The scaling of digital business is correspondingly accompanied by profit growth. If earlier the efficiency of an enterprise was associated with production costs (improvement of the organization and management of the production process), as well as the promotion of products to the target consumer (demand generation), today the rapid development of IT technologies has significantly reduced the level of costs in the context of entering new markets, creating and developing a business with a

significant reduction in transaction costs. The business model transformation caused by the emergence of digital technologies is an impetus to change the model of production organization, sales management, business process management in the direction of reducing the cost of work and services.

Thus, the basis of business in the digital economy is an information database, around which all business processes are built and improved, new business ideas and business models and ecosystems are formed, which provide for close interaction and interconnection of all structural elements of the economic system of enterprises in cyberspace. In turn, the introduction of digital technologies allows businesses to significantly reduce both transaction and transformation costs for business, as well as become customer-oriented, forming customized services and products. But in addition to data, there is another factor that causes specific economic effects for digital business - the network revolution, which has led to a fundamental economic and social transformation [6].

Today, digital technologies have completely changed business, as they have begun to provide innovative companies with the opportunity to gain an advantage over competitors by creating revolutionary and transformational business models. Further rapid transformational changes will be observed in the business process management system and customer interaction system. Business process management systems will continue to be based on standard proven technologies, such as classical automated enterprise management system, accounting, human resources, etc., despite the fact that cloud services have been spreading rapidly in recent years. Customer interaction systems provide an opportunity to differentiate and use more new technologies [8].

In order to meet and exceed customer expectations, business structures must accelerate the digitization of their business processes. In this aspect, the key goals of digital transformation are increasing the speed of decision-making, increasing the variability of processes depending on the needs and preferences of consumers, reducing the number of employees involved in the process. Target consumers need instant feedback and a clear and user-friendly interface to meet their needs.

Creating digital business processes involves fundamental re-engineering and review of existing constraints. At the initial stage of redesign, it is necessary to select those areas of the process that are related to the customer experience. The key advantage of digitizing business processes is the ability to collect information about customer experience and automatically adapt individual process scenarios in accordance with customer expectations, which allows you to accurately predict customer needs and the most relevant ways and channels of communication with them.

Therefore, for the successful digitization of business processes, a very important issue is the availability of specialists in accordance with the requirements of the digital era. To move to the digital level, it is necessary to restructure the internal business processes of organizations, including the transformation of marketing, planning, logistics processes, production, etc. This provides for the rejection of traditional ways of solving operational and strategic tasks in favor of innovative solutions ("smart" equipment, automation of business processes, digital marketing, and foresight technologies) [9]. Those business structures that successfully adapt their own organizational, economic and managerial infrastructure to the new needs of the information society have the opportunity to sustainably strengthen and consolidate their own competitive positions both in the domestic and foreign markets.

The key success factor in the process of digital transformation of business structures is determined not by information technologies themselves, but by progressive management models that allow to implement in practice the most promising technical and organizational solutions. The need to change management models is dictated by modern realities - the intensive spread of digital technologies, increasing the value of information resources, the development of the telecommunications industry, strengthening the production, economic and technological specialization of business entities, as well as increasing competition in dynamically changing markets. In this regard, business needs not only temporary data processing tools, powerful hardware and software, but also comprehensive solutions to transform the management structure of the enterprise, optimize business processes, and increase efficiency.

The application of a new approach to management in the context of business digitization will enable the formation of systems of mutually beneficial relations between various objects: product

manufacturers, transport, trade, insurance, IT companies, end consumers, as well as government agencies and scientific organizations. It will be possible to more effectively research consumer markets using big data and conducting a comprehensive multifactorial analysis of market conditions.

Thereby, in the coming years the national business will be transformed from an economic system that consumes and distributes various resources (goods and services) into an expert system that manages information, knowledge and experience. Gradually, a management model will be formed that will unite heterogeneous business entities into a single information system, which will have higher economic efficiency and will be more able to minimize current and potential threats of unprofitable business activities.

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Geographical sciences

ANALYSIS OF THE QUALITY OF DRINKING WATER IN THE ADMINISTRATIVE DISTRICTS OF THE SAMARA REGION

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АНАЛИЗ КАЧЕСТВА ПИТЬЕВОЙ ВОДЫ В АДМИНИСТРАТИВНЫХ РАЙОНАХ САМАРСКОЙ ОБЛАСТИ

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Abstract

The article considers the issues of water quality in Samara region. The ratios of exceeding the normative indicators for the main pollutants of the region's districts are given. The data on the provision of centralized water supply to urban and rural settlements are given. Based on the analysis of the most preferred types of water treatment, the main methods for bringing water quality to regulatory requirements are given. Purification methods are analyzed and the advantages and disadvantages of each type are shown.

Аннотация

В статье рассмотрены вопросы качества воды районов Самарской области. Приведены соотношения превышения нормативных показателей по основным загрязняющим веществам районов области. Приведены данные по обеспеченности централизованным водоснабжениям городских и сельских населенных пунктов. На основе анализа наиболее предпочитаемых видов очистки воды приведены основные методы для приведения качества воды к нормативным требованиям. Проанализированы методы очистки и показаны преимущества и недостатки каждого вида.

Keywords: water quality, pollution, drinking water supply, treatment methods, pumping and filtering station, source of water supply

Ключевые слова: качество воды, загрязнения, питьевое водоснабжение, методы очистки, насосно-фильтровальная станция, источник водоснабжения.

Водные ресурсы Самарской области принадлежат к бассейну Нижней Волги. На территории региона протекает 220 рек, протяженностью более 10 км, и находится свыше 8600 озёр и искусственных водоёмов.

Питьевая вода, выходящая после очистки, соответствует всем санитарно-гигиеническим нормативам. Но из-за изношенности сетей в некоторых районах, происходит вторичное загрязнение, и она доходит до потребителя с отклонениями.

Так, например, самая неблагоприятная ситуация сложилась в Куйбышевском районе города. По данным экспертизы, зафиксировано превышение по уровню жесткости в 2,5 раза, минерализации и сульфатов в 1.5 раза. В других районах, например, в Ленинском и Железнодорожном, наоборот, были в порядке все показатели, кроме присутствия органических веществ в воде. При взаимодействии с хлором они образуют тригалометаны и галоуксусные кислоты, которые способны нанести серьезный вред здоровью человека.

Водные объекты Самарской области зачастую загрязнены нефтепродуктами, хлорорганическими пестицидами, фенолами, соединениями тяжелых металлов. Более 60 % сбрасываемых в водные объекты сточных вод не проходят предварительное очищение и обеззараживание. Основными виновниками загрязнения являются промышленные предприятия, животноводческие комплексы и трубопроводный транспорт, находящийся в аварийном состоянии. Из-за негативного воздействия, ряд рек, например, Падовка и Кубра, стали больше похожи на сточные канавы и потеряли своё природное назначение.

В регионе насчитывается 786 водопроводов и 911 источников централизованного водоснабжения. 83,1% жителей Самарской области получают качественную питьевую воду. Из них городское население составляет 67,2%, а сельское – 65%. Стоит отметить, что около 30% сельских жителей получают недоброкачественную воду. [1] Из 118 подземных источников, по данным на 2014 год, 111 не удовлетворяли гигиеническим нормам по причине отсутствия зон санитарной охраны.

Централизованным водоснабжением обеспечено около 98% населения. 18,6% водопроводных сетей Самарской области не удовлетворяют санитарным нормам. Основным объяснением неудовлетворительного качества воды в регионе специалисты называют нестабильность состояния воды в поверхностных водоёмах по органолептическим показателям, которые являются питьевыми источниками. Стоит также упомянуть, что качество воды в некоторых транзитных реках, таких как Волга, Самара, Большой Кинель, первоначально при поступлении на самарские земли низкое.

В то же время, по данным анализов гидрохимического режима отмечается незначительное улучшение качества воды, в последние годы, по микробиологическим критериям. Однако в некоторых районах превышение норматива по загрязнениям превышает средние показатели по региону. Количество неудовлетворительных проб в Красноармейском районе составило 12,4%, в Большечерниговском -19,3%, в Большеглушицком - 20%. [2]

Самая благополучная ситуация отмечается в Самарском, Ленинском, Железнодорожном, Октябрьском, Советском, Кировском и Промышленном районах. Здесь вода из-под крана не нуждается в дополнительной очистке, она пригодна для питья и приготовления пищи. Все санитарные показатели соответствуют нормативам.

В Куйбышевском и Красноглинском районах для обеспечения питьевых и бытовых нужд используется вода из подземных источников. Для вод артезианских скважин характерно высокое содержание железа, сульфатов и повышенная жесткость. В некоторых населенных пунктах показатели этих веществ превышены в два раза.

Современные методы очистки воды.

В любых источниках, даже в тех, которые относятся к наиболее экологичным (скважины, родники), вода далеко не всегда безопасна для здоровья. В совершенно чистой и прозрачной на первый взгляд жидкости, не имеющей осадка и запаха, вполне могут присутствовать болезнетворные микроорганизмы или тяжелые металлы. Даже превышение содержания достаточно безопасных химических веществ, при длительном употреблении может нанести непоправимый вред здоровью. Поэтому при проектировании использования

природных вод для водоснабжения в первую очередь необходимо определить химический и бактериологический состав воды, а затем на основании полученных данных подобрать методику и способы очистки, которые позволят добиться оптимального качества. В качестве часто используемых видов очистки из природных источников выделяют следующие виды очистки. [3]

Термический. Элементарное средство умягчения воды своими руками, которое может позволить себе каждый это - кипячение. При подогреве жидкости до температуры кипения растворимые соли – чаще всего это гидрокарбонат и сульфат кальция – распадаются на углекислый газ (испаряется) и осадок (остается в емкости).

Этот способ наиболее удобен в повседневной жизни и наиболее прост в реализации: технология незамысловата. Все, что потребуется – это жаропрочный резервуар подходящего объема и топливо. Но также имеются недостатки, которые заключаются в небольшой производительности, нельзя убрать соединения магния, а также нужно отдельно удалять выпавший осадок.

Мембранный. В данном методе рабочая среда под давлением от 3 до 4 атмосфер проходит через специальную пластину, которая пропускает молекулы воды, но останавливает другие частицы. Получается подобие фильтра обратного осмоса. [5]

Плюсы метода:

- высокая степень очистки – ликвидирующая примерно 98% примесей;
- комплексный эффект – блокирует множество вредных веществ, помимо увеличивающих жесткость.

Минусы:

- необходимо создать в системе избыточное давление и поддержать его;
- дополнительно проводить минерализацию, чтобы потом жидкость была пригодна для бытовых нужд;
- большие затраты – закупка оборудования и регулярная замена комплектующих.

Химический (реагентный). Добавление в рабочую среду вещества, которое вступит с растворимыми соединениями в реакцию и в результате образуют осадок. Например: сода, известь, или комбинация, специализированные водоумягчители, синтетические расщепители и пр. [6]

Выбор материала зависит от сферы и случая. Например, для защиты бытовой техники, подойдут одни вещества, для очистки в питьевых целях нужны уже другие.

Достоинства:

- удаляются не только нерастворимые, но и мутные примеси;
- эффективность и производительность.

Недостатки:

- постоянное выпадение осадка;
- необходимо точно соблюдать дозировки и не превышать концентрацию активного вещества, так как процесс может пройти нестабильно;
- расходы на расщепители, которые необходимо пополнять;
- многие реагенты делают воду непригодной для питья.

Магнитный. На жидкость направляют магнитное поле, которое меняет структуру солей, молекулы не могут соединяться в устойчивые связи. В итоге отложения не только не оседают на поверхностях резервуара, но даже помогают разрыхлить уже существующую накипь. После чего они притягиваются уловителями и выводятся в отстойник. [7]

Преимущества:

- хорошая эффективность при небольшой интенсивности процесса;
- применимо для всех трубопроводов и бытовых приборов, с возможностью удаления ржавчины;
- больший ресурс теплообменников при меньшем расходе электричества;
- повышение производительности стиральных и посудомоечных машин.

Недостатки:

- постоянный мониторинг, чтобы крупные отложения не провоцировали засоры;
- эффективен при скорости до 0,5 м/с и средней жесткости;
- ограниченная дальность действия уловителей;
- дороговизна реализации.

Электромагнитный. Модификация магнитного метода, в этом случае:

- При воздействии тока, соли сразу удаляются;
- Частицы и примеси поступают в канализацию напрямую.

Что позволяет снизить степень контроля, но затраты на оборудование высоки.

Ионообменный. Заряженные частицы магния и кальция замещаются натрием. Соединение не образует отложений, и безвредно. Такую жидкость разрешено употреблять в пищу, она не уменьшает срок жизни бытовой техники. [8]

Помимо вышеперечисленных, есть комбинированные технологии, сочетающие в себе сразу несколько преимуществ, например, высокую эффективность мембранного фильтра с предотвращением засоров. Но они, как правило, максимально дороги в реализации, и недостатки тоже объединяют.

В последнее время получили популярность ионообменные водоумягчители.

Конструктивно представляют собой баллон из пластика, частично заполненный гранулированной полимерной смолой. Смола выступает в роли фильтра, отдающего заряженные частицы натрия и поглощающего магний с кальцием. Проходя через нее, среда очищается в результате реакции замещения.

Со временем концентрация ионов снижается. Для этого раствор хлорида закачивают через специальный солевой бачок. Во время регенерации жидкость не подается, поэтому тогда, когда нужно организовать непрерывный забор, устанавливают сразу два баллона и включают их поочередно.

Заключение

Неудовлетворительное качество питьевой воды в административных районах Самарской области, по цветности, перманганатной окисляемости, фенолам, нефтепродуктам обусловлено в основном плохим санитарно-техническим состоянием разводящих водопроводных сетей.

Несмотря на достаточно качественную очистку воды на НФС – 1, 2 Самарской области в соответствии с гигиеническими требованиями к питьевой воде в некоторых районах проблема не решена до конца. К примеру, качество питьевой воды в Куйбышевском районе не соответствует гигиеническим требованиям по жесткости и минерализации по сухому остатку, что обусловлено неэффективной работой НФС-3.

Питьевая вода во всех районах г.о.Самара не соответствует гигиеническим требованиям по ХПК. Это является свидетельством недостаточного эффекта очистки на всех НФС в отношении трудноокисляемого органического вещества. Данное положение является основанием к использованию ХПК в качестве дополнительного критерия при контроле качества питьевой воды, подаваемой населению и оценки эффективности водоподготовки исходной воды на НФС. А также для предупреждения ухудшения качества воды при подаче потребителю, необходимо выполнить замену разводящих сетей.

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Geological and mineralogical sciences

PETROCHEMISTRY OF SMALL INTRUSIONS AND DIKES OF THE KARAKUTAN DIKE BELT (ZIAETDIN MOUNTAINS, UZBEKISTAN)

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ПЕТРОХИМИЯ МАЛЫХ ИНТРУЗИЙ И ДАЕК КАРАКУТАНСКОГО ДАЙКОВОГО ПОЯСА (ЗИАЭТДИНСКИЕ ГОРЫ, УЗБЕКИСТАН)

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Abstract

The Karakutan diorite-lamprophyre-granitoid-porphyry dike complex forms a sublatitudinal belt up to 5-6 km wide and more than 30 km long. It was formed in the following chronological sequence: 1) tonalites and porphyritic granodiorites (?), 2) tonalite porphyries, biotite and amphibole-biotite granodiorite porphyries, garnet-bearing amphibole-biotite granodiorite porphyries; 3) garnet-bearing diorite porphyrites, quartz diorite-porphyrites, syenodiorite porphyrites; 4) spessartites, vogesite-spessartites, kersantites, kersantites-spessartites. The dykes are characterized by successively differentiated alumina undersaturation, consistent for all types of rocks, by the constant presence of normative corundum. Sodium in all rocks, as a rule, prevails over potassium, except for spessartites. Diabase porphyrites are classified as moderately high alumina, the rest are high and very high alumina porads. The considered dikes are intra- and post-ore, i.e. their formation in time coincides with the post-magmatic hydrothermal process, which is typical for gold and gold-silver occurrences in Western Uzbekistan.

Аннотация

Каракутанский диорит-лампрофир-гранитоид-порфировый дайковый комплекс образуют субширотной пояс шириной до 5-6 км и протяженностью более 30 км. Он образован в

следующей хронологической последовательности: 1) тоналиты и порфировидные гранодиориты (?), 2) тоналит-порфиры, биотитовые и амфибол-биотитовые гранодиорит-порфиры, гранатсодержащие амфибол-биотитовые гранодиорит-порфиры; 3) гранатсодержащие диоритовые порфириты, кварцевые диорит-порфириты, сиенодиоритовые порфириты; 4) спессартиты, вогезито-спессартиты, керсантиты, керсантито-спессартиты. Дайки характеризуется последовательно дифференцированной, выдержанной для всех типов пород недосыщенностью глиноземом постоянным присутствием нормативного корунда. Натрий во всех породах, как правило, преобладает над калием, кроме спессартитов. Диабазовые порфириты относятся к умеренно высокоглиноземистым, остальные – к высоко и весьма высокоглинземистым порадам. Рассматриваемые дайки являются внутри- и послерудными, т.е. их формирование по времени совпадает с постмагматическим гидротермальным процессом, что характерно золоторудным и золотосеребряным рудопроявлениям Западного Узбекистана.

Keywords: dikes, dike belt, tonalites, diorite porphyrites, grandiorite porphyries, spessartites, kersantites, kersantite-spessartites, normative corundum, postmagmatic, hydrothermal processes.

Ключевые слова: дайки, дайковый пояс, тоналиты, диоритовые порфириты, грандиорит-порфиры, спессартиты, керсантиты, керсантит-спессартиты, корунд нормативные, постмагматические, гидротермальные процессы.

Каракутанское рудное поле сложена метаморфизованными вулканогенно-терригенными отложениями каттармайской свиты нижнего девона, различными по составу сланцами (слюдисто-полевошпат-кварцевые, слюдисто-кварц-полевошпатовые и др.), мощными и протяженными покровами рассланцованных сильно измененных вулканитов основного состава (анкарамитовые базальты), составляющих северное крыло Катармайской антиклинали и ее ядерную часть, которые осложнены разрывными нарушениями преимущественно субширотного, реже северо-восточного и северо-западного направления. Вся это толща прорваны небольшими малыми интрузиями (тоналитов) и дайками (тоналит-порфиров, гранодиорит-порфиров, диоритовых порфиритов и их переходными разновидностями, кварцевыми, гранатсодержащими диоритовыми порфиритами, лампрофирами и др.) преимущественно среднего и кислого состава, дислоцированных и осложненных разрывными нарушениями широтного, северо-восточного и редко других направлений, к которым приурочена золоторудная минерализация [1, 2].

По отношению к золотому оруденению среди дайки имеются дорудными, внутрирудными и пострудными, что свидетельствует о генетической связи с золотым оруденением. Диабазовые порфириты образуют силлообразные тела, которые вскрыты горнопроходческими работами в пределах рудного поля, являются субвулканическими образованиями вулканогенной толщи катармайской свиты. Спессартиты, диоритовые порфириты и близкие к ним породы секут дайки тоналит-порфиров, они в свою очередь пересекают система кварцевых жил с золотом, что свидетельствует о внутрирудном характере даек [1].

Каракутанский диорит-лампрофир-гранитоид-порфировый дайковый комплекс образуют субширотной пояс шириной до 5-6 км и протяженностью более 30 км. Мощность отдельных даек от 0,3-0,5 до 28-30 м, в среднем 3,5-4 м; длина до 3 км.

Комплекс образован по данным [2] с существенными изменениями в следующей хронологической последовательности: 1) тоналиты и порфировидные гранодиориты (?), 2) тоналит-порфиры, биотитовые и амфибол-биотитовые гранодиорит-порфиры, гранатсодержащие амфибол-биотитовые гранодиорит-порфиры; 3) гранатсодержащие диоритовые порфириты, кварцевые диорит-порфириты, сиенодиоритовые порфириты; 4) спессартиты, вогезито-спессартиты, керсантиты, керсантито-спессартиты.

Химический состав даек каракутанского комплекса (таблица) характеризуется последовательно дифференцированной, выдержанной для всех типов пород недосыщенностью глиноземом постоянным присутствием нормативного корунда. Тоналиты, тоналит-порфиры и часть

диоритовых порфиритов попадают в поле развития диоритов, кварцевых диоритов и гранодиоритов нормального ряда. Что касается даек спессартитов, диабазовых порфиритов, гранодиорит-порфиров и частью диоритовых порфиритов, то они имеют более монцонитоидный уклон (рисунок).

Натрий во всех породах, как правило, преобладает над калием, кроме спессартитов. Диабазовые порфириты относятся к умеренно высокоглиноземистым, остальные – к высоко и весьма высокоглинземистым порадам. Коэффициенты железистости повышается в сторону основных, а фракционирования наоборот (таблица).

Диабазовые порфириты и часть спессартитов являсь более основными попадают в поле развития известково-щелочных и щелочных серий на треугольной диаграмме AFM (рисунок). Следует отметить, что диабазовые порфириты являются субвулканическими образованиями катармайской толщи, слагая межпластовые залежи среди песчано-сланцевых и вулканогенных образований.

Таблица

Средний химический состав даек и малых интрузий Каракутанского дайкового пояса (Зиаэтдинские горы)

Окисел	1	2	3	4	5	6	7
SiO_2	49,33	66,47	63,68	64,01	55,56	57,77	57,29
TiO_2	0,75	0,50	0,39	0,46	0,61	0,59	0,66
Al_2O_3	14,04	16,29	15,50	15,90	14,93	14,62	15,75
Fe_2O_3	2,13	0,48	0,52	0,77	1,45	1,37	1,29
FeO	5,27	2,67	3,30	2,88	4,27	3,89	4,95
MnO	0,15	0,04	0,05	0,05	0,11	0,08	0,09
MgO	7,65	1,28	1,81	1,32	5,15	4,29	3,01
CaO	5,89	3,48	3,89	3,12	5,01	5,00	5,16
Na_2O	3,44	3,97	3,97	3,76	2,71	3,31	3,27
K_2O	1,15	2,68	2,79	3,45	3,29	2,85	2,59
H_2O	0,47	0,13	0,20	0,24	0,12	0,44	0,25
П.п.п.	7,93	1,47	2,90	2,72	5,92	4,20	4,73
P_2O_5	0,26	0,13	0,13	0,18	0,17	0,25	0,19
CO_2	3,23	0,50	1,82	1,53	3,16	2,66	2,62
Сумма	100,01	99,61	99,95	99,73	99,95	100,07	99,59
al’	0,93	3,71	2,80	3,21	1,5	1,69	1,74
f’	15,81	4,95	6,03	5,44	11,5	10,14	9,93
Кф	49,23	71,3	68,46	73,72	55,3	56,98	68,22
Na_2O+K_2O	4,59	6,66	6,76	7,21	6,01	6,16	5,87
Na_2O/K_2O	3,45	1,49	1,47	1,13	0,88	1,29	1,31
Кварц	7,54	23,1	23,86	40,98	55,56	57,77	57,29
Плагиоклаз	36,52	48,1	38,23	21,64	0,61	0,59	0,66
Ортоклаз	6,79	15,8	16,53	21,74	16,65	15,41	14,48
Корунд	3,82	1,85	4,27	18,08	30,65	36,10	40,33
Диопсид	9,45	2,88	1,3	20,53	19,47	16,84	15,31
Гиперстен	24,59	6,60	9,38	5,87	5,37	3,66	5,88
Ильменит	1,43	0,96	0,75	0,81		1,38	5,73
Магнетит	3,09	0,70	0,75	3,7	18,49	15,48	13,02
Апатит	0,60	0,30	0,32	0,65	1,16	1,12	1,27
Кальцит	6,55	1,15	3,43	2,13	0,39	0,59	0,44

Примечание. 1 – диабазовые порфириты (4), 2 – тоналиты (11), 3 – тоналит-порфиры (6), 4 – гранодиорит-порфиры (9), 5 – спессартиты (6), 6 – диоритовые порфириты (6), 7 – диоритовые порфириты с гранатом (10). В кавычке количество определений.

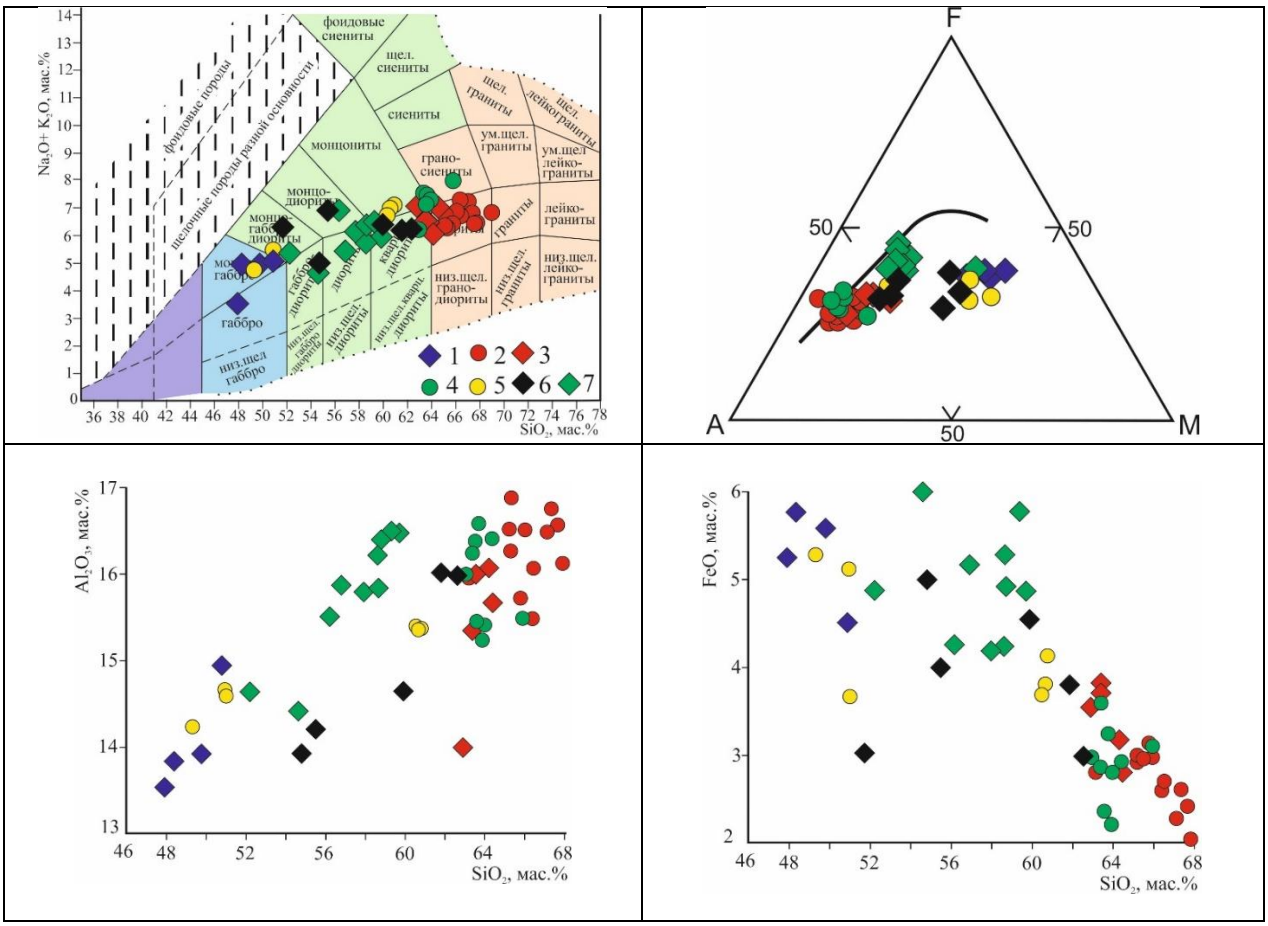

Рисунок. TAS, AFM и диаграмма Харкера для даек и малых интрузий Каракутанского дайкового пояса (Зиаэтдинские горы). 1 – диабазовые порфириты, 2 – тоналиты, 3 – тоналит-порфиры, 4 – гранодиорит-порфиры, 5 – спессартиты, 6 – диоритовые порфириты, 7 – диоритовые порфириты с гранатом.

На диаграмме Харкера отчетливо видно, что практически все разновидности даек образуют как бы единый тренд эволюции (рисунок) с небольшими отклонениями. Это видимо связано с постмагматическими изменениями.

Рассматриваемые дайки являются внутри- и послерудными, т.е. их формирование по времени совпадает с постмагматическим гидротермальным процессом, что характерно золоторудным и золотосеребряным рудопроявлениям Койташ, Сармич, Пистали, Кызылалма и др., где в подобных дайках в пределах рудоносной зоны содержание золота достигает 7 г/т; серебра до 8 г/т, что указывает на рудоконтролирующий характер даек и возможную генетическую связь с ними золотосеребряного оруденения [3-5].

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Pedagogical sciences

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PROFESSIONAL AND PEDAGOGICAL COMPETENCIES OF FUTURE ENGLISH TEACHER

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Abstract

This article focuses on the concept of professional competence. In particular, the professional competence of a foreign language teacher at the present stage of Kazakhstani education is considered. Under the conditions of innovative development of economy and society, cardinal changes are taking place in the education system: a variety of educational content is being offered, new pedagogical technologies, modern concepts and ideas appear. The specialty "Foreign language: two foreign languages" becomes more and more demanded in society. Foreign language training is one of the basic elements in the system of professional training of specialists at all levels, including higher professional education institutions. Knowledge of a foreign language in the professional sphere is necessary in order to be a competitive person in the labour market. Research on the concept of professional competence of a teacher in general and professional competence of foreign language teachers in particular shows that there is a variety of modern approaches, interpretations and definitions of the concept of professional competence.

Keywords: professional competence, competence, competence approach, foreign language, teaching methods, educational paradigm, foreign language education, professional education, modern approaches, cognitive aspects.

In today's rapidly developing technological society, the need for highly qualified and professionally qualified specialists is increasing. Education in the information society ceases to be a means of acquiring universal knowledge that is easily accepted, but rather as a way of exchanging and enriching individuals with each other, leading to their competence and erudition.

And a professionally competent specialist is a modern school teacher who is educated, has psychological and pedagogical knowledge of basic education, upbringing and development of children, is able to work with talented and difficult children, is ready to study, requires a free and critical system, is capable of pedagogical activities we can say a specialist who can organize his way of creating a personal development strategy, can gain personal reputation and status.

Overall speaking, about the concept of "competence", scientist K. Kudaibergenova said, "The concept of competence is a concept that has been introduced in the field of pedagogy in recent years as a result of paying special attention to the subjective experience of a person. "Competence means a specialist who can authoritatively make a decision on any questions, including the meaning of a well-informed expert in a certain field."[1].

The teacher's professional competence is considered an integral part of the teacher's pedagogical skill and professionalism. The concept of competence describes the readiness of a person to perform a certain activity. Currently, it is often used in the theory and practice of general and professional education.

A.K. Makarova singles out several types of professional competence and believes that their presence is an indicator of a person's professional maturity:

- Special competence;
- Social competence;
- Personal competence;
- Individual competence;

Peculiarities of pedagogical activity do not allow competence in only one narrow specialty, the professionalism of a teacher is determined by the unity of all types of professional competence.

There are several ways to define the structure of professional competence. One of them is related to the discovery of the structure of the teacher's professional competence through the system of pedagogical skills, while the other is determined by the structure of the division of the teacher's competence in different professional fields, which are: self-education and teaching; educational service; scientific-methodical and cultural-enlightenment; corrective and developmental service; management activity[2].

The quality of training of specialists at the current stage of the development of higher professional education is competence, independence, readiness to make decisions in the face of alternative choices, the ability to adapt to rapidly changing political, social and industrial conditions, as well as the qualification, independence, high professional qualification of the board at the current stage of the development of higher professional education. evaluated by indicators such as motivation for continuous education and professional growth. In this regard, the content and technologies of higher education are aimed at defining and forming a complex of special knowledge, skills and experience that constitute a set of general cultural and professional competencies in accordance with the new educational standard. It describes the competence of the future specialist in general. Currently, the method based on competence is used as a methodological basis in modern professional pedagogical education. Many scientists (Galskova E.D., Solovova E.N., Safonova V.V. and others) agree that this is the most popular way of training future teachers. S.S. In her monograph "Competency-based modeling of vocational education in a foreign language", Kunanbayeva points out that the meaning and content of the concept of "vocational education" in the current situation is radically changing and becoming more complicated...". "Currently, vocational education is designed to create a new specialist capable of giving a new impetus to the transfer of technologies in the strategic development of the country, to a qualitatively new level of the country's innovative and professional potential" [3].

Nowadays, not a specialist with encyclopedic knowledge, but a person who can apply the acquired knowledge to life situations can be called competent.

The specialty "Foreign language: two foreign languages" is in demand in society. Teaching a foreign language is one of the main elements of the system of professional training of specialists at all levels, including educational institutions of higher professional education. In order to be a competitive person in the labor market, it is necessary to know a foreign language in the professional field. The new status of the foreign language teacher sets the task of significantly changing the professional training of pedagogical personnel, updating the content and technology of linguistic education, and improving the quality of higher education. In order to effectively carry out his professional activity, a foreign language teacher should not only master a foreign language, but also have a basic level of professional competence [4].

Competence and competence, V.A. Metaev, complementary and interdependent concepts: a competent person without competence cannot fully realize it in socially important aspects [5].

The term "professional competence" began to be actively used in the 90s of the last century. Ushakov is given in two meanings:

- firstly, it is a complex of problems and phenomena with which a person has authority, knowledge, and experience;
- secondly, it is a field of problems, phenomena under someone's control, a technical task [6].

The analysis of relevant studies shows that almost all of them study the process of formation of professional competences in the context of teaching the basics of a profession or special subjects.

First of all, this is explained by the fact that the term "professional competence" refers to the profession, and therefore to the professional knowledge, skills, industrial and social experience that ensure its professional functioning. Also, the professional competence of a teacher is understood as a set of professional and personal qualities necessary for successful pedagogical activity. Research on the concept of professional competence of a teacher in general, including the professional competence of foreign language teachers, shows that there are a variety of modern views, interpretations and definitions of the concept of professional competence.

According to the definition, A.V. Khutorsky, "competence is a person's readiness to mobilize knowledge, skills and external resources for effective action in real-life situations. Competence is a set of personal qualities (value orientations, knowledge, skills, abilities), which is the ability to act in a certain personally important field. Competence of a foreign language teacher is a complex of professional and personal qualities (competencies) of the teacher that determine the effectiveness of his pedagogical activity" [7].

A.K. Markova, professional competence includes five aspects of a teacher's work: pedagogical activity, pedagogical relationship, teacher's personality, teaching (learning ability) and education (knowledge).

Each of these aspects consists of the following components: pedagogical knowledge (the meaning of the teacher's work, features of his pedagogical activities, relationship, personality, psychological development of students, their age characteristics, information from psychology, pedagogy), skills (activities performed at a sufficiently high level actions), professional psychological positions (stable systems of relations between the teacher and the student, colleagues, which determine his behavior, express his self-esteem, the level of professional requirements and closely related relationships, the teacher's enthusiasm, sense of the meaning of his work), to his cognitive sphere influencing psychological characteristics (qualities) (pedagogical thinking, reflection, self-assessment, control) and motivational (goal setting, motives, interests of an individual) [8].

It is clear that professional competence cannot be expressed by one definition, however, for teachers who provide professional training to students, it is important to understand the meaning of "professional competence" that is formed during classroom and extracurricular educational activities and during pedagogical practice in various types of educational institutions with the student's personal interest.In turn, the professional-pedagogical competence of a foreign language teacher can be understood as a systematic feature of a person that describes his/her foreign language competence, acquired professional skills and abilities, as well as personal experience and knowledge, self-confidence. Undoubtedly, professional competence is fully manifested only in a working teacher, but the fundamental foundations of this competence are formed during the period of study at a pedagogical university.

The professional competence of a foreign language teacher may include a number of components of generalized key competences represented by subject and general pedagogical competences. In turn, subject competence consists of:

- linguistic competence: ensuring that students acquire language knowledge and speaking skills: phonetic, lexical, grammatical;
- sociolinguistic competence: formation of the student's ability to purposefully use language and speech units due to changing conditions of education;
- socio-cultural competence: formation of the future foreign language teacher's ability to participate in the dialogue of cultures based on knowledge of universals and peculiarities of cultural contexts;
- strategic competence: formation of the student's ability to use compensatory communication strategies in case of insufficient language tools;
- discursive competence: formation of the student's ability to produce and understand speech characterized by a certain organization: consistency, logic, consistency, etc.;

General pedagogical competence can be demonstrated by:

- social competence (formation of the student's civic position, moral and aesthetic values, etc.);

- psychological-pedagogical competence (formation of the future teacher's ability to use the knowledge acquired during the study of pedagogy and psychology);

- methodological competence (not only the ability to use theories and actual interactive models of foreign language teaching, but also the ability to create and test the future teacher's own methodological system) [9].

According to the axiological point of view, the educational value of professional competence is to introduce a person into the general cultural world of values. This, in turn, allows you to realize yourself as a specialist and professional. A universal approach makes an attempt to combine professional competence with the basic qualifications of a specialist, allowing a person to solve a wide range of problems that are not limited to specialization. This allows a person to become a socially and professionally mobile person, to be open to changes, to engage in creative research, to be able to express himself, create himself, and educate himself. According to the personality-activity approach, the professional work of a teacher is considered, during which a person interacts with other people and influences them. The integrative approach involves adding the following approaches to a unified methodological space: systemic, personal, communicative activity, axiological, cultural, anthropological approaches. The integrative approach combines the elements of knowledge about the teacher into a single field of study, reveals the comprehensiveness and complexity of the phenomenon of professional competence of the foreign language teacher in all its important manifestations: social, professional, cultural manifestations.Thus, the systematic approach is aimed at choosing an invariant,

to study what is stable, what is general, and what is specific, changeable in terms of structure and content of system-forming connections and relationships, teacher's professional competence [10].

The specialty of the foreign language teacher's professional activities is that he is not obliged to solve only a whole complex of professional, educational, cultural-educational, research and project tasks. The readiness of the teacher to effectively create the process of teaching a foreign language, the formation of an adequate image of the world in students in the current situation should be based on the principles of integrating his personality into the world and national culture, that is, on the ability to communicate interculturally, taking into account the acquired qualities. Pedagogical profession requires a large amount of professional knowledge, as well as professional skills of pedagogical activity. For foreign language teachers, it is of particular importance to have established professional competences. The formation of professional competence of teachers is carried out in the process of teaching them subject teaching subjects at universities.The selection of these competencies is based on the features of modern foreign language teaching and the subject "Foreign language". All types of competences are directly related to each other, but the general pedagogical competence is considered the primary organizing link in the content of professional development of a foreign language teacher.It is intended to create such a model of a foreign language teacher based on a wide range of competencies related to the current level of development of the society, the introduction of new teachings and the introduction of changes to the existing system of updated content of education. This model should be based on a wide range of basic and professional subjects that contribute to specialist training on the basis of modern achievements of pedagogy, psychology, sociology and foreign language teaching methodology.

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THE ESSENCE OF THE COMPETENCE-BASED APPROACH IN MODERN EDUCATION

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Abstract

The article discusses the basic concepts related to the implementation of the competence- based approach in modern education. The analysis of sources on this problem, especially the history of its formation, shows the complexity, multidimensionality and ambiguity of the interpretation of both the concepts of «competency», «competence», and the approach based on them to the process and result of education.

Keywords: competency, competence, competence-based approach, education, knowledge.

Knowledge was considered the basis of the pedagogical process. They are the main value of education. The learning performance indicator is measured by the degree of knowledge proficiency. Practical activity is considered as the assimilation of experience in the implementation of knowledge by the method of practice. This approach to the construction of the pedagogical process is called competence. Therefore, «competency» is the capability to apply or use the set of related knowledge, skills, and abilities required to successfully perform 'critical work functions' or tasks in a defined work setting. R. White defines competence very broadly, linking it and with effective human interaction with the environment and with human personality characteristics that guarantee the quality of work performance combined with high motivation. [1]

The aims of this study are: to consider the key competencies that are relevant for modern society, as well as to identify important characteristics of competency. The method used of this study consists of analytical and experimental methods.

Here are three research questions that guide this study as follows:

–What are the reasons for the use of the competence-based approach?

–What key competencies are relevant in modern society?

–What competencies are characterized of a modern teacher?

The second half of the twentieth century is characterized by the acquisition of knowledge through school education, which loses its relevance and value. The main reason influencing this is accessibility to information. Mass informatization and the active development of mass communication media have shown this manifestation especially vividly. The modern world is characterized by the contradiction of the role of knowledge in the scientific, technical and social process, which is beginning to become an absolute value of education. A self-developing personality capable of searching, processing and applying knowledge in practice gradually replaced their place.

According to some Russian academics (D. A. Ivanov, V. K. Zagvozdkin, I. A. Zimniaia, A. G. Kasprzhak), the competency-based approach is a means for achieving a new level of quality within a new model of education. [2]

The competency-based approach, which personifies today’s innovative educational process, corresponds to the general conception of educational standards found in the majority of countries and is directly connected to the transition towards a competency-based system of constructing educational content and as its quality-assurance mechanisms. Moreover, the topical nature of the competency-

based approach, however one might interpret the term, reflects various cultural and educational tendencies presently found in CIS. [2]

The main idea of the competence-based approach is that education has to provide not isolated knowledge and skills but to develop students' ability and readiness for future professional activity in various social and working conditions.

The policy for the development of education in Kazakhstan provides for key competencies as the basis for the new content of education. The main result of education is not a combination of a system of knowledge, skills, skills, but the basic competencies of intellectual, socio-political, information and other spheres.

Kazakh schools recently use a competent campaign to formulate the goals and content of education. Davydov, Lerner, Kraevsky, Shchedrovitsky, Skatkin and many others followed this approach. They saw it as a response to new requirements dictated by society for the quality and skills of a professional.The application of this method is due to three reasons:

−the existence of pan-European and global trends towards the integration and globalization of the world economy;

−a phased shift in the educational paradigm, where the emphasis from the principle of adaptability is shifted to the principle of student competence;

−requirements of regulatory documents. [3]

The change in the value basis of education makes it necessary to introduce a new concept that would reflect the ability of an individual to solve emerging tasks that require a knowledge base, experience and their transformation according to skills and individual characteristics. This concept is called competence, that is, the ability of a person to deal with emerging tasks due to the specifics of practical activity. Competence is considered a general concept covering all activities and all tasks solved in it. Important characteristics of competence:

−competence is part of the field of skills, but not knowledge, that is, ability based on experience, values gained during the learning process;

−competence as a result of conscious activity;

−the dependence of the nature of the competence on the content of the activity, certain circumstances;

−development of competence, starting from the initial level;

−the presence of a multilateral, diverse and systemic nature as a result of the interaction of knowledge, ability and skills [4]

Foreign linguists distinguish six components of competence: linguistic competence, sociolinguistic, discursive, strategic, sociocultural and social. These components are based on comprehensive work with texts of different genres, where the work is related to the pre-text, text and post-text stage. Each stage has its own specific tasks to help you understand unfamiliar text and form components of communicative competence.

Competence is considered as certain ability required for the effectiveness of the implementation of a particular action from the selected area. It consists of highly specialized knowledge, subject skills and ways of thinking. A teacher is called competent if he has a set of competencies of different levels.

A competent teacher seizes every opportunity to encourage learning, believing that all students can learn. And learning isn't limited to the classroom. To this end, the teacher takes every opportunity to improve on his or her own professional practice, in order to provide quality learning.

Consider key competencies that imply a person has a high level of initiative, organizational abilities, readiness to submit an objective assessment and analysis of his actions. Identification of key competencies:

- Information competence - willingness to work with information.
- Communicative competence - readiness to communicate with other people.
- Cooperative competence - willingness to collaborate with other people.
- Problem competence - readiness to solve problems.

The introduction of a competency-based approach to the organization of the pedagogical process occurs through an understanding of the dependence of human progress on the level of individual development. This approach focuses on the result of education, when a person is able to act in difficult situations to find a solution.

How to teach students to develop key competencies, apply the acquired knowledge and skills in their own speech, including in a professionally oriented field? To answer this question, we conducted an experiment on the basis of the university. 23 students from university participated in the study. The aim of this study was: to teach students to develop key competencies for further use in professional activities. We have compiled a staged planning of several lessons to ensure a versatile impact on the intellect of students through intensive speech and mental activity.In these lessons, forms were used that stimulated the desire of students to engage in communication in order to be understood. These include the use of structural logic diagrams and tables, scheme, as well as presentations.

After analyzing the results of the reflection, during a practical experiment, we made the following conclusions:

Formation of key competences cannot be formed outside of activity. The basis of its formation is the experience of human communication. The teacher for this type of competence, setting by his own communication the standard of communicative skills, organizing the interaction of students with each other.

Due to using of various methods and forms focused on oral and written communication, it has allowed to provide a versatile impact on the intellect of students through intensive speech and thought activity. By doing so developing key competencies. The lessons were compiled according to the book English file (Intermediate) by Christina Latham-Koenig Clive Oxenden. The fragments of the lessons are shown in Table 1.

Table 1

Lesson plan

Lesson 1	
Look at the pictures. What are people doing? Work in pairs. Write down 3-4 things you Would like to learn more information about tennis. Read the texts and say whether you have found the answers to your questions. P.45	Work in pairs – formation of cooperative competence
Present you questions and the answers in the text. Which questions are still without answers? (выписать их на доску). H/w: Questions which are still without answers. – Find the information.	Formation of informative competence, selection of necessary information.
Find out where you could play tennis in Uralsk to present it the next lesson.	Formation of communicative competence - presentation of material.
Lesson 2 Where could we play tennis in Uralsk? Some more information about famous tennis player in your country.	The formation of cooperative competence is group work.
I would like to ask you one more question: Do you have any superstitions, e.g. when you are playing or watching sport, or before an exam? ex.4(g) p.45 (Work in 2 groups of 3-4) Evaluate your work in group.	Informative competence - individual work.

Present the ideas of your group. H/t Write a letter to your friend. Advise him a kind of sport to do and explain your choice.	Written communicative competence. Problematic competence-work with a common goal, collective summing up and evaluation.

Thus, a competency-based approach is an enhancement of the applied, practical nature of all school, education (including subject education). This direction arose from simple questions about what results of school education a student can use outside school. The key idea of this direction is that in order to ensure the "distant effect" of school education, everything that is studied should be included in the process. The formation of key competencies in the classroom requires special training of teachers, because this is especially true of theoretical knowledge, which should cease to be «dead duck» and become a practical means of explaining phenomena and solving practical situations and problems. [5]

Modern people live in unusual times. In the era of informatization of society, it is very important to be a purposeful person who can determine the most important thing for himself and concentrate on him. Only this will allow not to get lost in society, successfully adapt in it and self-realize. This is where the key competencies are needed.

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METHODS OF FORMATION OF COGNITIVE STRATEGIES IN MIDDLE-LEVEL SCHOOLCHILDREN

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СПОСОБЫ ФОРМИРОВАНИЯ ПОЗНАВАТЕЛЬНЫХ СТРАТЕГИЙ У ШКОЛЬНИКОВ СРЕДНЕГО ЗВЕНА

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Abstract

The article substantiates the need for the formation of cognitive strategies of the individual in the educational process, which determine the possibility of developing the ability of schoolchildren to learn. The concept of "cognitive strategies" is analyzed, their relationship with general educational skills is revealed, the need for personal orientation of the educational process is indicated as a condition for their formation. The structure of the process of formation and development of cognitive strategies of schoolchildren is described, a system of principles is presented that determines the orientation of education towards the formation of personal cognitive strategies of schoolchildren. The emphasis is on the fact that the development of personal cognitive strategies of students is carried out through the comprehension and consolidation of personal cognitive experience. The generalization of practical experience in organizing the educational process made it possible to structure a normative generalized cognitive strategy, clarify the requirements for task systems used in teaching English in order to develop personal cognitive strategies for schoolchildren, and offer guidelines for organizing the stages of forming cognitive strategies based on work with task systems.

Аннотация

В статье обосновывается необходимость формирования познавательных стратегий личности в образовательном процессе, определяющих возможность развития способности школьников к обучению. Анализируется понятие «когнитивные стратегии», раскрывается их связь с общеобразовательными умениями, указывается необходимость личностной направленности образовательного процесса как условие их формирования. Описана структура процесса формирования и развития познавательных стратегий школьников, представлена система принципов, определяющих направленность образования на формирование личностных познавательных стратегий школьников. Акцент делается на том, что развитие личностных познавательных стратегий учащихся осуществляется через осмысление и закрепление личного познавательного опыта. Обобщение практического опыта организации учебного процесса позволило структурировать нормативную обобщенную познавательную стратегию, уточнить требования к системам заданий, применяемым в обучении английскому языку с целью выработки личностных познавательных стратегий школьников, предложить методические рекомендации по организации этапов формирования когнитивные стратегии, основанные на работе с системами задач.

Аңдатпа

Мақалада мектеп оқушыларының оқу қабілетін дамыту мүмкіндігін анықтайтын оқу-тәрбие процесінде тұлғаның танымдық стратегияларын қалыптастыру қажеттілігі негізделеді. «Танымдық стратегиялар» түсінігі талданады, олардың жалпы білім беру дағдыларымен байланысы ашылды, оларды қалыптастырудың шарты ретінде оқу-тәрбие процесінің тұлғалық бағыттылығының қажеттілігі көрсетіледі. Мектеп оқушыларының танымдық стратегияларын қалыптастыру және дамыту процесінің құрылымы сипатталған, мектеп оқушыларының тұлғалық танымдық стратегияларын қалыптастыруға білім берудің бағдарын анықтайтын принциптер жүйесі берілген. Оқушылардың жеке танымдық стратегияларын дамыту жеке танымдық тәжірибесін түсіну және бекіту арқылы жүзеге асатынына баса назар аударылады. Оқу процесін ұйымдастырудың практикалық тәжірибесін жалпылау нормативті жалпыланған когнитивтік стратегияны құрылымдауға, мектеп оқушыларының жеке когнитивтік стратегияларын дамыту мақсатында ағылшын тілін оқытуда қолданылатын тапсырмалар жүйесіне қойылатын талаптарды нақтылауға және қалыптастыру кезеңдерін ұйымдастыруға арналған әдістемелік нұсқауларды ұсынуға мүмкіндік берді. тапсырмалар жүйесімен жұмыс істеуге негізделген танымдық стратегиялар.

Keywords: cognitive strategies, foreign language teaching, individual learning, formation process.

Ключевые слова: когнитивные стратегии, изучение иностранного языка, индивидуальное обучение, процесс формирования.

Кілт сөздер: когнитивтік стратегиялар, шет тілін оқыту, жеке оқыту, қалыптастыру процесі.

Introduction

For writing this article, a relevant, significant and an important topic - "Methods of formation of cognitive strategies in middle school students." its importance, urgency and importance are connected with the fact that one of the most important indicators socio-economic well-being of modern society is state of development of cognitive activity of schoolchildren. Because it is students who currently constitute the most important reserve of the country, who can reveal himself only with strong and solid knowledge, skills and abilities. Today's students will determine tomorrow economic and spiritual development, the state of science and culture Kazakh state. Therefore, the problem of cognitive development the activity of schoolchildren occupies a special place at the present stage. These reflections and determined the choice of the topic of our article.

Materials and types of research

The objectives of this study are: firstly, to determine the levels of development of cognitive strategies, secondly, to consider the methods and techniques for developing the cognitive strategies of schoolchildren in teaching English, and thirdly, to analyze the effectiveness of the development of cognitive strategies in middle school students. The method used in this study consists of qualitative and quantitative methods. The study aims to understand and explain the involvement of English teachers and their pedagogy, including the possible views of English teachers on the formation of cognitive strategies. [15]

Currently, there are many methods and principles of teaching a foreign language. In the educational process, the student uses cognitive strategies that are aimed at solving learning problems. A strategy is a specific set of task execution operations that are aimed at achieving an end goal. Using the entire set of strategies is not an innate skill, so learning experience plays an important role in the success of their use. [20] L. V. Trofimova notes that cognitive strategies are formed under the influence of learning styles, motivation, and belief in one's own abilities. [17]

The importance of problem-based learning in the development of cognitive activity of students, which increases cognitive activity, was noted by V. I. Zazvyazinsky, M. I. Makhmutov, Zh. B. Koyanbayev, A. A. Beysenbayeva. [4]

One of the effective means of activating educational cognitive activity, cognitive strategies of a student are the works of T. S. Sabirov, A. E. Abylkasymova, R. S. Omarova, M. A. Kudaikulov on independent work of a student, self-educational activity. [4]

The successful development of the use of a particular strategy is carried out taking into account the psychological and cognitive characteristics of students. V. A. Krutetsky notes that a teenager needs a change in the old forms and methods of teaching, which is characteristic of elementary school students, since the mental activity of a teenager has its own characteristics. It is noted that secondary school students have more developed abstract thinking. At the same time, concrete-figurative thinking continues to play an important role in the process of specifying, illustrating, revealing the content of the concept. [16]

The composition of cognitive strategies is determined by the structure and components of purposeful cognitive activity:

- presentation of the goal;
- motivation;
- criteria for achieving the goal;
- the main operations and actions aimed at achieving the goal;
– sequence of operations and actions;
- control over the execution of operations and obtaining an intermediate result;
- correction of the stage of the operation or presentation of the goal;
– criteria for terminating the activity process;
– fixing the result of activity. [14]

Among domestic and foreign researchers, we can find various classifications of strategies aimed at developing students' ability to perceive information, think, remember it and use it. According to the ideas of A.A. Pligin, strategies can be divided into five groups:

1. According to the level of detail of the involved elements of experience:

1) microstrategies - reveal the relationship of internal mental operations with elementary external actions;

2) macrostrategies - reveal external elements of activity that are significant for effective implementation;

3) metastrategies - reveal the necessary sequence of external and internal procedures for changing already developed strategies;

4) megastrategies (metasocial strategies) - reveal interpersonal strategies for generalizing human experience (this includes holistic generalizations accumulated in culture regarding education, training and strategy development). [3]

2. By areas of human activity:

- general - relate to the management of activities in general;

- special - relate to a specific area of human activity.

3. According to the specificity of the elements of the strategy:

- individual - consist of elements characteristic only for a particular person;
- universal - consist of elements characteristic of most people.

4. According to the success of the activity:

- effective - lead to the most complete result with a certain ease of achieving it in a relatively short time;
- inefficient - do not lead to the desired result in activities at the proper level of quality [13].

5. By the number of subjects of activity:

- individual - relate to the organization of the experience of one person;
- group - relate to the organization of the experience of several people;
- social –

relate to the experience of organizing a community of people, generations, cultures, etc.

Most often, each of these components is considered separately, without disclosing the entire individual chain of agreed elements within and between each component. That is why it is necessary to analyze integral units of cognitive experience. [6]

Thus, we call a cognitive strategy an individual interconnection (sequence) of operations and actions (intellectual and practical) aimed at realizing the result in cognitive (learning) activity.

At the same time, microstrategies reveal the interconnections within mental activity, and macrostrategies represent the interconnection of internal and a number of external elements of activity.

Let us give as an example several individual microstrategies for the correct spelling of dictionary words. [11]

Example №1

Heard a word whose spelling needs to be checked.

He said the word "to himself" several times.

I asked myself, could there be other options?

He spoke several words.

One of the options sounded better.

I wrote down my favorite.

Example №2

Remembered the internal image of the word (for example, written on the board, depicted in a book, textbook or notebook).

· Created another image with possible ways of writing different fragments.

Visually compared them with each other.

· As a result, on an emotional level, I determined which of them looks more beautiful (correct, pleasant, familiar), and wrote down the option that inspires the most confidence. [19]

Research results

Analysis of the composition and sequence of individual cognitive strategies can serve as a means of self-development of the student, building his individual trajectory of personal development within the educational process in the course of discovering and mastering knowledge. Teachers get the opportunity to analyze the course of thinking and practical actions of the child. The data obtained can become the richest tool for designing educational technologies of a fundamentally different type (in which individual cognitive strategies are transformed into means of further learning). [18]

The study of cognitive strategies also allows you to determine the cognitive (cognitive) style of the child. For example, a student may have the following preferences: a visual style of thinking, with the logic of building inductive connections, with preliminary analysis and planning of activity stages, with preferences for building external graphical models in the course of solving. These preferences are clearly visible when analyzing the internal elements of the cognitive strategy.

In our technology, students first identify their strategies, after which they conduct a collective analysis of the internal elements of the strategies, highlight the general: stages of activity and repetitive actions, as well as the special: individual successful actions (subject-logical and mental),

sequence of actions. Thus, the child identifies, comprehends and generalizes the orienting and performing foundations of his educational activity on his own, eventually turning them into universal models (schemes, algorithms) in the form of memos, diagrams and tables with high operational and control functions. [1]

The development of reflection on already established cognitive strategies in children at school should begin as early as possible with respect to most types of educational and objective activities proper. We propose to do this in stages, starting with a simple self-report on the progress and internal logic of organizing your actions. [10]

For example, in my practice it looks like this. I am preparing a small dictation in the form of a group of phrases or text. It is important that the selected words correspond to the entire complex of the material covered so far, suggest the widest possible application of known knowledge (including the vocabulary words passed). At each stage, the children work using carbon paper so that the results of their activities are both for me and for the students.

At the first stage, the children write a dictation, and then, after handing over their work to me, they move on to self-reports. They write down each word written in the dictation in a column, reveal the course of their thoughts about the correctness of their spelling, detail their actions as detailed as possible, after which a group discussion is organized. I ask a few students to comment on the course of their actions, and then they all discuss general and specific actions together. At the same time, as a teacher, I can always balance the group and individual activities of children.[5]

Most of these works take place without marks for writing literacy in order to teach children to boldly think “out loud” and analyze the course of their reasoning. You can give marks for the quality of self-reports and their analysis, and also more fairly separate the learning process and its results: it takes time to learn, and only after a certain time should one evaluate what has been achieved. In addition, in the final works, it seems important to us to evaluate not only the actual result, but also the presence of a thorough analysis of their reasoning, so the teacher can give the student two marks (by analogy with a school essay). In particular, it can be low for literacy, and high for reflection. Then the teacher not only evaluates the final result, but also the learning process, which, in feedback, sets a personality-oriented orientation to learning, filling it with relationships, positive motivation for further actions and personal meaning. [7]

We propose to use simple self-reports throughout the training, gradually complicating the content of reflection.

For example, intermediate students could write the following dictation, consisting of phrases, aimed at applying various types of rules and checking the spelling of learned vocabulary words.

Dictation example.

A sidelong glance, suburban ticket offices without detracting from dignity, city suburbs, captain's calling, document preamble, intolerable character, distinct noise, fastidious comrade, wooden spindle, illuminated terrace, narrow corridor, touch the palm of your hand, tanned boy, trans-European express, bone marrow, avenue of heroes, begged to act [2].

Children need to implement the most important components of learning activities within the organization of an individual cognitive strategy in order to ensure a successful learning outcome, especially the following include:

- distinguishing orientation
- application-performing. [12]

Students should distinguish between words that can be written in an ambiguous way, which are a special object of analysis in terms of spelling vigilance. And it is also important to correctly interpret the applicability of the rule. Each of these components within a comprehensive strategy for writing a dictation will require a specific organization of attention and cognitive processes from the child: memory, perception, representation, thinking, fantasy. For example, in writing vocabulary words, it will be important to use different types of memory (visual, auditory, kinesthetic) and fantasy to construct different spellings of words. And in the case of spellings into separate groups of rules, thinking comes to the fore (building the logic of reasoning and inference). It is important for teachers

and students to understand that all internal, intellectual processes are provided by a system of mental actions and operations that lead to different results. [9]

Conclusion

Thus, the process of formation and development of personal cognitive strategies of schoolchildren should ensure that students understand not only what and how to do it, but also why it needs to be done, and this, in turn, can be achieved on the basis of understanding and consolidating their personal cognitive experience. The main task of the teacher in the process of forming cognitive strategies is to ensure the active participation of students in educational and cognitive activities, which can lead to the achievement of planned learning outcomes. It is useful to remember that what the student does is actually more important than what the teacher does. In this regard, the dialogic nature of the learning process, the inclusion of schoolchildren in cognitive interaction largely determines the effect of the personal significance of learning, determines the emotional ties between the participants in the educational process, expands the possibility of stimulating students, as a result of which the process of enriching individual cognitive cognitive strategies is accelerated. experience based on the formation and development of personal cognitive strategies.

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ACTIVATION OF STUDENTS PROJECT AND RESEARCH ACTIVITIES

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АКТИВИЗАЦИЯ ПРОЕКТНО-ИССЛЕДОВАТЕЛЬСКОЙ ДЕЯТЕЛЬНОСТИ СТУДЕНТОВ

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СТУДЕНТТЕРДІҢ ЖОБАЛАУ-ЗЕРТТЕУ ЖҰМЫСЫН БЕЛСЕНДІРУ

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Abstract

The relevance of this work requires solving the current situation in the development of education and society. If earlier, in order to be a socially quite developed person, it was enough to be a good specialist with manifestations of manifestations and manifestations, then at present, to be an extraordinary person, able to independently pose and solve problems that arise. Only this is certainly a successful, sought-after specialist.

One of the forms of formation of the professional, social, creative personality of students is design and research activities. This type of activity allows the student to reveal his creative potential, discover knowledge, research abilities, independence, activity, creativity, the ability to plan his activities qualitatively and achieve results, and the ability to work in a team.Design and research activity is interesting in that it can be considered as a joint educational, cognitive, research creative activity of students and teachers, which has a common goal, common methods, methods of activity aimed at achieving a common result in solving a problem that is significant for everyone. project participants.

Аннотация

Актуальность данной работы требует решения сложившейся ситуации в развитии образования и общества. Если раньше для того, чтобы быть социально достаточно развитой личностью, достаточно было быть хорошим специалистом с проявлениями проявлений и

проявлений, то в настоящее время быть личностью неординарной, способной самостоятельно ставить и решать возникающие проблемы. Только это непременно успешный, востребованный специалист.

Одной из форм формирования профессиональной, социальной, творческой личности студентов является проектно-исследовательская деятельность. Данный вид деятельности позволяет студенту раскрыть свой творческий потенциал, раскрыть знания, исследовательские способности, самостоятельность, активность, креативность, умение качественно планировать свою деятельность и добиваться результатов, умение работать в коллективе. Проектно-исследовательская деятельность интересна тем, что ее можно рассматривать как совместную учебную, познавательную, исследовательскую творческую деятельность студентов и преподавателей, имеющую общую цель, общие методы, приемы деятельности, направленные на достижение общего результата в решении значимой для всех проблемы. участники проекта

Аңдатпа

Бұл жұмыстың өзектілігі білім беру мен қоғамның дамуындағы қазіргі жағдайды шешуді талап етеді. Егер бұрын әлеуметтік тұрғыдан дамыған адам болу үшін көріністері мен көріністері бар жақсы маман болу жеткілікті болса, қазіргі уақытта туындайтын мәселелерді өз бетінше қоя алатын және шеше алатын ерекше тұлға болуы керек. Тек бұл, әрине, табысты, ізденетін маман.

Студенттердің кәсіби, әлеуметтік, шығармашылық тұлғасын қалыптастырудың бір түрі – жобалық-зерттеу іс-әрекеті. Іс-әрекеттің бұл түрі оқушының шығармашылық әлеуетін ашуға, білімін ашуға, зерттеушілік қабілеттерін, дербестігін, белсенділігін, шығармашылық қабілетін, өз қызметін сапалы жоспарлап, нәтижеге қол жеткізуін, топта жұмыс істей білуін қамтамасыз етеді. Жобалау және зерттеу әрекеті – бұл қызықты, оны әркім үшін маңызы бар мәселені шешуде ортақ нәтижеге жетуге бағытталған іс-әрекеттің біртұтас мақсаты, әдістері, әдістері ортақ студенттер мен мұғалімдердің бірлескен оқу-танымдық, зерттеушілік шығармашылық қызметі ретінде қарастыруға болады. жобаға қатысушыларқолданудың кемшіліктері бар, өйткені зерттеуде желілік және техникалық мәселелер де қарастырылды.

Keywords: Design and research activity, activity,creative potencial ; cognitive ,achieving a common result

Ключевые слова: проектно-исследовательская деятельность, деятельность, творческий потенциал; познавательный, достижение общего результата

Кілт сөздер: Жобалық-зерттеу қызметі, белсенділік, шығармашылық потенциал; танымдық, ортақ нәтижеге жету

Introduction

The structure of the work is determined by the purpose and objectives of the study. The work consists of an introduction, two chapters, a conclusion, a list of references, an appendix.Before considering the essence of project activity, it is necessary to consider the very concept of activity, and find out its components. The project activity of students is also one of the methods of developmental education, it is aimed at developing independent research skills, helps develop creative abilities and logical thinking, combines the knowledge gained during the educational process, and attaches to vital problems.The purpose of the project activity is the knowledge and application by students of the skills, abilities and knowledge acquired in the study of various subjects (on an integration basis).[1]

Materials and types of research

The objectives of this study are: first, Formation of skills for collecting and processing information, materials (the student must be able to choose the appropriate information and use it correctly) Ability to analyze (creativity and critical thinking); To form a positive attitude towards work (the student must show initiative, enthusiasm, try to complete the work on time in accordance with the established work plan and schedule).Prepare students for the implementation of projects (carrying out a special orientation so that students have time to choose a project topic, at this stage students with experience in project activities can be involved);Provide project management by teachers - discussion

of the chosen topic, work plan (including execution time) and keeping a diary in which the student makes a reflection - appropriate records of his thoughts, ideas, feelings. The diary should help the student write a report if the project is not a written work. The student uses the diary during interviews with the project manager.

Research results

The increase in motivation and the development of creative abilities is due to the fact that in the project activity there is a key feature - an independent choice.The development of creativity and the transition from an instrumental approach to a technological one is due to the need for deliberate choice and planning of activities to achieve the best result. [2] A sense of responsibility is formed subconsciously: the student tries to prove to himself that he made the right choice. We should also note that the desire to assert oneself is one of the main factors in the effectiveness of project activities. During the solution of practical problems, cooperation relations with the teacher are naturally formed, since for each of them the task is of substantive interest and stimulates the desire for an effective solution. This is especially intense in the tasks formulated by the student himself.

For a student, a project is a chance to maximize their creative potential. This is an activity that allows you to express yourself personally or in a group, try your hand, apply your knowledge, make a great difference, show the publicly achieved result. This is an activity aimed at solving an important problem that the students themselves have formulated. The result of this activity is the discovered way to solve the problem - it is practical and significant for the discoverers themselves. And for a teacher, an educational project is a unifying didactic tool for development, training and education, which allows developing and developing design skills and abilities: problematization, goal setting, activity planning, reflection and introspection and self-presentation, as well as information search, practical application of academic knowledge, self-realization, research and creative activityMost of the authors who define the project identify a number of characteristic features of the project as a teaching method. Initially, this is the presence of a problem that needs to be solved during the work on the project. Moreover, this problem should have an important character for the author of the project, motivate him to look for a solution. The project must certainly have a clearly defined, realistically achievable goal. In the most general sense, the goal of the project is always to solve the original problem, but in each specific case, this solution has its own, which is not repeated. This incarnation is the final product that is created by the author in the course of his work and also becomes a means of solving the problem of the project. Clarification of the original problem, the formulation of the goal and the creation of an image of the project product are important characteristic features of the project.[3]

Another difference of the project is the preliminary planning of the forthcoming work. The whole path from the initial problem to the implementation of the project goal should be divided into separate stages with their own intermediate tasks for each; as well as to identify ways to solve these problems and find resources; develop a detailed schedule of work indicating the timing of the implementation of each of the stages. The implementation of the project work plan is associated with the following actions:

- the study of literature and other sources of information, the selection of information;
- conducting various experiments, experiments, observations, studies, surveys;
-analysis and generalization of the obtained data;
-formulating conclusions and forming on this basis their own point of view on the initial problem of the project and ways to solve it.[4].

To implement the found method of solving the project problem, it is necessary to create a project product. The design product must have certain properties of consumers, i.e. meet the needs of any person who has encountered this problem, for the solution of which this project was implemented. The project must have a written part - a progress report, which describes all the stages of work (starting with the definition of the project problem), all decisions made with their justification; all the problems that have arisen and how to overcome them; the collected information, the conducted experiments and observations are analyzed, the results of surveys are given, etc.; the results are summed

up, conclusions are drawn, the prospects of the project are clarified.One of the most important conditions of the project is public defense, presentation of the result of the work.[5]

During the presentation, the author not only talks about the order of work and shows its results, but also demonstrates his own knowledge and experience in solving the problem of the project, acquired competence. The stage of self-presentation is the most important part of the work on the project, which involves a reflexive analysis by the author of all the work he has done, as well as the experience that he has acquired. The project method of teaching is close to problematic teaching, which involves the logical and purposeful presentation of cognitive problems to students, after solving which, under the guidance of a teacher, they have a dynamic perception of new knowledge. Problem-based learning coordinates the stability of knowledge and its creative use in the student's practical activities. The project method has an analogy with developmental learning. Developmental learning is an active-activity method of learning, with it purposeful learning activities take place. The student, being the subject of this activity, consciously sets the goals and objectives of self-realization and self-determination creatively, achieves them.The project method is not new in world pedagogy. It originated in the new century in the United States. It was called the project method and it was integrated with the ideas of the humanistic direction in philosophy and education, developed by the American philosopher and teacher J. Dewey, and his student V.Kh. Kilpatrick. J. Dewey recommended that learning be developed on an active basis, through the expedient work of the student, together with his personal interest in this knowledge. [6]

At the same time, it was extremely important to show students their personal interest in the acquired knowledge, which can and must be useful to them in later life. This requires a problem that was taken from real life, familiar and valuable to the child, for the solution of which he needs to apply all the acquired knowledge, new knowledge that has yet to be obtained. The teacher has the right to suggest sources of information, or he can incline the students' thoughts to the desired orientation for self-searching. But in the end, students are obliged to solve the problem independently and in joint work, applying proper knowledge from various fields, to get a real and significant result. All work on this problem is restructured into project activities. Over time, the concept of the project method has evolved. Originating from the idea of independent education, at the present time it is becoming an integrated component of a fully developed and organized education system. But its essence remains unchanged - to stimulate the attention of students to a variety of problems, involving the possession of certain knowledge and through project activities, providing for the solution of these problems, the ability to practically apply the knowledge gained, the development of reflex (in the terminology of John Dewey or critical thinking). [7]

The meaning of reflex thinking is a long-term search for facts, their analysis, reflections on their reliability, logical alignment of facts for learning new things, for finding a way out of doubt, developing confidence based on reasonable reasoning. The project method interested Kazakhstan teachers already at the beginning of the twentieth century. The very essence of the project method is the process of developing students' cognitive skills, the ability to independently distribute their knowledge, the ability to navigate the information flow, the development of critical and inventive thinking.The project method is a term from the field of didactic science, private methods, if it is used within a specific subject. Method - is a didactic category. This is a set of techniques, operations for acquiring a certain area of practical and theoretical knowledge, a particular type of activity. This is the stage of cognition, a way of organizing true cognition. Therefore, if we are talking about the method of projects, then we understand it as a way to achieve an instructive goal through a detailed development of the problem (technology), which involves the completion of a real practical result, formalized in one way or another. To solve their didactic tasks, teachers turned to this method. The principle of the project method was based on the idea that is the essence of the concept of the project - its pragmatic orientation to the result that can be obtained by solving one or another practically or theoretically significant task. The result obtained can be comprehended, seen, and also applied in existing practical activities.[8]

In order to obtain such a result, it is necessary to teach children or students not only to think independently, but also to identify and solve problems, using for this purpose knowledge from various

fields, the ability to predict the outcome and the possible outcome of different solutions, the ability to find cause-and-effect relationships.The project method is aimed at independent work of students - individual, pair, group, which students perform for a certain period of time. This method is inseparably combined with group methods. The project method involves solving a problem. The solution of the problem involves the use of a complex, a variety of methods, teaching aids, as well as the need to integrate knowledge, the ability to use knowledge from various fields of science, technology, engineering, and creative fields. The method of projects as a pedagogical branch assumes a commonality of research, search, versatile, problematic methods and tasks that are creative in their entirety. The results of experimental work on the formation of design and research skills among students at the M.Utemisov West Kazakhstan University

Teaching a foreign language is a complex and multifaceted process, with its own methods and methods, which contributes to the effective use of language knowledge, skills and abilities within the academic subject and beyond. For bachelor's students, the methodology of forming foreign language communicative competence within the framework of design and research activities becomes especially successful. [9]

Experimental work to understand the level of formation of design and research skills among students at Makhambet Utemisov West Kazakhstan University, 2nd year students took part in the experiment, the main purpose of this event was to identify the level of readiness of students for design and research tasks, independent or group search for a non-standard solution to the situation using various resources or in a situation of limited choice.

The tasks were directly aimed at identifying the creative abilities of students, the level of development of critical thinking and the degree of independence of students. The event was aimed at the consulting role of the teacher, whose task was only to direct and prompt, but not to impose the search for solutions in their own ways. It is these algorithms of actions that are key in the formation of design and research skills, since in our work, design and research skills are understood as intellectual and practical activities that are aimed at designing one's own research, its implementation and evaluation of the results obtained.

A modern person should be able to navigate the endless flow of incoming information, be able to choose only what is necessary and be able to use it. To determine its nature and significance, it is necessary to gain experience in critical analysis, evidence of the propositions put forward. Based on the level characteristics of design and research skills, as well as taking into account the age characteristics of students, we have identified the criteria for the formation of design and research skills:

1) the interest of students in research activities and research objectives;

2) readiness to implement design and research skills;

3) the degree of independence of students in educational and search activities;

4) the manifestation of a non-standard and creative approach in solving tasks. [30]

These criteria are the basis for the identification of the levels of formation of design and research skills of students:

1) adaptive level – the manifestation of the student's unstable interest in the proposed activity, difficulties in completing tasks at different stages of the study, inaccuracies in presenting the project solution, work under the clear guidance of the teacher;

2) productive level – the student shows interest in the proposed activity, has some skills that he tries to show in working on the project, the research can be carried out with the help of a teacher, shows a small degree of creativity in developing the project and presenting its results;

3) creative level – the student shows a high level of skills, cognitive and creative activity, originality and independence are used in the work on the project at different stages of research. [10]

One of the main elements of a person's creative development is the ability to think critically, to be able to present non–standard solutions to tasks. The student needs to be able to make a choice independently, without relying on someone else's opinion and suggestions.

The main factor of project work is the manifestation of students' independence. It is a condition of an active thought process, a volitional action, a manifestation of interest in cognitive search, which means the development of the level of certain personality qualities, such as: will, cognitive activity,

the need for new knowledge, independent search for new information. With the help of independence, students have the opportunity to freely navigate in various situations, to show individuality in solving their goals, to show the skills of analysis, systematization and planning of their activities without the practical help of a teacher. [11]

In order to accurately determine the level of formation of design and research skills, it is possible to use the following diagnostic methods:

1) the teacher may carry out pedagogical supervision during the term and extracurricular activities using design and research activities;

2) the teacher must analyze the activities of students in these training sessions;

3) the teacher can develop and give questionnaires, questionnaires that will allow to assess and identify the level of formation of certain skills: creativity, independence, the level of motivation for academic research.

To identify the level of formation of critical thinking skills, students were given a task that is aimed at showing the following qualities: the ability to analyze, compare and select the necessary information. The students were given the text "Computers – New Era of Technologies". Some sentences were omitted in the text, students had to fill in the gaps and explain their choice. This text is presented by us in Appendix No. 1. Through this task, students should manifest:

1) the ability to compare and select information;

2) the ability to build a logical chain of representation of statements;

3) the ability to express and defend your point of view. [12]

Having received the results after carrying out this task, we concluded that:

- four students completely lack the skill of critical thinking;
- six students showed an average level of critical thinking skills;
- three students showed proficiency in analysis, comparison, the ability to build a logical statement and an independent search for a solution to the task.

Based on the obtained research results, we can conclude that a low level of critical thinking formation affects the acquisition of research skills in English lessons. Critical thinking is high-level thinking that allows you to question incoming information. [13]

At the lesson, the students were divided into two teams: 6 and 7 people. They were distributed depending on the level of proficiency in a foreign language so that the forces in knowledge were distributed equally in the teams. 5 stages were held for the warm - up:

1) Warming-up task. The task is to guess the words, because all letters are mixed, and to read them aloud.

2) Answer the questions. Every player of your team must answer a question, nobody can help him.

3) The next task: I will give you these cards; there are 14 irregular verbs in the box. Try to find them.

4) The next task for you is to fill in the gaps. You will listen to the song by Louis Armstrong and you will have sheets of papers with this song, but some words will be missed.

5) The next task is to find synonyms to the given words.

These tasks were done in order to prepare students for the most important thing - the beginning of design and research activities. As expected, the students coped with the first five tasks quickly enough, so there was more time left for the project.

The meaning of the projects was that the captains of the teams approach the host and pull out 2 topics out of 6 proposed. All of them are associated with a certain type of transport. Previously, in English lessons, we covered this topic, the students were introduced to the modes of transport, briefly discussed the advantages and disadvantages, their favorite modes of transport. The first team's modes of transport were a bus (bus) and a train (train). The team presented schematically the type of transport, pros and cons, explained whether they prefer and recommend this type of transport, expressing their ideas in full sentences.

The second team's modes of transport were a plane and a car (car). The team at Watman was able to present photos of modes of transport by finding them via the Internet and having time to print

them on a printer in the office. Next to them, in different colors, they painted the pros and cons, which kind of transport each of the students likes and why.

In general, it can be concluded that the event was successful, since a game was used for the initial warm-up, which allowed stimulating interest in working in a foreign language, during the transition to the main part, in which the guys showed their research and creative abilities, they were able to develop and defend successful projects in groups. Each student tried to contribute to the event, the students' interest in the topics was visible, as a result, the students did not remain indifferent to the assigned educational task and offered many solutions to the problem. [14]

Summing up the results of this event, a special evaluation apparatus was created and used, through which the levels of formation of design and research skills of students of the 8th grade were determined:

1. Adaptation level (from 0 to 1 point) – 4 students, caused by insufficient level of formation and proficiency in a foreign language, difficulties arose during the work due to lack of vocabulary, errors in the construction of grammatical constructions, incorrect pronunciation of words.

2. Productive level (from 2 to 4 points) – 6 students, caused by some difficulties in the use of vocabulary, rare mistakes in the pronunciation of words and the use of grammatical constructions, independence of work is not fully manifested.

3. Creative level (from 5 to 6 points) – 3 students, practical absence of pronouncing errors, correct and appropriate use of the studied vocabulary, rare errors in the construction of grammatical constructions. The students had a huge number of creative ideas that they willingly offered, i.e. they were leaders who took on the role of managing the process of research and project implementation.

Based on the analysis of the event, we identified the level of formation of design and research skills among students of the 8th grade:

-20% of students have a high degree of formation of design and research skills;

-50% of students have an average level of formation of design and research skills;

-30% of students are at a low level of formation of design and research skills.

Based on the conducted experiment , the following conclusions were made:

- it is necessary to add more tasks to the educational project aimed at developing the creative abilities of students;

-it is necessary to instill in students the habit of working independently;

-it is necessary to reveal the inner potential of each student, try to develop critical thinking;

- it is necessary to explain to students the importance of tasks on design and research activities, because in the process of independent search for a solution, the student learns a foreign language better.

After receiving the project topics, the students had a free choice of how to present their project. The main task is to reflect the new vocabulary studied and demonstrate the correct construction of grammatical constructions. On a separate table there were materials that students could use in their presentation: pencil, felt-tip pens, watmans, scissors, glue, sheets, etc. Despite the limited time, the guys used a lot of material and were able to present their projects in an interesting way.

Thus, the project activity or design method is a new, scientifically based method of educational work, in which the student is the organizer, motivator, performer and controller of his educational activity, which meets the requirements of the concept of modernization of the dynamically developing Kazakhstan education.

Conclusion

Design and research activity is one of the important tools for obtaining information from students in the course of independent research. The main purpose of design and research activity is reduced to the active work of the student on the design of the study, its implementation and analysis of the results. Project-research activity is of practical value in teaching English, especially in the middle level of a comprehensive school. It is designed to master one of the main tasks of teaching English - communicative competence, and also plays a role in the formation of a multifaceted personality. The feeling of success associated with the successful implementation of a research project

increases the interest of students in a foreign language, and hence the level of their intrinsic motivation.

After analyzing the role of design and research activities in the development of foreign language communicative competence (in the aggregate of language, speech, social, sociocultural, compensatory and educational and cognitive competencies), it seems possible to conclude that the development of research projects in English lessons should become one of the most important teaching aids. The teacher needs to pay special attention to this type of activity, which involves the active introduction of developmental tasks, taking into account their practical value and relying on the age characteristics and interests of students. The importance of the introduction of this educational technology at the middle stage of training is due to the fact that it is in the middle link that there is a clear formation and mastery of the skills of using communication tools. During the performance of tasks, project presentation, students master the technique of organizing research work, project implementation, public speaking, which allows them to successfully develop "flexible" skills (critical thinking, autonomy, search for non-standard solutions, teamwork, etc.), which are in high demand in the modern labor market.

At the same time, it is necessary that classes in design and research activities be systematic and systematic, represent a graduated system where each new stage of research is carried out at a new, more advanced level, but at the same time relying on previously acquired skills, developing them and forming new ones.

The developed recommendations should become an effective tool for the competent organization of design and research work in a modern educational institution.

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Philological sciences

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FORMATION OF FOREIGN LANGUAGE COMMUNICATIVE COMPETENCE

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Abstract

The article deals with the problem of forming foreign language communicative competence of university students. The notion of "communicative competence in a foreign language" is briefly characterized. The article presents the necessity of formation and improvement of foreign language communicative ability as a whole of its components. The development of communicative skills in foreign languages is considered.

Keywords: foreign language communication competence, foreign language teaching, students, competence.

In the context of Kazakhstan's active entry into the global economy and rapidly developing industrial and scientific relations with foreign countries, one of the requirements for graduates of higher education institutions is a working knowledge of foreign languages. All specialists with higher education should know a foreign language and be able to communicate in it in all professionally relevant situations and spheres of communication. [1]

Communicative competence is nowadays considered to be an important competence not only for specialists in humanities but also for technical specialists. Communicative competence ensures successful performance of the main tasks of communication and self-realization of an individual and is expressed in the mastery of language skills and compliance with certain socio-cultural norms of speech behavior. [2]

It is the communicative skills, including non-verbal, that help university graduates consistently communicate with others, organise and direct their activities, and fully realise their professional goals. Communication skills are not only a requirement of the times, but also a prerequisite for successful professional activity. In addition, it is a means of self-development of the future professional student's personality, "a way of contact with professional and universal culture, a component of social relations, an indicator of intelligence". [3]

In the social development phase, future professionals are not only required to have advanced knowledge and skills in their subject areas, but also to be proficient in foreign languages. Professionals acquire new information from foreign sources. Therefore, learning a foreign language will help you get acquainted with the latest technologies and scientific approaches, education, scientific and technological innovations, establish contacts with foreign partners, companies and educational institutions, as well as the level of professional competence of specialists. areas of professional activity, such as increasing We are convinced that learning a foreign language is a need of modern society.

Foreign language learning for non-linguistic students has many peculiarities and many factors need to be reconsidered. Students often see no point in learning a foreign language alongside their professional studies and their motivation to learn a language is often very low. They see no point in

learning a foreign language alongside specialised classes and their motivation to learn the language is often very low.

The problem of developing foreign language skills of non-linguistic students has always attracted the attention of researchers. With the development of social needs, the focus of practical foreign language education in educational institutions has changed and the development of foreign language communication skills has become an urgent task.

The aim of this article is to clarify the content of the concept and structure of foreign language communicative competence as well as to examine the peculiarities of its formation.

In modern language education, one of the important goals of foreign language teaching is the development of communicative skills. However, the question arises what tools, methods and techniques can be used to develop and assess levels of communicative competence. We have to understand that the world of this century is radically different from the world of the last century. The level of communicative competence should correspond to the level at which communication takes place in modern sociocultural contexts.

The right level of communicative competence helps people to communicate and collaborate effectively with people in all spheres of their lives. When the aim of foreign language education becomes the development of communicative skills, foreign languages are no longer just an academic subject, but also a means of enhancing cooperative relationships, achieving mutual understanding, and enriching individual education. Communicative competence is what allows a person to integrate into other cultures, to analyse, communicate and receive information, i.e. to carry out formalised activities. The use of information and communication technologies not only implements the person-centered principle of 21st century education, but also plays a great role in the formation of communicative skills. [8]

Many factors influence the development of a student's communication skills. The main ones are internal and external factors. Internal factors include motivational domains, internal positioning of the individual, self-development and formation, and the individual's sense of identity. External factors include social conditions, i.e. the society in which a particular speech is used, its social structure, age, social status, level of culture and education, differences between speakers, such as place of residence, and the context of communication, including differences. In their speech behaviour because Internal and external factors are interrelated, and external factors depend on internal factors and vice versa. [5]

Today we are increasingly talking about the need to substantially update the content of foreign language education, actively introduce modern competence-oriented techniques and methods that help students to engage in practical communicative activities, practical acquisition of foreign languages, etc. Competence-oriented methods and techniques in foreign language teaching include project methods, debating methods, case studies, role-playing games, using internet resources in foreign language teaching. [4] Let us be specific. One of the modern methods of teaching a foreign language is the project method. By the project method E.S. Polat understands how to achieve educational goals through detailed development of tasks (techniques) which end up with quite real and concrete practical results, framed in some way. The results can be seen, understood and put into practice. This requires the ability to think independently, to discover and solve problems, making full use of knowledge from different fields, the ability to predict the results and possibilities of different solutions, and the ability to build causal relationships. The project method always emphasises independent activities, such as individual, paired or group activities that students carry out over a period of time. The project consists of a topic, selection of ideas, identification of problems, discussion, organisation of participants (formation of groups, distribution of responsibilities), implementation of the project (search and discussion of information, selection of methods for project implementation), follows a certain scheme of presentation, discussion and review. When using this technology in teaching a foreign language it becomes possible to shift the emphasis from various exercises to active thinking activities of the students. Thus, the project method not only stimulates creative and student activity, but also stimulates students' communicative skills.

Next is the debate method as a method of organising competence-based learning. According to S. I. Ozhegov's Dictionary and Dictionary of Borrowings, a debate is "a discussion, an exchange of opinions at a meeting or conference". However, debate as a technique and method has its own specifics. It is not just a free exchange of opinions about something. It is a discussion formalised according to certain rules and of a framework nature. Here two opponents try to convince a third party (the judge) of the correctness of their position. The aim of debate is to develop a full and comprehensive understanding of the topic, to develop critical thinking and the ability to defend one's point of view.

The scheme for practising this method consists of identifying the problem (issue), discussing the issue within the group or collective, presenting the team with a claim "for" - discussing the information received, questioning, "against" the claim Presenting the team with the information received can be presented as discussions, questions, decisions, considerations, conclusions.

According to M. Kaneil, a component of foreign language communicative competence is discursive competence (ability to organise individual sentences into a coherent oral or written message or discourse, using a variety of syntactic and semantic means), sociolinguistic competence (ability to perform speech actions and discourse in accordance with the specific sociolinguistic context of foreign language communication) strategic competence (ability to choose appropriate discourse strategies to enhance competence in foreign language. [6]

Conclusion

Acquisition of foreign language communicative competence will allow a future specialist to perform various types of work with authentic professional literature, namely [7]:

- to understand and interpret the content, be able to retrieve necessary information, translate or abstract the necessary material;
- to be able to communicate at the dialogical level within professional topics, as well as have a coherent monological speech at the level of both independently prepared and unprepared statement, understand the dialogical and monological statement within professional topics;
- to Master the skills of bilateral interpretation and translation;
- to know the basics of keeping business documents in a foreign language
- to use professional dictionaries and reference books;
- to be able to express oneself concisely and precisely in two languages;
- to be able to use the tools of modern information technology in communication and information transfer.

Foreign language communication is possible if the subject is proficient in language as a means of communication. The determining factor is the level of the subject's foreign language communication skills.

The process of developing communicative competence in a foreign language aims not only to equip future specialists with systems of knowledge, skills and competences necessary for effective communication in a foreign language, it should be aimed at forming and participating in a meaningful and communicative position to enable self-determination. , self-development and self-improvement in the educational space.

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THE ROLE OF PROJECT WORK IN THE EDUCATIONAL PROSESS

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Abstract

Project work is a set of interrelated tasks and activities planned by the teacher involving careful independent work on a subject done by the students and intended to achieve a particular purpose and produce something new. It helps to bridge the gap between l study and use of language. In the article, theoretical foundations for project work are reviewed.The study was conducted within 3 weeks in a Higher Pedagogical College named after Zh.Dosmukhamedov. The participants were first -year students majoring in English. 30 students were asked questions about using project work and the results revealed that the use of project work encourages learners to use the foreign language and motivates them. Moreover, it develops the learners´ the ability to cooperate together - because they often work in groups on their project, and their sense for responsibility for their work

Keywords: Project work, educational process, learners

Over the past two decades, project work has been considered as those teaching methods which are repeatedly discussed in publications on modern teaching methodology. In a world that is changing very quickly, teachers are looking for a method which would meet all important requirements of the education process. Project work in the language classroom is recognized as the opportunity for learners to develop their language skills. Haines (1989) argues that in the context of language learning, projects are multi-skill activities focusing on topics or themes rather than on specific language targets. [1]

In the Republic of Kazakhstan, the project activity of students began to develop and be studied from the first days of the development of the sovereign stage of the country's development. [5]

Already in 2003, the Kazakh scientist Zh.R. Bashirova in her monograph "The development of university education in the field of higher school teacher training" emphasized: "motivated inclusion of students in the development of projects is currently an alternative way to comprehensively overcome the shortcomings of traditional education and has a number of additional advantages" (Bashirova, 2003: 53). She referred to the advantages of project-based training of students at the university:

- "social orientation of project activity, which allows to implement projects that change the appearance of the faculty and schools;
- the real involvement of students not only in the comprehension of their socio-cultural environment, but also in the transformation of it;
- the ability to solve problems and implement ideas that are personally significant for students;
- obtaining real results of their work, their implementation in the life of the faculty and their own [6]. Modern Kazakhstani scientists note the need for the formation of a "design style of thinking", combining in this concept a system of theoretical and practical components of human activity, opening everyone access to information resources of education, which allows to reveal, develop, realize the creative potential of the individual (Kasen, Mynbayeva, Sadvakasova, 2013). [7]

Different types of projects allow students to use multiple modes of learning and they are related to the linking of theoretical knowledge and practical actions**.** Types of projects suggested by W. H. Kilpatrick [2] are presented in the drawing below.

Table1

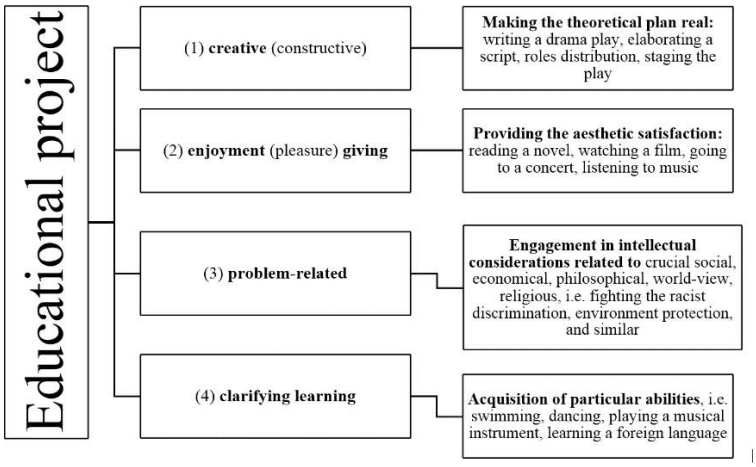

Table. 1 *Types of projects by W. H. Kilpatrick* [2]

To create research projects the learning group is divided into small groups/ teams that are allowed to define their projects themselves with respect to their major. The use of cooperative learning groups allows projects to be considerably more complex and elaborate than projects completed by any one student. Project work requires that the participants work actively and commit themselves to the project. To work jointly in a team means that students must learn to work together to take common decisions and figure out how to share and coordinate work among them.

The project duration is usually several weeks. Students give their English teacher a quick progress report after each work phase has ended. In quick reports, the students describe what they have done and learned as well as any problems and questions that may have arisen during their studying. Acting as a facilitator, the teacher is responsible for offering the group the necessary attention. The teacher's role is to support and guide the work. The end result of the group work is a presentation and a discussion.

The teacher evaluates the contribution of the students, that is, they assess individual students' learning and performance in addition to the team's output. Thus, the students get two grades (a group grade, equally shared grade, and an individual one). There is also peer assessment which might improve group and individual grades. The students assess the outputs of other students and groups by giving bonus points to those they like most of all. [3]

Experimental

Methods: analysis, observation and survey methods were applied as the instruments to collect the data.

As a teacher of English I tried to identify the impact of project work on my students` learning. First, within 3 weeks I conducted 2 lessons for 1 year students with the usage of project work.
Tasks

for our project work were taken from the book "*Aspect for Kazakhstan 10 grade"* and considered 2 of 4 aforementioned types of projects by W. H. Kilpatrick. They are :1) Creative project work on the theme "Famous character in literature" and 2)Problem related project work on the theme "How immigrants can become residents in our country". Also it was important to fulfill all the stages of project work so we followed *detailed algorithm* of work on the project from "Methodological recommendations on the organization of research and project activities of students" by National Academy of Education named after I. Altynsarin (see table2)

Table2

	Stage of work on the project	**Students' activities**	**Teacher's activity**
Organiza	1. Preparation a) definition of the topic and objectives of the project;	a) Discuss the topic of the project with the teacher.	Introduces the meaning of the project approach and motivates students.

	b) selection of participants in the working group.	Define the goals of the project. b) Form groups.	Helps in determining the purpose of the project. Helps in the formation of groups.
	2. Planning a) identification of sources of necessary information; b) determination of methods of collection and analysis information; c) determination of the method of presentation of results (project form); d) the establishment of procedures and criteria for evaluating the results of the project; e) the distribution of tasks (responsibilities) among the members of the working group.	Form the tasks of the project. Develop an action plan. Select and justify the criteria for the success of project activities. Assign the responsible at each stage, form a responsibility matrix and formalize it.	Offers ideas, makes suggestions. Supervises the work of students.
	3. Research a) collection and clarification of information (main tools: surveys, observations, experiments, etc.); b) identification through brainstorming (or other methods) and discussion of alternatives that have arisen during the implementation of the project; c) choosing the optimal course of the project; d)step-by-step implementation of research tasks.	The tasks of the project are carried out in stages. It is advisable to make a calendar plan and mark the completion of the work in it.	Observes, advises, indirectly directs the activities of students. Checks the calendar plan, noting how each group is progressing in completing the tasks.
	4. Conclusions a) information analysis; b) forming conclusions.	They carry out research and work on the project, analyzing the information. Design the project.	Advises, monitors the work of students

Final stage	5. Presentation (defense) of the project and evaluation of its results	They represent the project, participate in its collective analysis and evaluation. Each student presents the results of their work first in a group, then the group presents to the class. Each student carries out a self-assessment of the work performed.	

[8]

After the final stage of project work 30 questionnaires were physically distributed to respondents. The questionnaire was used to determine how project work affected respondents` learning. To collect data on project work usage, teacher asked participants to fill out a questionnaire.

Results

During direct observation of the lessons with the usage of project work and after interviewing students on their views on project work, we can clearly see that project work had a positive impact on the students` learning. Although most of the students encountered difficulties in organizational and preparatory stage, they admitted that while working on projects, they had an opportunity to practice and learn English language and at the same time they gained a lot of new information and developed various important skills. It should also be mentioned that most of the students had better marks for making a project in comparison with marks they obtained during other activities.

Conclusion

The application of the project method in students` education has a great significance for their development as well as the act of knowledge acquisition and use. The greatest advantages of this method were presented in the first part of the article. [2]

Also in experimental part we attempted to examine the impact of project work on educational process by conducting lessons with the usage of project work and interviewing students after the completion of the experiment. The results showed that project work has a lot of advantages like the opportunity to gain a lot of new information and develop various skills of the students.

However, this study has its limitations that may affect the validity of its results. First, only first year students participated in our lessons and took part in the survey . The findings of this study, nonetheless, provide informative and valuable insights into how the project successfully implements various forms of organization of educational activities, during which students interact with each other and with the teacher, whose role is changing: instead of a controller, he becomes an equal partner and consultant .In project work, the whole process is focused on the student: first of all, his interests, life experience and individual abilities are taken into account here.

In conclusion, we can say that project work plays significant role in the educational process and it should be a mandatory and significant part of professional education in all colleges and universities of our country, training future specialists for practical activity

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TECHNOLOGY OF BINARY LESSON OF ENGLISH LANGUAGE AND MATHEMATICS IN UNIVERSITY

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ТЕХНОЛОГИЯ БИНАРНОГО УРОКА АНГЛИЙСКИЙ ЯЗЫК И МАТЕМАТИКА В ВУЗЕ

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АҒЫЛШЫН ТІЛІ ЖӘНЕ МАТЕМАТИКАНЫҢ ЖОО-ДАҒЫ БИНАРЛЫ САБАҒЫНЫҢ ТЕХНОЛОГИЯСЫ

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Abstract

Content and Language Integrated Learning (CLIL) technology is one of the types of bilingual education and it is successfully applied in educational institutions in European countries. The technology of bilingual education CLIL makes it possible to go beyond the traditional curriculum, allows you to expand the cultural horizons of the individual, improve the quality of education, both subject content (mathematics) and a foreign language (English language), accelerate the development of students' professional skills, and also opens up new opportunities for them to continue their education and work. For the effective implementation of CLIL, specific organizational and pedagogical conditions are necessary, since it is needed to pedagogically manage English language while teaching mathematics. In this study to analyze the improvements of students' cognitive skills, by using English language while teaching mathematics, was used qualitative approach. 60 students with elementary-intermediate levels of English language and 2 teachers of mathematics with an upper-intermediate (B2) level of English language were participated in held lessons/classes.

Аннотация

Технология интегрированного предметно-языкового обучения (CLIL - Content and Language Integrated Learning) является одним из видов билингвального образования и успешно применяется в учебных заведениях в странах Европы. Технология двуязычного образования CLIL позволяет выйти за рамки традиционной учебной программы, расширить культурные кругозор личности, повысить качество образования, как предметного содержания (математика), так и иностранного языка (Английский язык), ускорить развитие профессиональных навыков студентов, а также открывает для них новые возможности для продолжения их обучений и работы. Для эффективной реализации CLIL необходимы особые организационно-педагогические условия, так как необходимо педагогически управлять английским языком при обучении математике. В этом исследовании для анализа улучшения когнитивных навыков учащихся при использовании английского языка при обучении математике был использован качественный подход. В проведенных уроках приняли участие 60 учащихся с начальным - средним уровнем владения английским языком и 2 учителя математики со знанием английского языка на уровне выше среднего (B2).

Аңдатпа

Пәндік-тілдік кіріктіріп оқыту технологиясы (CLIL - Content and Language Integrated Learning) қос тілді білім берудің бір түрі болып табылады және Еуропа елдерінің оқу орындарында табысты қолданылады. CLIL-дің екі тілде білім беру технологиясы дәстүрлі оқу бағдарламасының шеңберінен шығуға мүмкіндік береді, жеке тұлғаның мәдени ой-өрісін кеңейтуге, білім беру сапасын, пәндік (математика) мазмұнын, сонымен қатар шет тілін (Ағылшын тілі) де арттыруға, студенттердің кәсіби дағдыларын дамытуды жеделдетуге мүмкіндік береді, сондай-ақ олардың оқуы мен жұмысын жалғастыру үшін жаңа мүмкіндіктер ашады. CLIL тиімді жүзеге асырылуы үшін арнайы ұйымдастырушылық-педагогикалық жағдай қажет, себебі математиканы оқыту кезінде ағылшын тілін педагогикалық тұрғыдан басқару қажет. Бұл зерттеуде математиканы оқытуда ағылшын тілін қолдану барысында оқушылардың танымдық дағдыларының жақсаруын талдау үшін сапалы әдіс қолданылды. Сабақтарға ағылшын тілін бастапқы-орташа деңгейде меңгерген 60 оқушы және ағылшын тілін ортадан жоғары (B2) деңгейде білетін 2 математика мұғалімі қатысты.

Keywords: CLIL (Content and Language Integrated Learning), teaching mathematics by using English language, lesson/class.

Ключевые слова: CLIL (Content and Language Integrated Learning), обучение математике используя Английский язык, урок.

Кілт сөздер: CLIL (Content and Language Integrated Learning), Ағылшын тілін қолдана отырып математиканы үйрету, сабақ.

Introduction

At the present time in Kazakhstan flourishing teaching subjects at schools and universities in 3 languages, which are Kazakh (first L1), Russian (second) and English (third L2) languages. Integrating English language for teaching subjects (contents) is more concerned, due to Russian language commonly spoken by most of Kazakhstan people. Hence, the CLIL technology is used more with English language and it is getting integrated in our schools and universities.

The term CLIL was first used by D. Marsh in 1994. According to D. Marsh, Content and Language Integrated Learning (CLIL) can be used in cases where disciplines or certain topics within disciplines are studied in a foreign language and two goals are pursued: studying the content of this academic discipline and simultaneously learning a foreign language [2].

More than 40 definitions of CLIL are used in modern European scientific and methodological literature. For example, the European Commission considers CLIL as a concept in which a foreign language acts as a learning tool [1].

In the Cambridge textbook on TKT (Teaching Knowledge Test) several definitions of CLIL are given [4]:

1) technology of learning, the main components of which are languages, intercultural knowledge, understanding and skills, as well as preparation for internationalization and improvement of learning as such [6];

2) a content-oriented teaching method, the purpose of which is to study a subject and a foreign language at the same time;

3) a general term used to characterize bilingual education programs;

4) developing technology of teaching and learning subjects through a non-native language (TKT: CLIL Handbook).

Materials and types of research

The purpose of the study to teach mathematics effectively while it will be carried out in students' non-native language. There have been several difficulties regarding the language in general, because it is not their native language and the mathematics students are tend to have more analytical mindset. The subject content, which is mathematics, in CLIL technology is more important than the language content, however to explain the terms and formulas teacher should have a proficiency level. As a result without understanding the mathematical language in English a lesson/class could not carried out.

Research questions

Here are few questions to guide the research:

1. What are the two general steps of starting teaching mathematics in English by CLIL technology?
2. What are students' test results on the materials that have been taught?
3. What are the pros and cons of the CLIL technology?

Participants

Two full-time mathematics teachers and sixty students from Mathematics departments of our university were participated in this study. A test was held at the end of those lessons/classes.

Tools

The tools for this research are the syllabus and a test questions and tasks. First, the study was performed by two general steps: first step – two teachers took 8 lessons/classes from syllabus for their own mathematics subjects that were stated by university guidelines; second step started with teaching the basic terms of mathematics and the specific terms to the 8 lessons/classes that have been chosen to be taught in a lesson/class. Second, at the end of the lessons/classes students took a test on the materials that have been taught. Third, the discussion of the CLIL technology was held the statements of its pros and cons were made.

Procedure

Two mathematics teachers set to teach by the Mathematics Department of our university with upper-intermediate (B2 by CEFR – Common European Framework of Reference for Languages) level of English language. They chose and translated 8 topics for 8 lessons/classes and performed them by the curriculum. At the beginning both teachers taught basic terms of mathematical language in English. Two lessons from syllabus were performed in referencing their foreign colleagues, they used interactive board and played the videos of teaching chosen mathematical topics on YouTube by the American/British/Canadian mathematics teachers.

At the end teaching students took a test according to their studied materials. A test comprised of forty questions thirty of them were about the basic and specific mathematical terms and ten questions were mathematical tasks in English.

For example,

Q8. What is the English equivalent of "квадратные уравнения":

A. cubic equations

B. quadratic equations

C. cubic expression

Task 4. Evaluate the following indefinite integrals. Check your answer by differentiating: $\int \left(8x^3 - \frac{4}{x}\right) dx$.

The pros of the CLIL technology in binary lessons of mathematics and English language was that it resulted in forming students' understanding mathematical terms and task sentences in English. It will be quite beneficial if they are going to get the master's degree in the future.

And the cons was that mathematics is an exact science, and while it was possible to teach and explain in native language, but it was difficult in English. The linguistic part of this technology was strenuous for students with mathematical mindset.

Providing the necessary support was quite a challenge for the CLIL teacher, since each student needed different help at a certain stage of learning. They might need more support in one subject and less support in another.

The results obtained

The English language levels of sixty students were varied between elementary (A2) and intermediate (B1) levels. Consequently, the results were varied too. All of them got good results in solving tasks, however only seventy percent of students succeeded in answering the questions.

Research results

The teachers followed the syllabus by curriculum. They carried out the lessons/classes by translated materials and by referencing to their foreign colleagues, using their teaching videos. The materials were as follows:

1. Theoretical knowledge of the topic;
2. Discussion of terms;
3. Tests and quizzes;
4. Tasks.

The teachers both considered the lessons/classes that it can be burdensome and enjoyable at the same time. Burdensome, hence it was teaching students their major subjects in not their native language, but they enjoyed opening new perspective in their teaching. They said that starting the lesson was a bit stressful. They were worried about how their abilities would further and would it reach the edge.

The students who achieved good results 70% at their test were students with higher level of English language, however others 30% were not fallen behind. To solidify their knowledge they took online quizzes between lessons and discussed the occurred problems in solving the tasks.

They have learned plenty resources of knowledge such as:

1. Mathematical textbooks/handbooks written in Russian/English languages;
2. The online English speaking mathematics teachers and their content on the Internet;
3. Solving mathematical quizzes in English.

Discussion

Research question №1. What are the two general steps of starting teaching mathematics in English by CLIL technology?

According to the study there are two general steps, they are addressed as general because they can be applied to every subject in content-language integrated learning. There is already established syllabus to the subject in native language in every university. It was needed to translate the materials that used by teachers in Kazakh language, to find materials in English language which already written and used by foreign colleagues. They were combined and performed by teachers.

Research question №2. What are students' test results on the materials that have been taught?

The overall results were actually good. Most of mathematical language consists of formulas and solving tasks was not difficult for the students. The strenuous part of learning mathematics in English was the terms, mostly the specific ones. They should pay attention to learning the terms. Then they will achieve good results in given tests.

Research question №3. What are the pros and cons of the CLIL technology?

The CLIL technology is used in our private schools where the subjects taught in 3 languages (Kazakh, Russian, English). For students who will graduate from private schools it will not be hard to study in experimental lessons that performed in this research. But for students who are graduating from general schools, it is going to be difficult. The most pros of the CLIL technology are that there are generous loads of materials on the Internet that can be used in lesson/class. The most cons of the

CLIL technology is the language barrier. If the students are able to step over this barrier, then they achieve great results in their field.

Conclusion

Teaching mathematics by using English language in CLIL technology can be achievable in universities with students who have basic levels of knowledge in English language, for example the universities that provide teaching in trilingual (Kazakh, Russian, English) and in universities with in-depth studying English language. Our educational system provides teaching English language from third grade till the end of school, however teaching mathematics in every language is difficult, due to terms and academic words. Hence, there is more pressure for teachers who are going to teach mathematics in English language rather than for teachers who are teaching in native language.

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Technical sciences

GAS-HYDRODYNAMIC AND THERMODYNAMIC STUDIES OF WELLS AND FORMATIONS FOR DUAL COMPLETION OPERATION OF WELLS

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Abstract

The article presents the results of complex field studies of oil wells and formations of the Altyguyi field in order to establish gas dynamic parameters, as well as to study their gas condensate characteristics. The main attention in the study of wells and reservoirs was paid to a more accurate determination of the initial value of reservoir pressure, temperature, bottom-hole pressure, oil density and pressure recovery curve, which were carried out under various operating modes of wells. In addition, the main attention in the study of the well and reservoir was paid to the separation of condensate and water from products, as well as work on measuring the determination of the amount of condensate extracted from 1 m3 of gas carried out at a complex field installation equipped with mobile block separators. And also the results of complex studies for the period of exploratory drilling and testing of the productivity of drilled gas condensate wells, in steady-state modes of liquid or gas filtration are presented. The results of the conducted studies are necessary for the identification of operational facilities, their drilling systems, taking into account the need for DC operation in wells.

Based on the results of the conducted research, the justification for the allocation of operational facilities, their drilling systems, taking into account the need for dual completion (DC) in wells, was carried out.

Keywords: flow rate, condensate, barometric, bottom-hole zone, pressure recovery curve (PRC), filtration mode, hydraulic conductivity, separator, oil, stationary mode.

The determination of the initial indicators of wells and formations at the Altyguyi deposit was achieved using the method of steady-state sampling, which, even under steady-state filtration regimes in the bottom-hole zone of the formation, were carried out in order to establish the gas-dynamic parameters of the formation and wells, to study their gas-condensate characteristics.

The filtration mode was changed by selecting the diameter of the fitting at the wellhead.

The duration of operation in oil and gas wells for at least 24 hours and for gas condensate wells in each mode was from 5 to 24 hours. The measurement on each mode began after the full stabilization of the wellhead pressures of P_{buf} and $P_{annul.}$

The measurement of reservoir and bottom-hole pressures and the recording of the pressure recovery curve were carried out with deep pressure gauges of the MGN2-800kgs/cm^2 type and MSU-1-100-160 and in some places with electronic geophysical devices "Granite" and "Sakmar".

The necessary indicators for calculating the determination of the daily gas flow rate were carried out using a separator of the PBS-350/64 type with a measuring diaphragm with a diameter of 50 mm.

Measurements of the daily gas flow rate were carried out using a complex field installation equipped with a separator of the "Demag" type and flow meters of the DSP-0.063 and DPS-1.6 types.

The parameters for determining the gas flow rate were calculated using 4- or 2-inch diaphragm meters of critical gas flow (DICT) [1].

Wellhead pressures (P_{buf} and P_{annul}) were recorded with model pressure gauges of the MO type at 250, 400 and 600 kgf/cm^2, accuracy class ± 1, ± 0.6% and ± 0.4%.

Bottom-hole and reservoir temperatures are determined by thermometers with mercury columns of the TP-7 type.

In some facilities, it was not possible to close the well to the reservoir pressure value due to technical reasons. In these circumstances, the reservoir pressure was determined by the experimental method [2].

Application of the method under steady-state filtration conditions of products in the bottom-hole zone of the formation for trial operation (with a change in mode), complex hydrodynamic studies were carried out in 17 objects, 16 wells, in an amount of 22 times. Only on 6 wells (№№12, 19, 107, 108, 111 and 112), measurements of the daily flow rate were carried out, and in 4 wells (№№. 7, 21, 105 and 107), a one-time measurement of reservoir and bottom-hole pressure was carried out. At oil well sites № 2 and №. 7, the study was carried out by the method of normalizing the fluid flow – pressure recovery curve (PRC). As a result of processing the obtained materials, the coefficient of hydraulic conductivity and permeability of the formation was calculated by the Horner method. The obtained results of the development, measurements and their definition are given in the table 1. Graphs of the pressure recovery curve are shown in Figures 1 and 2.

Table 1

The results of hydrodynamic studies at the wells of the Altyguyi field

Well number	Horizon	Perforation interval (m)	Fitting diameter (m)	Coefficient			Note
				Capacity (kg/cm^2)	Hydroconductivity (sP)	Permeability (mD)	
Research in order							
1(I)	NK_9	3670-3680	5	-	-	-	
			6	-	-	-	
			8	-	-	-	
			-	0,1807	4,4	14,52	
			Repeated research				
			6	-	-	-	
			5	-	-	-	
			4,8	-	-	-	
			5,6	-	-	-	
			6,4	0,264	6,43	21,2	
2(I)	NK_9	3608-3618	4	-	-	-	
			5	-	-	-	
			6	0,9043	10.1 on PRC	34,34 on PRC	
3(I)	NK_9	3732-3738	4				
			5				
			6	0,171	4,2	23,1	
4	NK_9	3728-3740	4,8				
			5,6				
			6,4	1,1107	27,1	74,53	
7(II)	NK_9	3746-3750	4	-	-	-	
			4,8	-	-	-	
			3,1	0,8493	22,03 on PRC	93,4 on PRC	
10(I)	NK_9	3653-3662	6,3	-	-	-	
			8,0	-	-	-	

			4,8	0,4914	12,00	44,0	
106(I)	NK 9	3783-3792	4	-	-	-	
			5	-	-	-	
			6	1,3552	33,0	-	

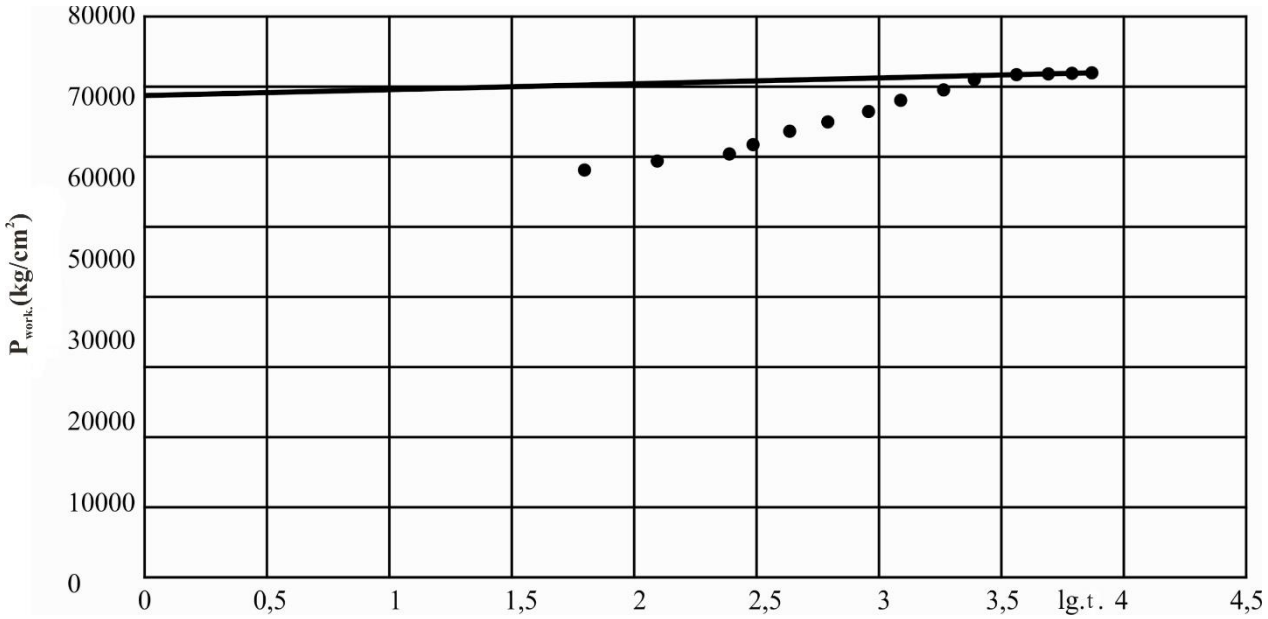

Fig. 1. Graph of the curve of recovery of bottom-hole pressure to reservoir pressure, during the study of production well № 2 of the Altyguyi field

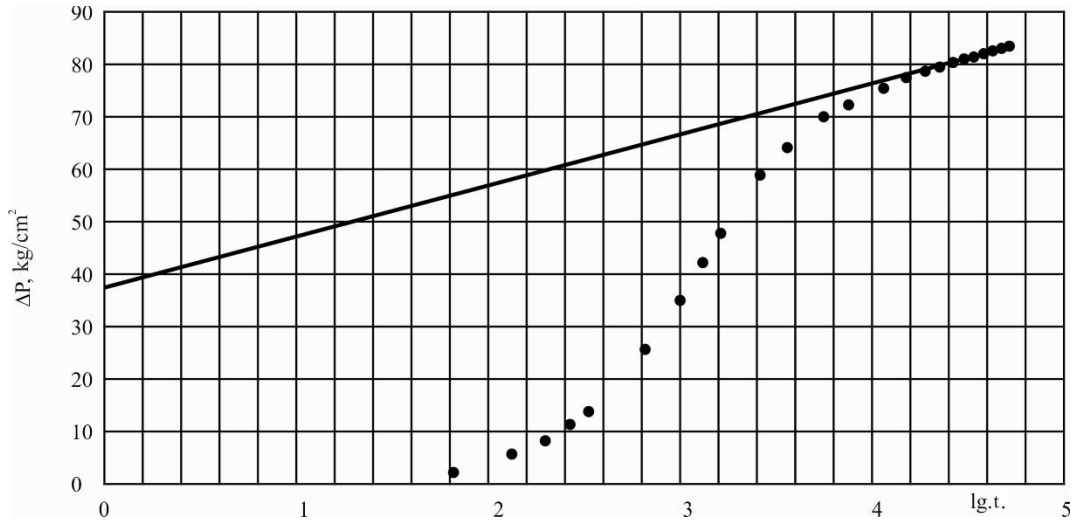

Fig. 2. Graph of the curve of recovery of bottom-hole pressure to reservoir pressure, during the study of the II-th object of the exploration well № 7 of the Altyguyi field

The specific gravity of Altyguyi oil in comparison with the oil of other fields in the Southwestern part of Turkmenistan is very heavy (0.910 g/cm^3) and has a lot of paraffin in its composition. In the process of oil extraction, the paraffin contained in the product freezes due to a decrease in temperature at a depth of 800-1000 meters. In this regard, the freezing of paraffin leads to a decrease in the inner diameter of the tubing, an increase in downhole pressure and a decrease in daily oil production [3]. This phenomenon has the opposite effect on determining the productivity coefficient of the well and the exact calculation of some reservoir indicators.

Before conducting hydro and gas dynamic studies, it is recommended to clean the inner walls of the tubing from the layers of paraffin.

Taking into account the above, the proposed values of the initial reservoir pressure and temperature of the NK_9 oil horizon are assumed to be the values of the accurately performed measurements

of the II-th object of well № 7 - 643 kgf/cm^3 and 87 ^{0}C.

To study the indicators of a gas condensate field and to determine the amount of condensate released from 1 m^3 of gas, as well as conducting gas-hydrodynamic studies in productive wells and formations, were performed by methods and instruments that were used in gas-hydrodynamic studies in oil horizons.

In some wells, for technical reasons, the reservoir and bottom - hole pressure was determined by the barometric formula on uncovered and not lowered depth gauges:

$$P_{b\text{-}h.} = P_{b(annul)} \cdot e^{s},$$

The separation of condensate and water from the products, as well as work on measuring the determination of the amount of separated condensate from 1 m3 of gas, was carried out at a complex field installation equipped with a mobile block separator of the PBS-350/64 type and a separator of the DEMAG type.

In general, during the period of exploratory drilling and testing of the productivity of drilled gas condensate wells, complex studies were carried out in 11 objects of 5 wells in the established modes of liquid or gas filtration (№ 2, 5, 102, 1, 20). In three wells (№1, 2 and 101), 4 comprehensive studies were carried out on unsteady filtration modes (pressure recovery curve) [4].

The result of working off the PRC for production well № 101 is shown in Fig. 4.

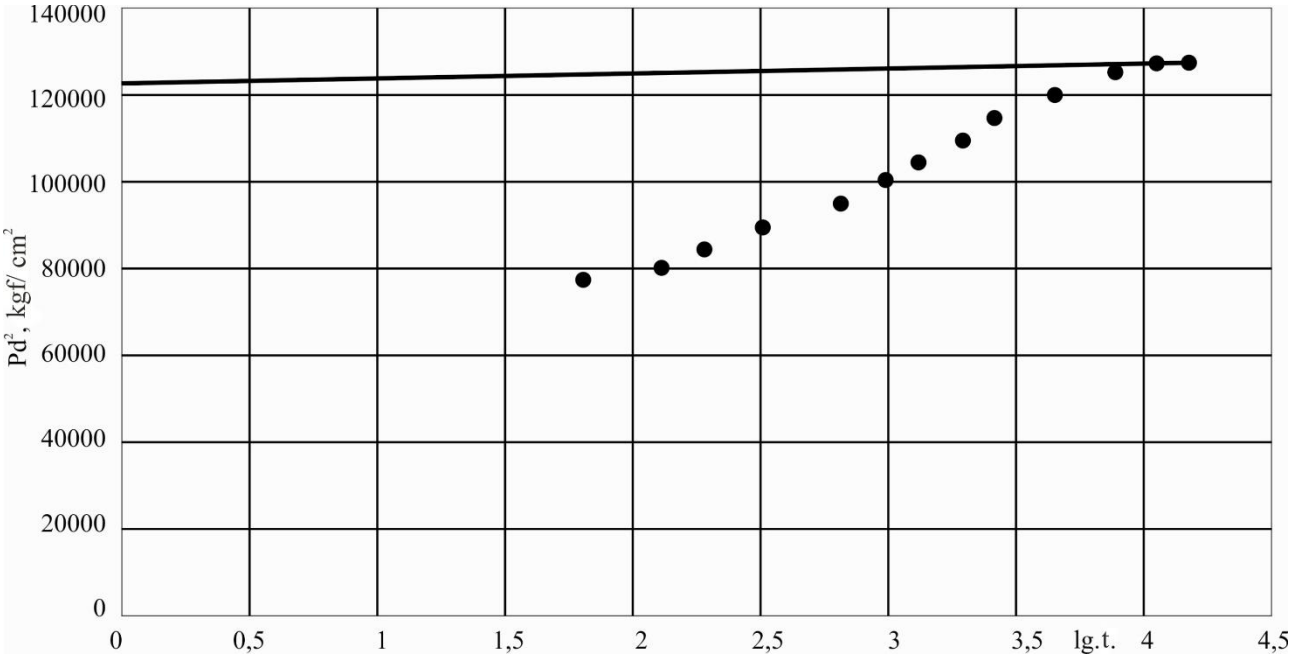

Fig. 3. Graph of the curve of recovery of bottom-hole pressure to reservoir pressure for production well № 101 at the Altyguyi field

To determine the initial reservoir pressure and temperature of the NK_{7d} horizon, the average reservoir pressure values of 517 kgf/ cm^2 and 87 ºC are proposed, which were obtained during the study of the NK_{7d} horizon of the II object of well № 2 and the I object of well №.5.

Considering the close location of the NK_{7d} and NK_8 horizons (about 30 m.), the reservoir pressure and temperature were assumed to be P = 517 kgf/cm^2, T = 87℃. Work on the determination of condensate indicators and the study of thermodynamic characteristics of wells and reservoirs for both horizons was carried out jointly.

Gas condensate wells and reservoirs were studied in three stationary filtration modes [5].

The results of gas dynamic studies and determination of the amount of condensate released from 1 m^3 of reservoir gas (gas condensate factor - GCF) are shown in Table 2.

Table 2

The results of field studies to study the gas condensate properties of wells and formations at the Altyguyi field

№ well	Horizon	Perforation interval, (m)	Fitting diameter (mm)	Operation in the mode (hour)	Condensate output (cm^3/m^3)		Molecular weight of condensate
1	2	3	4	5	6		7
1(II)	NK_8	3616-3625	12	24	241,9	181,4	-
			10	15	157,4	118,4	-
			-	-	-	-	151,5
			8	8	114,7	88,6	-
			9,5	24	11,7	9,6	-
			8	15	13,9	11,4	-
			6	15	15,5	12,7	-
1(I+II)	NK_8+ NK_9	3512-3522 3670-3680	-	-	-	-	150
			10	24	NKH productive		-
			8	18			-
			6	16			-
			-	-			-
			6	24	NKH productive		-
			8	22			-
			10	20			-
2(III)	NK_{7d}	3512-3522	8	24	64,6	56,2	-
			-	-	-	-	-
			12	24	-	60,5	159
			8	22	-	29,6	-
			10	18	-	46,3	-
2(III)	NK_{7d}	3512-3522	6,5	24	107,5	93,4	-
			8	18	97,2	81,6	-
			9	15	99,8	86,2	-
			-	-	-	-	159
			9,5	22	14,3	13,1	-
			8	17	12,9	12,0	-
			6	15	23,4	21,5	-
			-	-	-	-	-
5(I)	NK 7d	3618-3624	10	20	111,8	102,8	-
			8	21	118,6	104,4	-
			6	15	113,1	101,8	-
			-	-	-	-	144,5
			9,5	20	10,6	8,7	-
			8	21	12,8	10,5	-
			6	15	16,2	13,2	-
			-	-	-	-	153,5
			8	24	50,9	43,8	-
			-	-	-	-	149
			12	24	-	51,4	
			8	21	-	46,9	
			10	16	-	46,3	
101	NK 8	3564-3566	12	24	-	-	-

			10	24	-	-	-
			8	16	-	-	-
20 (III)	NK 8	3950-3958	-	-	-	-	-
			9,5	22	-	-	-
			8	17	-	-	-
			6	15	-	-	-
			-	-	-	-	-

The results of hydro - gas dynamic studies of wells and formations of gas condensate deposits were processed using a two - term formula:

$$P_{res.}^2 = P_{b\text{-}h}^2 = aQ_2 + b \cdot Q_2^2,$$

where: $P_{res.}$ and $P_{b\text{-}h}$ - respectively, reservoir and bottom-hole pressure, kgf/cm^2;

Q_g is the flow rate of separation gas, thousand m^3/day;

a and b, respectively, are the coefficients of filtration resistance, depending on the parameters of the bottom-hole zone of the formation and the design of the well bottom.

The flow rate of the reservoir fluid $Q_{res.fl}$ is calculated using the following formula:

$$Q_{res.fl.} = Q_{s.g.} + \frac{Q_{c.}^{sat} + G_{eqv.}}{10^3},$$

$Q_{res.fl}$ - reservoir fluid, thousand m^3/day;

$Q_{s.g}$ -flow rate of separated gas, thousand m^3/day;

$Q_{c.}^{sat}$ -saturated condensate flow rate, m^3/day;

G_{eqv} is the calculated gas equivalent of the transfer of the liquid phase (condensate) to the gas phase.

The gas equivalent is determined by the formula

$$G_{eqv.} = 23342 \cdot \rho / M,$$

Here ρ and M are, respectively, the density and molecular weight of the C_{5+b} fraction.

The value of the molecular weight (μ) of the C_{5+b} fraction is calculated by the formula

$$M = \frac{44{,}29\left(\rho_{c.}^{st.} + 0{,}004\right)}{\left(1{,}034 - \rho_{c.}^{st.}\right)}.$$

where $Q_{c.}^{st.}$ is the density of stable condensate.

Tables 3, 4 and 5 show the values of reservoir and well parameters determined when processing the results of gas-dynamic studies and the output of stable condensate for the studied objects.

Table 3

The results of calculations of studies to study the gas condensate properties of wells and formations at the Altyguyi field

№ well	Horizon	Perforation interval, (m)	Type of research	Reservoir pressure (kgf/cm^2)	Reservoir temperature (^{0}C)	Stable condensate output (cm^3/m^3)
1(II)	NK $_8$	3616-3625	initial	496	84	119
			regular	452	89	11,4
1(I+II)	NK $_8$+NK $_9$	3512-3522	regular	452	91	-
		3670-3680	regular	308	88	-
2(III)	NK $_{7d}$	3512-3522	regular	510	81	86,2
			regular	490	87	12
			regular	471	82	56,2
			regular	270	81	60,5

5(I)	NK $_{7d}$	3618-3624	regular	524	84	103
			regular	487	90	8,7
			regular	426	82	43,8
			regular	274	84	51,4
20	NK $_{8}$	3950-3959	regular	400	96	4
			regular	336	87	96,1
101	NK $_{8}$	3564-3566	regular	358	78	85,6

Table 4

The results of calculations of studies to study the gas condensate properties of wells and formations at the Altyguyi field

№ well	Horizon	Perforation interval, (m)	Filtration resistance coefficient		Absolutely free gas flow rate (thousand m^3/day)	Coefficient of gas conductivity (m/sP)	Filtration coefficient (mD)
			a	b			
1(II)	NK $_{8}$	3616-3625	57,7	0,38	732,3	7,87	26,2
			137,6	0,243	677	3,4	11,2
1(I+II)	NK $_{8}$+ NK $_{9}$	3512-3522 3670-3680	86,1	0,411	713	5,37	8,1
			11,0	0,423	460,7	41,7	65,9
2(III)	NK $_{7d}$	3512-3522	92,5	0,1	1205,5	4,73	14,2
			37,9	0,112	1304,3	12,1	36,3
			-	-	-	-	-
			67,8	0,0123	921,2	6,6	20,0
5(I)	NK $_{7d}$	3618-3624	187,8	0,194	800,4	2,42	12,1
			80,5	0,111	1144,6	5,74	28,7
			-	-	-	-	-
			93,1	0,0144	725,1	4,9	24,4
20	NK $_{8}$	3950-3959	-	-	-	-	-
			134,4	0,784	303,2	3,4	12,8
101	NK $_{8}$	3564-3566	84,2	0,327	510,4	5,3	79,7

The proposed indicators of stable condensate yield are accepted along the horizon of NK $_{7g}$ -95 cm^3/t^3; along the horizon of NK$_8$-118 cm^3/t^3.

According to the results of measurements, an accelerated drop in reservoir pressure was revealed at the beginning of the operation period [6].

Despite the short period of the start of operation of gas condensate reservoirs, the results of measurements revealed an accelerated drop in reservoir pressure.

For example, well №2 was put into operation in 2009 with an initial reservoir pressure of 510 kgf/cm^2. In 2010, the reservoir pressure was measured at 490 kgf/cm^2, and in 2014 it was 270 kgf/cm^2.

Table 5

The results of the study of the field determination of the properties of stable condensate

№ well	Horizon	Perforation interval, (m)	Fitting diameter (mm)	Condensate output from 1 m^3 of reservoir gas, (cm^3/m^3)		The rate of entry of the fluid into the barrel is tubing (m/sec)
				intense	stable	
1(II)	NK $_{8}$	3616-3625	10	157	118	4,95
			9,5	12	10	4,5
			10	A light hydrocarbon is oil. The specific gravity is 0.8455 g/cm^3. Due to the high gas factor, calculations were carried out on gas.		
			6			

2(III)	NK_{7d}	3512-3522	8	97	82	4,1
			8	13	12	4,3
			8	65	56	3,5
			10	-	60,5	4
5(I)	NK_{7d}	3618-3624	8	119	105	4,1
			8	13	11	4
			8	51	44	3,8
			10	-	46	4
20	NK_8	3950-3959	8	-	4	-
			12	-	55	4
101	NK_8	3564-3566	10	-	83	4

Well № 1 in the gas condensate facility of the NK_8 horizon was put into operation during development with an initial reservoir pressure of 496 kgf/cm^2 in 2009. In 2014, when measured, its readings amounted to a drop to 306 kgf/ cm^2.

We believe that the reason for the low values obtained during the study is not the creation of an appropriate regime for the separation of products.

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THERMODYNAMIC ANALYSIS OF FLOW CONDITIONS OF THE SOLID-PHASE PROCESS OF IRON CARBURIZATION CARBON IN DIRECT REDUCTION FROM WUSTITE

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ТЕРМОДИНАМИЧЕСКИЙ АНАЛИЗ УСЛОВИЙ ПРОТЕКАНИЯ ТВЁРДОФАЗНОГО ПРОЦЕССА НАУГЛЕРОЖИВАНИЯ ЖЕЛЕЗА УГЛЕРОДОМ ПРИ ПРЯМОМ ВОССТАНОВЛЕНИИ ИЗ ВЮСТИТА

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Abstract

The article presents the results of a thermodynamic assessment of the possibility of chemical reactions of carburization and direct reduction, followed by carburization of solid iron from wuestite with the help of solid carbon. The purpose of the work is to find, using expressions for calculating the numerical values of the Gibbs free energy depending on the temperature, which were derived by the author in the work, the numerical values of the boundary temperatures, above which the chemical reactions of the process of carburizing solid iron with solid carbon are thermodynamically possible.

Аннотация

В статье приведены результаты термодинамической оценки возможности протекания химических реакций науглероживания и прямого восстановления с последующим науглероживанием твёрдого железа из вюстита с помощью твёрдого углерода. Целью работы является нахождение с помощью выражений для расчёта численных значений свободной энергии Гиббса в зависимости от температуры, выведенных в работе автором, численных значений граничных температур, выше которых протекание химических реакций процесса науглероживания твёрдого железа твёрдым углеродом термодинамически возможно.

Keywords: thermodynamic analysis, chemical reaction, wustite, solid carbon, reduction, carburization, solid iron, Gibbs free energy, enthalpy, entropy, boundary temperature.

Ключевые слова: термодинамический анализ, химическая реакция, вюстит, твёрдый углерод, восстановление, науглероживание, твёрдое железо, свободная энергия Гиббса, энтальпия, энтропия, граничная температура.

Введение

Науглероживание железа – технологический процесс внесения углерода из углеродосодержащих компонентов (древесного угля, каменноугольного кокса, антрацита, графита и т.п.) в железо или сталь. На механизм науглероживания влияют свойства и структура исходных материалов, а также температуры и давление процесса. В доменных печах науглероживание восстановленного железа является основой технологического процесса производства чугуна. Несколько иной вариант науглероживания железа применяется при цементации поверхностного слоя стальных изделий за счёт доведения (повышения) в нём процента содержания углерода до некоторого необходимого уровня в целях увеличения поверхностой твёрдости, износостойкости, несущей способности и предела усталости под действием знакопеременных нагрузок и т.д.

Постановка задачи

В доменной печи и других восстановительных агрегатах процессу науглероживания железа предшествует процесс его восстановления из оксидов железа шихты, происходящий

ступенчато – за счёт отщепления кислорода и последовательного превращения более высшего оксида железа в более низший оксид, последний из которых превращается в железо [1–3]:

$$Fe_2O_3 \rightarrow Fe_3O_4 \rightarrow Fe \text{ (ниже 570°C);} \quad (А)$$

$$Fe_2O_3 \rightarrow Fe_3O_4 \rightarrow FeO \rightarrow Fe \text{ (выше 570°C)} \quad (Б)$$

Все металлургические процессы происходят при высоких температурах, т.е. восстановление железа происходит по второй (высокотемпературной) схеме (Б).

Науглероживание восстановленного железа происходит в результате его способности вступать в реакцию с печными газами и растворять углерод кокса или другого углеродсодержащего материала, при этом считается, что процесс науглероживания происходит за счёт взаимодействия железа с газом–восстановителем CO [4] и/или с твёрдым углеродом C [5, 6]. Образуется сплав железа с углеродом, который значительно насыщается углеродом, проходя через слой угля (кокса), и дополнительно растворяет в себе примеси (марганец, кремний, фосфор, серу и другие), в результате чего получается чугун. Указанные процессы относятся к числу сложных гетерогенных физико–химических процессов, в которых участвуют твёрдые, жидкие и газообразные вещества. Возможность протекания этих реакций и их характер зависят от состава шихты, температуры, давления и других факторов.

Поэтому термодинамический анализ условий протекания химических реакций науглероживания будет представлять значительный интерес для понимания и теоретического обоснования технологий прямого получения железа из железосодержащего сырья в одном агрегате – жидкого чугуна или его гранулированного аналога, а также непосредственно стали (что ещё не удавалось осуществить в современных восстановительных печах, в том числе и в домне), исключая стадию получения чугуна, как это происходило в древние времена в различных конструкциях сыродутных печей.

Цель работы

Целью данной работы является термодинамический анализ условий протекания процесса науглероживания железа при его прямом восстановлении из вюстита за счёт углерода (принимаем, что C, FeO, Fe и Fe_3C находится в твёрдых фазах) для нахождения численных значений граничных температур $T_{гр}$, выше которых протекание химических реакций процесса науглероживания твёрдого железа твёрдым углеродом термодинамически возможно. Проведённый автором ранее [7] термодинамический анализ условий протекания процесса науглероживания восстановительным газом CO твёрдого железа при его косвенном (за счёт CO) восстановлении из вюстита показал, что науглероживание твёрдого железа с помощью газа CO в металлургических восстановительных печах с высокой температурой их рабочего пространства (от 1000°C и выше) термодинамически невозможно.

Материалы и методы

Автором статьи были выведены выражения для расчёта численных значений свободной энергии Гиббса (изобарно–изотермического потенциала) $\Delta G_т^O$ в зависимости от температуры T для химический реакций восстановления и науглероживания железа, находящегося в твёрдой фазе, твёрдым углеродом; для осуществления вычислений с их помощью и обработки полученных результатов задействована компьютерная программа MS Excel 2013.

Обзор существующих теорий

Как известно [1, 8, 9], восстановление железа твёрдым углеродом C (коксом, древесным углём) называется «прямым», и протекает оно в нижней части печи (зона распара), где более высокие (выше 950–1000°C) температуры, по реакции:

$$FeO + C = Fe + CO \quad (1)$$

Считается [10, 11], что при температуре 1000–1100°C восстановленное из руды твёрдое железо, взаимодействуя с оксидом углерода, углеродом кокса и сажистым углеродом, интенсивно растворяет углерод, образуя чугун; в последних двух случаях – по реакции [12–14]:

$$3Fe + C = Fe_3C, \quad (2)$$

причём насыщение углеродом железа способствует понижению его температуры плавления.

При этом их суммарной химической реакцией будет следующая реакция прямого восстановления железа из вюстита с последующим науглероживанием первого твёрдым углеродом С до состояния чугуна (карбида железа), указанная в источниках [15, 16]:

$$3FeO + 4C = Fe_3C + 3CO \quad (3)$$

Данные реакции (1)–(3) в литературных источниках приводятся в различных комбинациях, в том числе и с другими реакциями, при этом протекание их трактуется по–разному.

Так, в источниках [1, 17–20] указывается, что насыщение железа углеродом происходит во второй, третьей и четвертой стадиях процесса науглероживания (после процесса ступенчатого восстановления железа – схема (Б), см. выше), при этом:

– во второй стадии науглероживание железа происходит за счёт диффузии в его массу при температурах 950–1150°С сажистого углерода $C_{саж}$ (реакция (2а)), который образовался в первой стадии процесса, по следующей схеме:

$$2CO = C_{саж} + CO_2 \quad (4)$$

$$+ \quad 3Fe + C_{саж} = Fe_3C \quad (2а)$$

$$3Fe + 2CO = Fe_3C + CO_2, \quad (5)$$

при этом суммарной реакцией считается не реакция (2а) науглероживания железа сажистым углеродом $C_{саж}$ (т.е. фактически реакция (2)), а реакция (5) науглероживания за счёт газа СО.

– в третьей стадии науглероживание железа происходит по реакции (2) при стекании по коксовой насадке капель расплавленного металла с содержанием ≈2% С при температуре выше 1150ºС с растворением в нём углерода кокса $C_к$;

– в четвёртой стадии науглероживание железа продолжается в горне за счёт растворение углерода кокса $C_к$ в жидком металле (зависит от температуры в горне, времени пребывания в горне чугуна и его химического состава), при этом параллельно идёт процесс (зависит от размеров печи) окисление углерода чугуна в фурменных очагах.

По аналогии с процессом восстановления железа первые две стадии науглероживания названы «косвенным», а вторые две – «прямым» науглероживанием железа [1, 18, 19].

В источниках [21, 22] указывается несколько иной механизм науглероживания:

$$3Fe + 2CO = Fe_3C + CO_2 \quad (5)$$

$$+ \quad CO_2 + C = 2CO \quad (4а)$$

$$3Fe + C = Fe_3C, \quad (2)$$

хотя химические реакции указываются практическим те же самые, что и во второй стадии из предыдущих источников [1, 17–20] (см. выше), но суммарной их реакцией считается химическая реакция (2) науглероживания железа твёрдым углеродом.

Термодинамический анализ

Учитывая, что протекание реакций (4) и (5) при высоких температурах железовосстановительного процесса (свыше 1000°С) термодинамически невозможно, что было установлено автором ранее [7, 23], процесс науглероживания твёрдым углеродом железа в твёрдой фазе при его прямом восстановлении может происходить по следующей схеме: [реакция (1) + реакция (2) = реакция (3)]. Проведём термодинамический анализ всех химических реакций (1)–(3) данной схемы с целью выяснения возможности их протекания при высоких температурах печи и выявления лимитирующей стадии в процессе восстановления и науглероживания железа. Термодинамический анализ включает вывод автором формул и расчёт по ним $\Delta \mathbf{G}_т^{\mathbf{O}}$ для химических реакций (2) и (3) науглероживания железа твёрдым углеродом (химическая реакция (1) является реакцией прямого восстановления железа из вюстита твёрдым углеродом и её термодинамический анализ уже был выполнен автором в его работах [24–27]).

Вывод расчётных формул осуществлялся по методике, описанной в источниках [28, 29], с применением имеющихся в литературе стандартных значений энтальпий образования $\Delta H_{f,298}^{O}$ неорганических веществ и их энтропий ΔS_{298}^{O} [30]; численные значения необходимых из них приведены в табл. 1.

Методика вывода формул [28, 29] для вычисления значений свободной энергии Гиббса $\Delta G_т^{O}$ в зависимости от температуры Т заключается в следующем.

Таблица 1.

Стандартные значения энтальпии образования $\Delta H^{O}_{f,298}$ и энтропии ΔS^{O}_{298} некоторых веществ

Вещество	Состояние	$\Delta H^{O}_{f,298}$, кДж/моль	ΔS^{O}_{298}, Дж/(моль·К)
FeO	кристаллическое	– 264,8	60,8
Fe	кристаллическое	0	27,15
Fe_3C	кристаллическое	25	105,1
C	кристаллическое (графит)	0	5,74
CO	газообразное	– 110,52	197,54

Как известно [31], в любом химическом процессе одновременно действуют два противоположных фактора: энтропийный ($T \cdot \Delta S^{O}$) и энтальпийный (ΔH^{O}). Суммарный эффект этих противоположных факторов в процессах, протекающих при постоянном давлении и температуре, определяет изменение численного значения энергии Гиббса ΔG^{O}_{T}.

Численные значения свободной энергии Гиббса ΔG^{O}_{T} для каждой химической реакции в зависимости от температуры Т находятся, исходя из следствия закона Гесса, по следующей формуле [28, 29]:

$$\Delta G^{O}_{T} = \Delta H^{O} - T \cdot \Delta S^{O}, \quad (6)$$

где ΔH^{O}, ΔS^{O} – соответственно численные значения энтальпии (Дж/моль) и энтропии (Дж/(моль·К)) рассматриваемой химической системы (реакции); находятся по следующим выражениям [28, 29]:

$$\Delta H^{O} = \Sigma\Delta H^{O}_{прод} - \Sigma\Delta H^{O}_{исх} = \left(c \cdot \Delta H^{O}_{3} + d \cdot \Delta H^{O}_{4}\right) - \left(a \cdot \Delta H^{O}_{1} + b \cdot \Delta H^{O}_{2}\right); \quad (7)$$

$$\Delta S^{O} = \Sigma\Delta S^{O}_{прод} - \Sigma\Delta S^{O}_{исх} = \left(c \cdot \Delta S^{O}_{3} + d \cdot \Delta S^{O}_{4}\right) - \left(a \cdot \Delta S^{O}_{1} + b \cdot \Delta S^{O}_{2}\right); \quad (8)$$

где $\Sigma\Delta H^{O}_{исх}$ и $\Sigma\Delta H^{O}_{прод}$ – сумма стандартных энтальпий образования соответственно исходных веществ и продуктов реакции, Дж/моль; $\Sigma\Delta S^{O}_{исх}$ и $\Sigma\Delta S^{O}_{прод}$ – сумма стандартных энтропий соответственно исходных веществ и продуктов реакции, Дж/(моль·К); ΔH^{O}_{1}, ΔH^{O}_{2} и ΔH^{O}_{3}, ΔH^{O}_{4}; ΔS^{O}_{1}, ΔS^{O}_{2} и ΔS^{O}_{3}, ΔS^{O}_{4} – стандартные энтальпии образования (ΔH^{O}, Дж/моль), стандартные энтропии (ΔS^{O}, Дж/(моль·К)) соответственно для исходных веществ и продуктов реакции (см. табл. 1); *a*, *b*, *c*, *d* – стехиометрические коэффициенты химической реакции[1].

Формула для расчёта численных значений свободной энергии Гиббса ΔG^{O}_{T} химической реакции (1) в зависимости от температуры Т (в градусах К), выведенная автором в работе [24], имеет следующий вид:

$$\Delta G^{O}_{T}(1) = 154280 - 158{,}15 \cdot T, \text{ Дж/моль CO} \quad (I)$$

Формулы для расчёта численных значений свободной энергии Гиббса ΔG^{O}_{T} химических реакций (2) и (3) в зависимости от температуры Т (в градусах К), выведенные автором в данной работе, соответственно будут следующими:

$$\Delta G^{O}_{T}(2) = 25000 - 17{,}91 \cdot T, \text{ Дж/моль CO}; \quad (II)$$

$$\Delta G^{O}_{T}(3) = 162613{,}33 - 164{,}12 \cdot T, \text{ Дж/моль CO} \quad (III)$$

Зависимости численных значений энергии Гиббса ΔG^{O}_{T} от температуры Т (в °С) иллюстрирует рис. 1; данные графические зависимости построены автором согласно проведённых расчётов по выведенным им выражениям (I)–(III) для расчёта значений свободной энергии Гиббса ΔG^{O}_{T} химических реакций (1)–(3) соответственно. При этом численные значения граничных температур $T_{гр}$ для реакций (1)–(3) можно определить элементарным расчётом: $T_{гр} = \Delta H^{O} / \Delta S^{O} - 273$, °С, используя полученные уравнения (I)–(III). т.е. для условия химического равновесия $\Delta G^{O}_{T} = 0$ каждой из химических реакций (1)–(3). Самопроизвольное

[1] Термодинамические параметры ΔH^{O}_{4} и ΔS^{O}_{4} со стехиометрическим коэффициентом *d* отсутствуют при расчёте численных значений свободной энергии Гиббса ΔG^{O}_{T} для химической реакции (2).

же их протекание в прямом направлении будет термодинамически возможно при выполнении условия $\Delta G_т^O < 0$ для каждой из реакций (1)–(3).

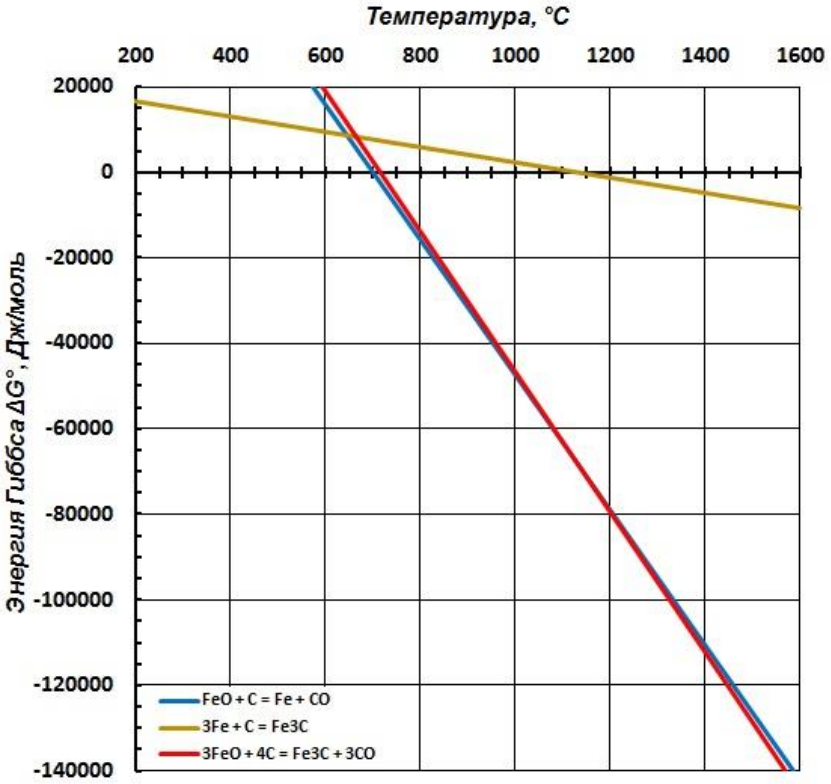

Рисунок 1. Зависимости величины свободной энергии Гиббса $\Delta G_т^O$ от температуры T для химических реакций (1)–(3), рассчитанные по формулам (I)–(III) автора

Обсуждение полученных результатов

Согласно полученным выражениям (I)–(III) условие $\Delta G_т^O < 0$ для химических реакций (1)–(3) будет выполняться при следующих численных значениях температур протекания процессов $T_{пр}$, которые во всех случаях будут выше вычисленного для каждой конкретной из указанных реакций численного значения граничной температуры $T_{гр}$ (см. рис. 1):

- реакция (1): $T_{гр}$ = 702,530°C, $T_{пр} < T_{гр}$;
- реакция (2): $T_{гр}$ = 1122,868°C, $T_{пр} < T_{гр}$;
- реакция (3): $T_{гр}$ = 717,820°C, $T_{пр} < T_{гр}$.

Таким образом, проведённый термодинамический анализ с использованием стандартных значений энтальпий образования $\Delta H_{f,298}^O$ исходных веществ и продуктов реакций (1)–(3) и их энтропий ΔS_{298}^O позволил установить, что химические реакции науглероживания твёрдого железа (2) и его восстановления с последующим науглероживанием (3) твёрдым углеродом могут самопроизвольно протекать в интервале положительных значений температур: соответственно свыше 1122,868°C и 717,820°C (рис. 1), т.е. при температурах рабочего пространства железовосстановительных печей их термодинамическое протекание возможно. При этом, для химической реакции (3), состоящей из 2-х стадий, описываемых химическими реакциями (1) и (2), лимитирующей стадией, как видно из результатов термодинамических расчётов, является стадия науглероживания, описываемая реакцией (2), т.е. науглероживание восстановленного железа в твёрдом состоянии с помощью твёрдого углерода будет возможно при значениях температур свыше 1122,868°C, несмотря на то, что восстановление железа из вюстита твёрдым углеродом C (см. реакцию (1)) термодинамически может происходить уже после 702,530°C [24–27], а суммарная химическая реакция (3) восстановления и науглероживания железа термодинамически может протекать при значениях температур, превышающих 717,820°C (см. выше). Всё это свидетельствует о возможности

термодинамического протекания всех реакций (1)–(3) в высокотемпературном рабочем пространстве восстановительных печей (сыродутного горна, доменной печи и т.д.) свыше 1130°С.

Выводы

Результаты проведённого термодинамического анализа с использованием выведенных автором выражений (I)–(III) для расчёта значений свободной энергии Гиббса $\Delta G_т^o$ химических реакций (1)–(3) позволили установить, что науглероживание восстановленного железа, находящегося в твёрдой фазе, с помощью твёрдого углерода термодинамически возможно свыше 1122,868°С по химической реакции (3), состоящей из 2-х отдельных стадий восстановления и науглероживания, описываемых реакциями (1) и (2) соответственно. Это позволяет сделать вывод, что науглероживание с помощью твёрдого углерода твёрдого железа при его прямом восстановлении в металлургических восстановительных печах с температурой рабочего пространства от 1130°С и выше термодинамически происходить может.

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