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"INTERNATIONALIZATION OF HIGHER EDUCATION,
METHODOLOGY OF TEACHING TECHNICAL
AND HUMANITARIAN DISCIPLINES IN THE CONTEXT
OF GLOBALIZATION OF HIGHER EDUCATION"

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The internationalization of higher education is not new as a concept. These processes are already around 30 years old. However, right now they are becoming particularly relevant due to a number of factors, including strengthening the role of developing countries in matters of academic cooperation, regionalization of higher education, increasing competition for talented international students, especially in the field of STEM disciplines, strengthening the role of technology transfer and university cooperation with business.

A special role is assigned to the faculty staff of universities in the internationalization of education both in terms of implementing joint research projects and in bridging the digital divide. The study and application of innovative approaches, digital and mixed methods in teaching and learning is the key for inclusion in virtual exchange programs, MOOCs and international online learning projects.

Most universities in Europe were created in XVII – XIX centuries. They played merely national role. Study abroad was often prohibited. Latin lost its position as a universal language and was replaced by local languages. However, already in the beginning of the XX century between the World Wars there was a need for tighter international cooperation with the focus on restoring peace and mutual understanding. Such key institutions in academic exchange were created as: Institute of International Education (IIE) in 1919 in the United States, the Deutscher Akademischer Austauschdi enst (DAAD) in Germany in 1925, and the British Council in the UK in 1934.

After the Second World War, Europe was devastated and concentrated all its effort on reconstruction. However, the national security and foreign policy became the driving forces behind internationalisation in higher education fostering programmes in foreign languages and area studies. The US introduced the Fulbright Programm as well as technical assistance and capacity building programmes to developing countries including those in Europe.

The rise of Japan as an economic power in 1960-s challenged the US dominance not only in political and business spheres but also in research and science. The international dimension of higher education moved from occasional individual contacts to organised activities, projects and programmes. National states recognised the advantage of expanding higher education beyond the borders and used it to their political benefit. Internationalisation became strategic.

The introduction of the Erasmus programme by the European Union in the 1980-s illustrated this stronger strategic approach to internationalisation in higher education. Further EU programmes – Socrates and Erasmus + were based primarily on cooperation through student and staff exchanges, joint curriculum development and joint research projects shaping the European approach to internationalisation.

The only exception to this approach was the United Kingdom in the EU. The Thatcher Government introduced fees for international students and used recruitment of international students to the British universities for income generation. This model was followed by Australia and other English-speaking countries.

Universities nowadays may be considered international institutions. However, they still reflect the strategy of national states that created them.

Ekaterina Tsaranok
Director for Educational Programmes
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I. EXPERT OPINION
More and more citizens, teachers and political leaders care about education all around the globe. They are recognising its impact on key factors of well-being. Jean-Marie Sohier has taught to adolescents, adults, teachers, principals, civil servants and political leaders in over 30 countries. He has seen more than 200 proven successful practices. In this article, he takes us along through the best ones.

**WHAT ARE WE LOOKING FOR, IN FACT?**

This is probably the key question. Officially, we all agree, of course. We want the «best education for all our citizens, all along their lives». Because this is probably what is needed to ensure «peace, health, sustainable development, equal opportunities, independence, contribution to our public governance»…


Once we scratch deeper, we are less sure about our real goals. Yet, objectives, conscious or not, are our key success or failure factors. Any development, move, incident, wind, current that happens in our lives will make us move towards our real goals, good or bad.

**WHAT DO WE CURRENTLY HAVE?**

Most of us have good reasons to complain. The best education, whatever it is according to each of us, is not always accessible to all. Our schools and universities do not deliver the results expected by most stakeholders, especially the learners themselves, and employers. Our national education costs a lot, levels are going down, failure rates are a serious concern, officially at least. And results in international assessments show poor results for most of us.
Teachers are not paid enough, don’t get much respect, and too many of them leave the profession very early in their career. Recruiting them is sometimes difficult as the profession is less and less a first choice, and as the capabilities of candidates have often gone down lately.

Pupils, students, parents or adults are under increased stress because of difficult relations with teachers while learning, and because of the pressure to succeed in a world considered more and more competitive. As education is linked to jobs and jobs to well-being, it is a serious concern for citizens, and hence for officials and political leaders. Many of them have lost their mandates in this difficult responsibility.

WHAT COULD BE THE CAUSES OF OUR WEAKNESSES?

Of course we always link them to the usual suspects: lack of resources, and all the «other» stakeholders in the world of education. «Politicians are in education only for short periods and use it just as a springboard towards more glorious responsibilities». And «how many politicians would really want all citizens to become intelligent?» «Old teachers are too old», «Young ones are too young». «Levels are going down» for some, or «too high» for others «Parents no longer educate, learners no longer work». Good old education wars will go on forever, between networks, cultural orientations, religions, socio-economic contexts. Many are waiting for long expected reforms, the beauty of which being that they will probably never happen but are ideal excuses not to move forward. What works elsewhere will never work for us, of course, as «Here it is different» or «Comparison is not reason». And some are very good at using our weaknesses as excuses to... remain weak.

One full day of discussions is not even enough to just list these difficulties. And most participants are keener on serving their interests than on moving forward. Not to mention the wide discrepancies between their individual and real motivations and the abstract official ones.

If I look for real causes for our weaknesses, I find that the first and biggest one is in our objectives. Just ask 10 people in the street, in the profession, among learners, in the administration or political parties what they expect, concretely, from a good education system. And what they think our common official aims are, concretely. After a long and embarrassed smile, they may start proposing plasters on our weaknesses, or measures, but real objectives? These will probably vary widely and not be very concrete. Let's remind ourselves that objectives can only be useful if they are specific, measurable, ambitious, and linked to real responsibility over time.

Once we really share the same, appropriate and concrete objectives, much of the rest derives from them easily. But in most countries, not much is being done to go that way.

Still, resources remain a real challenge in some areas of course. They have a serious impact on the number and level of education of teachers, on distances to reach a school, on health issues that stop teachers and learners alike from attending courses. But we all know examples of teachers and learners that have achieved fantastic education levels with very modest means.

WHAT ARE THE MOST EFFECTIVE SOLUTIONS?
WHAT ARE THE BEST PRACTICES?

As already mentioned, the ones with the most impact concern our objectives, which can then launch all the other ones, processes, resources and evaluation. I have yet to meet a good education system with bad or missing objectives, conscious or unconscious. Let’s just review a few of the most effective practices I’ve seen around the globe.

OBJECTIVES: WHICH VISION?

First, the best systems have «smart» objectives, conscious or not: Specific, Measurable, Ambitious, and linked to real Responsibilities anchored in Time.

And these objectives point to certain values. Let us consider that a child born today will probably live over 100 years, if we don’t destroy the planet before. Education is supposed to make him happy,
free, independent, healthy and contributing to the community for his whole life. We cannot know today which knowledge and competencies this child will need until 2117. So, the idea is rather to develop the capabilities of all according to our world’s best standards: Intellectual, emotional, social, technological, manual and artistic, plus critical sense and creativity. Because such capabilities will last, whereas mere knowledge or competences can quickly become obsolete.

In some countries, we currently suffer a tendency to go for poor, low level common trunks, comfortable but unfair parking grounds where all pupils are maintained for a few years at the level of the weakest, without any reinforcing options. Good systems certainly aim at the global capabilities mentioned earlier, for all learners, but their general education is able to combine a higher level common trunk with real oriented reinforcement, over the 6 years of secondary school. Why limit ourselves to the «or», whereas we can go for the «and»?

In some confused systems with lots of lower grade paths due to orientation by failure, there is also a tendency to «revalorize» those while maintaining lower levels than in general education. This cannot fool us, and does not make sense, of course. Once education improves, those lower level «escape routes» are no longer needed, and all learners should benefit from higher standards.

Already today, education must make each learner capable of offering more than a worker from a low-cost country, or a machine, if he wants to make a decent living. In the long run, it is not a matter of being the best, or of beating the rest, but simply of staying compatible, relevant, in a world that evolves. While the capabilities demanded may always go up, I think we can – and should – always ensure them for all, out of solidarity and common sense. And for those who wouldn’t care for others, will they always be able, or willing, to assist those who can no longer fend for themselves?

While some may believe in taking the best things in life for themselves and ignoring the rest, one can clearly see the negative impact of that approach for all of us including themselves: insecurity, terrorism, war, and a planet that becomes unlivable for mankind. The best education systems consciously aim at securing peace, health, wellbeing, and the future of our planet.

While some argue about raising minimum, average or top levels, the best aim at all three. Again, is it because our world is getting more binary that many limit us to the «or»? The «and» is still available and is far more fertile.

**PROCESSES: WHAT SHALL WE DO?**

Instead of just «going on functioning», the best systems I have found are always looking for ways to develop more capabilities in less time. They commit themselves to results (levels, success…), not only to vague means (what does «helping all students realise their full potential» actually mean?).

They will use multiple intelligences to build up multiple capabilities. They make course material fully available for all. They ensure its proper understanding. They help memorise it. They show clearly what is expected, and ensure capabilities through deliberate practice. This is probably better than trying to listen to what the teacher is saying, while we are trying to write down what he wrote some time ago on the blackboard, trying to catch up before he wipes it off, only hoping that we got it right, that we will understand it sometimes later, and try to memorize it, hoping we can figure out what will be expected from us at the exam…

Good systems may make students learn through failure, but only while learning, or during formative evaluation, not at certification.

Some use solidarity and equity, the idea that no one will be left behind. This can be done simply by teaching so that the minimum scores within the group meet the required standards, instead of just the best ones. With significant improvements both in results and in values.

There are of course many other successful approaches, such as, to name but a few:

- blended learning, in which we use different supports such as text, video, audio, practice…
- putting learners in search mode, where they must find themselves answers or solutions, thereby being very active in their learning process. This works even better when doing this individually and by groups. I use this a lot when time is short, such as for teaching adults,
- which leads us to formative evaluation, where evaluation shows where learners are while not excluding them,
• and to immediate feedback, which is much more effective than simple marks that arrive days later. This can be achieved among others through auto– or socio-evaluation, fast, immediate, and less embarrassing for all,
• the Antibi approach, where one gives learners some questions and answers before they start preparing for their exams, indicating that a number of these questions will be asked at the exam, thereby helping create more confidence between learner and teacher, and making sure students see and learn better what is expected from them,
• nano-learning, in which students learn during many short moments on their telephones, while travelling or waiting,
• repetitive memorising, because repeating is very effective to remember courses,
• serious games, where the gaming motivation enhances the attention given to the subject matter, and provides the emotions and repetitions that also help learning,
• flipped classroom, where learners are learning by themselves and share their knowledge and do exercises in the classroom, instead of learning in class and doing their homework at… home,
• mentoring or coaching, often between learners, maybe of different ages, supporting morale, and unlocking learners when they are in difficult positions,
• using information and communication technology is of course extremely useful in implementing several of these approaches, but it is not an absolute must. I must add that while it may appear to be out of reach in many areas, ICT is becoming less expensive than many classical schooling structures, and may also solve problems such as distances and shortages of teachers.

RESOURCES, HUMAN AND OTHER

The most significant path is probably to constantly look for best practices and to spread them throughout teachers: best objectives, best results, best processes, best resources, and best evaluation methods. The best education systems train them at world class level, throughout their career, not only in their topics, but also in pedagogy. And give them their full pedagogical freedom.

Attracting the best teachers, and constantly developing their capabilities by training them and meeting their strongest motivations is also important. A good way to recruit better is to revalorize education and teachers. Sincerely recognizing their importance, their efforts and their good results makes a lot of difference and raises standards, at no cost.

Whereas the best teachers often work in «good» schools, hence with «easy» publics, some systems try to use them where they can generate more added value, such as in pre-school or primary classes, or in difficult areas. Some pay them accordingly, such as based on the improved levels over the school year.

Headmasters should be able to drive their teachers, and to help each of them find in education a sense to their life. This is a matter of competence and leadership, but also of reducing their administrative burden.

Despite instinctive demands to reduce classroom sizes, quality teaching seems to be more important. The best teacher I ever had used to manage two classrooms, of 40 pupils each. And one was oriented towards Latin and Greek, while the other one towards mathematics, with two different ages…

Many options have sometimes been offered to compensate for poor success rates. Reducing them now seems to match the current tendency to widen capabilities, and to save resources. And better pass rates will also lower the need for all those less followed courses.

As already mentioned under «processes», good systems have made their teachers and course material more available to students, thereby solving frequent problems that used to have dramatic and unacceptable consequences.

EVALUATION, THE ESSENTIAL LINK WITH OBJECTIVES

A reliable evaluation is essential in achieving our objectives. Good systems evaluate through the most adequate approaches (MC, oral, portfolio, practice, etc), ensuring a reliable and repeatable evaluation.
This is not always the case in lesser systems, often because of less than perfect multiple choice questions, no real evaluation standards, or when the institution is both judge and party.

The best systems use more formative evaluation, and less certificative assessments. This does not mean that learners pass without having to meet standards, nor that letting everyone pass gives better results as is sometimes falsely claimed. The idea is more to test often, but while teaching, to stay tuned to the situation of learners. Certificative evaluation takes more time and can be done less often, especially when results get better.

In good systems, all stakeholders are more accountable for their results. Either formally or by culture. In poorer systems, results have no real consequences for the teachers or the schools. On the contrary, failing may have benefits for them, in selecting only the easiest pupils, reassuring parents as to the level, or keeping subsidies for less favoured schools.

As for sports activities, it makes sense to evaluate the capabilities of all players from the start, not only at the end. It is also a good idea to evaluate with a view to the end result, not only looking at the current year. In education, success or failures often manifest themselves only a few years later. As in secondary education for failures in pre-school or primary classes. And at university for secondary.

In poor systems, orientation is merely the result of failures. In good ones, there is no failure, and higher levels. Orientation is done more logically, on the basis of strengths.

It makes sense to evaluate and reward all players according to their training, capabilities and/or results. Oddly, this is almost impossible in most northern countries, while it may be considered quite normal in southern countries, even in less democratic ones, such as Kenya, Pakistan or India. As systems become better, they become more able to reward more stakeholders, not only a few champions, and more frequently.

Education according to world standards has become more and more essential. Thankfully, it has never been so easy to emulate the best. We have never had so many good results, information about how they can be achieved, and communication tools to inspire us of best practices. At least for those who want it.

And you? How do you see this? What would you propose? How is it going for you? Good luck in all your projects!

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**ACHIEVING CURRENT STANDARDS, ENSURING QUALITY FOR EVERYONE?**

Every child was born a genius. Albert Einstein (1879-1955, de)  
It is not because things are difficult that we don’t dare. It is because we don’t dare that they are difficult. Seneca the younger (-4-65, it)  
Education is not the filling of a pail, but the lighting of a fire. William Butler Yeats (1865-1939, ie)  
Don’t tell people how to do things. Tell them what to do and let them surprise you with their results. George Patton (1885-1945, us)  
We can easily forgive a child who is afraid of the dark; the real tragedy is when men are afraid of the light. Plato (-428--348, gr)
Internationalisation of Higher Education in Flanders

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Abstract

Internationalisation in Flanders, especially in the University Colleges, took off some 30 years ago, with the start of the Erasmus programme, supporting student and staff mobility. This brought new dimensions in the management structures of the colleges and universities and led to new collaborations at local, regional, national and European level. Due to the globalisation process, it is essential now to go worldwide. But what effects has this on students, staff, the curriculum, the recognition and the quality assurance of study periods abroad, languages skills, double or joint degrees? How are our links growing building cross-border bridges with regional and international stakeholders? How international is our curriculum content? How international interdisciplinary is our mind-set? What do we expect from the next Erasmus+ programme in 2020?

Keywords: internationalization, EU programmes, regionalization, higher education networks.

60 years ago the Treaty of Rome was signed, a first milestone of European integration and 30 years ago the EU-Erasmus programme was created and is also a major milestone of uniting people.

It is exactly 30 years ago that a very alert director of the University College, where I was teaching, called us for a special meeting: «There is European money available for our students! Go and look for it!» It was indeed the very start of the Erasmus programme. 30 years ago, this means the period without mobile phones, without email traffic, without online news, all contacts had to go through telephones and through postal services with letters and perhaps a telex machine. And the big question was: we are an excellent University College, located in Ghent, under the umbrella of the University of Ghent, but is there excellence to be found North, East, South, West of it? Sending students abroad means: look out for reliable partners with valuable programmes, most of all people you can trust because you are sending away somebody’s child.

The Erasmus programme proved to be a godsend: it was the time of setting up networks: ICPs Interuniversity cooperation programmes. For University Colleges, practically without international practice, unlike the Universities with their international research units, it was great to meet kindred spirits, all very trustworthy and with a great love for their students. I had contacts in Ireland, they gave me contacts with France, and from there onwards contacts with Greece, Finland and Germany. Believe it or not, those very first contacts of more than 25 years are still alive and kicking. And we still
meet ever so often. Those ICPs were fantastic: at one time I managed 10 networks for a University College located in West-Flanders, VIVES, Kortrijk, under the umbrella of the KUleuven, and we had a lot of money, to send students abroad and most of all to encourage staff to go abroad and come back with new ideas to improve their teaching methods and most of all opening their curricula to new insights.

Then we had the Socrates programmes, with its building blocks Comenius, Erasmus, Grundtvig, Leonardo da Vinci, Lingua, Minerva, which ran till 2006, followed by the Lifelong Learning Programme till 2013. Next to it we had also Tempus. And then starting in 2014 the new programme combining all the EU’s current schemes for education, training, youth and sport: called Erasmus Plus, the new 14.7 billion euro catch-all framework programme for education, training, youth and sport. The new Erasmus+ programme combines indeed all the EU’s current schemes for education, training, youth and sport, including the Lifelong Learning Programme (Erasmus, Leonardo da Vinci, Comenius, Grundtvig), Youth in Action, Jean Monnet and five international co-operation programmes (Erasmus Mundus, Tempus, Alfa, Edulink and the programmes for co-operation with industrialised countries).

What started as a student mobility programme in 1987, has grown into something quite bigger and has enriched the lives of more than 9 million direct participants, not to mention the indirect impact it has had on so many others. This means for example that I have an Austrian son-in-law, a Malaysian daughter-in-law and an Irish daughter-in-law...

Due to the globalisation process, it is indeed necessary to go worldwide, as an essential service to our students, to shape them into global citizens and to provide them with the competences needed to lead independent, fulfilling lives and help them find their place in our societies and develop a sense of a world citizen identity – an identity that complements our national, regional, local identities.

This means that the people in charge of the Internationalisation in the different faculties and departments of a University or a University College have to be aware of their responsibilities towards their students and their colleagues. They need to know not only their own value as an international entity but also the international value of their counterpart abroad. Here in Flanders with the support of the Flemish department for Education and Training, Flanders Knowledge area and the University of Ghent a tool has been developed: «eQuATIC» (http://www.equatic.ugent.be/tool/) and that addresses the growing need for quality in international cooperation. It exposes and visualizes strengths and weaknesses, supporting policy makers and practitioners in evaluating international cooperation. It is a kind of ranking system, a kind of objective benchmarking but serves at the same time for introspection of the programmes on offer for the incoming students and staff.

Without going into too many details, I would like to stress the value of the efforts made for the recognition of the period abroad. ECTS is a central tool in the Bologna Process (1999) to which Kazakhstan acceded as a full member since 2010, and which aims to make national systems more compatible. ECTS also helps with the planning, delivery and evaluation of study programmes, and makes them more transparent. Egracons helps on top of that for grade conversion (http://egracons.eu/). The ECTS users guide was recognized in 2015 at the Yerevan EHEA conference, this means that 48 countries of the European Higher Education Area recognized its value. This way it is also possible to talk about double degrees, which play a very important role towards employability of our students, as do the language skills. You'll notice that I didn't talk about joint degrees! Experience tells me that it is one of the most difficult things to achieve in internationalisation, because legislation concerning recognition differs from country to country, and some countries have flexible systems, while others keep to a very strict centralized system of recognition of degrees. Interesting is also the concept of Mobility windows (ACA paper by Irina Ferencz) http://www.aca-secretariat.be/fileadmin/aca_docs/images/members/ACA_2013_Mobility_windows.pdf) to offer for example a semester abroad as a full package that can be recognized in the home institution as compatible to the own courses.

So we are now going worldwide with Erasmus+, with three Key Actions. Certainly the KA107 needs our full attention. A University or a University College applying for this action, for student and staff exchanges worldwide is confronted with the finances governed by the National Agencies and the strict rules of the Erasmus+ Guide Programme Guide. And the results can be very disappointing as too many institutions want to send students and staff to the same countries. Writing this kind of applications – per country – requires high professionalism. No ‘cut and paste’ is accepted! At least four pages have to be filled in per country, about the relevance of the exchanges of staff and students, the quality of the cooper-
ation arrangements, the quality of the project design and implementation, the recognition of the period abroad, and impact and dissemination procedures.

It is essential also for the International Office to check on the language skills of the students going abroad and... on the political situation in the targeted country, and to make students aware that the shift from a teacher-centred to a learner-centred approach, which is, under the term of Student-Centred Learning (SCL), recognised as an underlying principle of the EHEA, has not yet been implemented fully in all countries...

Writing an application for KA2 is not to be compared with writing 30 years ago an application for an ICP! Between 5 and 8 hours were necessary at that time, now it requires an intensive preparation together with the partners for at least 5 months. The application covers easily 80 pages. KA2 strategic partnerships is managed by the National Agencies, but the specific KA2 Capacity building with the neighbouring countries is governed by the Executive Agency EACEA and requires also the support of the National Erasmus+ Office, like yours in Almaty. Confusing is the use of the vocabulary: programme countries and partner countries...

Thinking already about the New Call 2018 (when? July, September?) and the next deadlines in the spring of 2018, we could start to focus on some basics: «Give to Caesar what belongs to Caesar, and give to Europe what belongs to Europe», this is to say if you want European money, abide by the rules of Europe... and read the Programme Guide thoroughly! And keep always in mind that you are setting up a project not for your own sake, nor for your university or faculty alone, but for «Europe» and now for the «World»....

An item that could be interesting is to work on regionalisation as opposing national populism, so look out for regional collaboration agreements. Look out also for regional cooperation in higher education and invest in cross-border bridge building with regional and international stakeholders and start thinking about a multinational flagship university! New buzz-word!

Brexit and its impact on HEIs worldwide could also be a topic as well as devolution could be.

Another topic could be «peace-ing» and linking with partner countries in crisis, specifically for staff concentrating on critical thinking, studying ways and means to combat ethnocentric insularity through cross-cultural negotiations?

And go resolutely for setting up interdisciplinary curricula, and connected curricula, through High Impact Learning that Lasts (HILL) (Prof. Dochy, KULeuven), based on the findings of the Tuning methodology for Central Asia Higher Education Area.

And let's start think about 2020: what can we suggest to DG Education and Culture, or to the new Commissioner for Education (after the EP elections of 2019)....Please, dear Commissioner for Education and Culture and your DG: emphasize the Erasmus for All thinking, make sure that all countries are equally represented for KA107, and...encourage your people at the EACEA to write simple applications. 20 pages must be a maximum! But continue to encourage the positive impact of European integration and international outreach, for a future that we can build together!
II. EDUCATION
THE TECHNOLOGY OF APPLYING THE DIDACTIC POTENTIAL OF ETHNOCULTURE AT SCHOOL

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Abstract

In the article the didactic potential of national pedagogics is defined as a set of national didactic ideas and experience of instruction, representation and comprehension by people of the essential features and necessary connections of the process of education in aggregate with national ways of didactic work, in their close connection and interdependence. The analysis of patterns of ethnoculture - oral national arts, national customs and traditions, religious beliefs, economic and cultural traditions, national art from the point of view of reflection of national didactic ideas and experience allowed to define rich didactic potential of ethnoculture. The suggested technology of applying the didactic potential of national pedagogics in teaching and educational process includes the objectives, tasks, content, forms and methods of organizing the process of instruction at school on the basis of integration of traditional, innovative and ethnopedagogical approaches to pedagogical process, in addition diagnostics of productivity of educational process. The results of the research work, their analysis carried out on the basis of quantitative methods show the efficiency of the worked out technology of organization of the educational process at school applying the didactic potential of ethnoculture.

Keywords: national pedagogics, didactic potential of national pedagogics, technology, application, ethnoculture, school.

THE ACTUALITY OF THE RESEARCH

In conditions of the growth of national selfconsciousness, revival of cultural, spiritual traditions, and language the necessity of thorough, more deep acquaintance of students with cultural values of the people, national ideas, customs and traditions arises. Thus connection between the past, present and future should be realized, and education, teachers, traditions are its bearers.

Throughout the history the human was and remains the object and the subject of upbringing and education, that is the national pedagogics serves as the intermediary, the link between wisdom of the people and society. Popular wisdom not only contains valuable thoughts on education of a child, on formation of his/her personality, but in some cases represents the elements of didactics specifying, at what age, on the basis of which procedures and methods in the course of instruction it is necessary to impart these moral qualities.
Many of the laws and mechanisms of national pedagogics have a didactic range of action and can be successfully applied not only in education, but also in school instruction, especially in connection with approval of personality-centered teaching and educational process. Each nation should «develop», that is to realize the necessity of national education, to participate in creation of infrastructure for organization of teaching the native language, literature, art, in general – for familiarization of students with national culture.

National representations, ideals concerning instruction are significant for modern education practice, creation of a new model of modern national school, creation of new didactic systems and educational technologies.

Realization of didactic possibilities of national pedagogics requires their ethnopedagogical «instrumentation», perfect in pedagogical sense comprehension, design and realization that, certainly, should be carried out with application of innovative technologies in education.

Despite an extended interpretation of the issues of ethnopedagogics in pedagogical literature, the didactic ideas and experience of national pedagogics in the Central Asia and Kazakhstan remain not sufficiently enough investigated in theoretical and methodological context, and the problem of their application in practice of teaching and educational process of modern school is especially urgent.

Thus, in modern theory and practice of ethnocultural education of students there is an objective contradiction between practical demand for scientific researches of didactic possibilities of national pedagogics and their application in teaching and educational process of modern school as there is no effective technology of its realization.

These contradictions determine the problem of working out the technology of applying the didactic possibilities of national pedagogics as effective means of improvement of education quality and perfection of ethnocultural instruction of students.

THE METHODS OF RESEARCH

Theoretical analysis of scientific and pedagogical, ethnographic, psychological, philosophical, art criticism, historical and scientific literature on the researched problem; analysis and generalization of the advanced pedagogical experience and mass school practice; theoretical analysis and systematization of didactic ideas and views prevailing in the sources of national pedagogics; systems and structural analysis of national didactic experience; typologization, classification of sources, generalization of the materials included; Q and diagnostic methods; monitoring; the method of subjective testing; pedagogical experiment; the methods of mathematical statistics.

ANALYSIS OF THE OBJECTIVE

The historical and genetic analysis of the problem of didactic possibilities of national pedagogics is possible only on the basis of its direct connection with studying the history of development of pedagogical thought, in particular of didactic views and theories in retrospective review. From this point of view the works of such classics of pedagogics as Ya.A. Komensky [1], J.H. Pestalozzi [2], K.D. Ushinskiy [3], P.P. Blonskiy [4] were analyzed, and the idea that «ethnic pedagogics takes its theoretical sources from classical pedagogics» is proved again. It is represented that studying of the didactic potential of national pedagogics is closely connected with development of didactic ideas, formation of didactics as a science, with its further development in the works of teachers-scientists.

In the context of studying the genesis of the researched problem the work of M.V. Boguslavskiy [5] is of high interest for us, as it is convincingly proved in it that valuable ideas concerning organization of national education, content of forms and methods of studying the traditional national experience of upbringing and education at a comprehensive school were expressed by progressive-minded teachers and scholars of the Russian education of the beginning of the XX-th century.

Meanwhile, certain positive experience of application of the elements of national pedagogics in teaching and educational process was stored at domestic schools in 20th – 30th years of the XXth century. There was provided application of national pedagogics in the sphere of education of a rising
generation at school, and the documents and publications of that period indicate it. The goal sets of school programs became closer to national comprehension of education and upbringing, and the new school became oriented to local economic needs. The programs of all disciplines took into consideration complex knowledge of the mode of life, customs, and culture of the people. New forms of teaching and educational work that purposefully used the experience of national pedagogics appeared. The ideas of national pedagogics were successfully applied in teaching and educational work and had effective results (A.P. Orlova [6]). Among the supporters of effective application of experience of national pedagogics were outstanding teachers of that time – A.S. Makarenko [7], P.P. Blonskiy [4], S.T. Shatskii [8], etc. The ideas of organization of education and upbringing at the Kazakh school on the basis of the centuries-old national traditions in education and upbringing are clearly traced in the heritage of outstanding Kazakh educators of that period – Zh. Aymauytov [9], A. Baitursynov [10], M. Dulaev [11], Kh. Dosmukhamedov [12], etc.

Historical and pedagogical works indicate that in the first Soviet school documents the democratic ideas were declared, which were in keeping with the best ideals of pre-revolutionary Russian pedagogics. But, since 1930th and during the next decades, alienation of centuries-old national pedagogical traditions from school is observed. The school gradually lost its contact with the national roots. The national school reached a crisis situation.

Interest to researching the problems of national pedagogics, in particular its didactic possibilities, partly increased since the end of 1950th and most essentially in 1960-1970th. The didactic possibilities of national pedagogics were investigated on the basis of the materials of national creativity in the works of such scholars and teachers as V.Kh. Arutyunyan [13], Z.M. Mirtursunov [14], A.F. Khintibidze [15], etc.

In the late eighties and beginning of 1990th in connection with democratic transformations in society, the pedagogical science started to get rid of rigid party-ideological pressure. Scholars and teachers-practitioners for the first time in the last decades started to support revival of the national school. A number of scientific and pedagogical works appeared, in which national aspects of education and upbringing were investigated. The research by M.I. Stelmakhovitch is a big contribution to working out of the problem investigated. The author considered national didactics «as a component of family ethnopedagogics» and «a set of methods and means of national upbringing of children», tried to specify its content, and classified national methods of education of children [16].

Obvious revival of the researches in the field of ethnopedagogics in the post-Soviet period is observed after 1991, when the former Soviet republics got the state independence. Acceptance of national legislations on education, working out and introduction of conceptual regulations of education and upbringing of the youth, attempt of creation of own national models of education – all these factors served activization of ethnopedagogical researches, and expansion of the subject matter.

K. Boleev [17], to V.F. Volodko [18], E.P. Zhirkov [19], S.K. Kaliev [20], K.Zh. Kozhakhmetova [21], R.K. Duisembinova [22], etc. point to the importance and ample opportunities for realization of the idea and experience of national pedagogics in teaching and educational process.

Investigating the methodology and technology of renewal of the content of education at the national school, E.P. Zhirkov put forward a number of propositions which have a positive role for research of the phenomenon interesting for us – didactic possibilities of national pedagogics, their realization in teaching and educational process at school. Undoubtedly, E.P. Zhirkov was right asserting that accepted at school standard approaches to the structure and content of the teaching material, assessment of the results of teaching, cannot be considered perfect in respect of certain national schools and that is why the major problem of national school is taking into account the ethnopsychological features of students as an objective basis of renewal of the content of education, namely, volume and sequence of studying the teaching material, creation of the final results of education and upbringing [19, p. 18].

Last years a number of ethnopedagogical works concerning the problems of the ethnodiadic approach to the content of national education appeared (F.G. Yalalov [23], V.I. Matis [24], Sh.M. Mukhtarova [25], etc.). The monograph «Ethnodidactics» by F.G. Yalalov can be estimated as a big contribution to the research of didactic possibilities of national pedagogics [23]. A successful attempt to single out ethnodidactics as an independent branch of ethnopedagogics was undertaken by F.G. Yalalov.
The approach to determination of the key components of ethnodidactics suggested by F.G. Yalalov is the most substantiated. The author emphasizes that «ethnopedagogics has an extensive subject of research. And ethnodidactics singles out rather narrow area of ethnopedagogics, only connected with research of the problems of teaching the representatives of various ethnoses». According to the statement of the scholar, «ethnodidactics is ethnically original didactics. Therefore the subject of ethnodidactics is the theory and technique of teaching, corresponding to the ethnic nature of a child». As the author notices, «ethnodidactics is didactics both of concrete ethnoses, and ethnic groups, and the people as a whole. There are some special features in didactics of each ethnos. But there is also an invariant centre in ethnodidactics, identical to ethnic groups and the people» [23, p. 47].

As a result of the analysis of the literature it was found out that nowadays the following aspects of the investigated problem had their reflection in the literature: the didactic ideas in folklore; didactic views of thinkers of the past; national ideas and experience of teaching, considered in the context of traditions of intellectual, physical, labour and esthetic upbringing; the didactic potential of a family and its application in school practice; particular methodical questions of applying the elements of national pedagogics at teaching school disciplines and in out-of-class activities. In general it is possible to state that understanding of the essence and features of application of the didactic potential of national pedagogics, working out of the technology of their realization in school practice is out of the authors’ sight.

**DESCRIPTION OF THE RESEARCH**

For investigating the didactic potential of national pedagogics it is necessary to reveal its essence, structure, content and functions. More precise definition of the concept «national pedagogics» is of paramount importance. There is a great number of definitions of the concept «national pedagogics» in modern pedagogical literature. In the research as a basic we take the definition that considers national pedagogics as a set and interdependence of concepts, views, opinions, ideas, skills and techniques in the field of education and upbringing, reflected in the folklore [26].

The didactic possibilities of national pedagogics we consider as a set of national didactic ideas and teaching experience, representation and comprehension by the people of the essential features and necessary connections of the teaching process in aggregate with national ways of didactic work, in their close connection and interconditionality.

In the course of the research work carried out in 2004-2008 at schools of South-Kazakhstan region, the productivity of realization of didactic possibilities of national pedagogics in teaching and educational process of school was determined and tested. The total number of participants of the experiment: 662 students, 52 teachers of natural-science disciplines and form masters.

The experimental work was carried out with application of the worked out technology of realization of didactic possibilities of national pedagogics during class and out-of-class work, and the revealed pedagogical conditions of the efficiency of this process were put in its basis (Figure 1).
The aim: to improve the efficiency of the process of instruction and ethnocultural education of schoolchildren, applying the didactic possibilities of national pedagogics.

The results: a high level of formation of program knowledge and abilities of schoolchildren, their cognitive interests and attitude to national values.

The tasks: formation of the system of scientific knowledge, abilities and skills, ethnocultural competencies; development of universal and ethnic stereotypes of behavior; development of scientific outlook and ethnic consciousness.

Conceptual fundamentals: the national pedagogics is a methodological basis of the teaching and educational process at school (S.A. Uzakbayeva); the ideas of renewal of the content of education in national schools (E.P. Zhirkov); the ideas of introduction of the materials of the Kazakh national pedagogics in teaching and educational process (K.Zh. Kozhakhmetova); the activity of a teacher on introduction of the Kazakh ethnopedagogics should be formed on modern achievements of pedagogical science and essential characteristics of the Kazakh ethnopedagogics (R.K. Dyusembinova); the development of ethnocultural education and qualitative changes in general educational preparation of schoolchildren are provided by realization of the complex of pedagogical conditions, ways and techniques of application of didactic possibilities of national pedagogics in teaching and educational process of schools.

Diagnostics of teaching and educational process: it is carried out on the basis of the worked out criteria and levels of formation of knowledge, abilities and skills of schoolchildren, their cognitive interest, attitude to national values with application of the complex of diagnostic methods and techniques of their studying and estimation.

The content: - in the course of instruction students acquire the bases of traditional national knowledge, ways of action, world-view and moral-esthetic ideas from the national experience, generalized and systematized in the content of education;
- in out-of-class activities the acquired national knowledge is extended and broadened, the abilities and skills on traditional art and management forms are formed.

The means: modern technical, information and multimedia means of instruction, means of national pedagogics (works of decorative and applied arts, manuscripts, means of labour, items of household culture and etc.).

The forms: integrate traditional, innovative, and also organizational modes of instruction and upbringing borrowed from national pedagogics.

The methods: traditional, active, interactive methods and techniques of instruction in aggregate with the methods of national pedagogics.

Figure 1. Technology of application of didactic possibilities of national pedagogics in teaching and educational process at school
Experimental teaching was carried out on the basis of natural-science disciplines, with application by the teachers of physics, chemistry and biology of the multiplied syllabuses of the lessons, which were prepared on the basis of the designed technology. The teaching material contained data from the national knowledge, selected on the basis of the singled criteria out. National didactic means were applied at various stages of a lesson.

During outside regular hours there was organized participation of students in various kinds of collective and individual creative work, providing their inclusion in real practical activities on mastering the national values. The system of out-of-class activities with application of the mentioned above forms of work was oriented on development at students of complete representations about national values, formation of effective interests to original culture, labour activities, traditions and customs of the people and other ethnoses of Kazakhstan. The content of out-of-class activities was coordinated with national traditions and provided participation of students in various kinds of activities covering studying of the language, history, mode of life, economic and cultural traditions, crafts of the ethnoses. Such forms of activities were applied: facultative courses on history of branches of sciences, organization of work on regional studies, circles on traditional kinds of economy, meetings with national craftsmen, public reviews of national knowledge, organization of school theaters for children, etc. Besides, at schools where the research work was carried out, the methodical seminars for teachers and supervising teachers were organized, in the course of which scientific and methodical aspects of realization of didactic possibilities of national pedagogics during classes and out-of-class activities were investigated.

THE RESULTS OF THE RESEARCH

For comparison of the results of experimental and control groups the following criteria were formulated: the levels of formation of knowledge, abilities and skills of students; cognitive interest to disciplines; attitude to national values. Besides, the issues of influence of experimental teaching on development of national consciousness of students and formation of ethnic stereotypes of their behavior were investigated.

The monitoring of efficiency of influence of realization of the didactic potential of national pedagogics at a lesson on the level of formation of knowledge, abilities and skills of students in natural-science disciplines was carried out on the basis of the following indicators: awareness and durability of comprehension; volume of the acquired material; ability of knowledge transfer; proficiency in logic operations; ability to search new knowledge.

On the basis of these parameters, regulations on four possible levels of activity, forming the basis for diagnostics of degree of its mastering (V.P. Bespalko), and also signs of the mentioned parameters there were singled out four levels of formation of knowledge, abilities and skills of students in natural-science disciplines: low, satisfactory, sufficient and high.

For assessment of the influence of applied didactic possibilities of national pedagogics on interest of students to studying of the disciplines we applied the technique of diagnostics of cognitive interests. The following criteria of formation of cognitive interests were differentiated: degree of cognitive activity of students; character of independent activity of students; attitude to the difficulties; correlation of interest and aptitude. There were singled out three levels of formation of cognitive interest, in which basis the mentioned criteria were put.

The technique worked out by A.D. Soldatenkov and O.V. Lebedeva was used as the basis of diagnostics of the levels of formation of national values. The level scale of formation of the national values, suggested by these researchers, is designed on the basis of the following criteria: recognition of dialectics of the ratio between international, universal and national by students; knowledge of cultural and historical values; attitude to national values; application of national values in activities. On the basis of these criteria three levels of formation of national values were differentiated.

In order to find out the initial level of acquiring the knowledge and abilities on the disciplines, the levels of formation of cognitive interests to studying of school disciplines and national values the ascertaining experiment was carried out. Assessment of the levels of acquiring knowledge, abilities and skills was carried out using the following didactic parameters: comprehension and durability of acquiring the teaching material; ability of knowledge transfer; ability to use the basic logic operations; ability to search the new knowledge; volume of knowledge (the material acquired); character of of students’ activities. For monitoring of
the levels of acquiring the knowledge, abilities and skills at the beginning of the experiment there were worked out 4-level tasks on the chosen disciplines for all the students. On the basis of the analysis of curriculums, textbooks and methodical manuals for teachers the possibilities of realization of the didactic potential of national pedagogics in the course of studying biology, physics and chemistry were determined.

In the phase of forming experiment monitoring of the efficiency of the worked out technology on application of the didactic potential of national pedagogics in the course of teaching natural-science disciplines and out-of-class activities was carried out.

In the phase of control experiment assessment of the results of forming experiment at the end of the academic year was conducted. Moreover, the levels of formation of natural-science knowledge and skills of students, their cognitive interest to the disciplines, and the levels of formation of national values of students were determined.

For checking the students’ knowledge, abilities and skills in natural-science disciplines there were held written control tests of identical content in experimental and control classes, giving the possibility to reveal and compare the results of teaching. The received results were evaluated according to the 4-level scale. For comparative percentage distribution of students according to the levels of formation of knowledge and skills at the beginning and at the end of the experiment see table 1.

<table>
<thead>
<tr>
<th>Disciplines</th>
<th>Physics</th>
<th>Chemistry</th>
<th>Biology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
<td>control</td>
<td>experi-mental</td>
<td>control</td>
</tr>
<tr>
<td>Sample size</td>
<td>n1=327</td>
<td>n2=335</td>
<td>n1=327</td>
</tr>
<tr>
<td>I (low)</td>
<td>89</td>
<td>91</td>
<td>95</td>
</tr>
<tr>
<td>II (satisfactory)</td>
<td>103</td>
<td>122</td>
<td>110</td>
</tr>
<tr>
<td>III (sufficient)</td>
<td>106</td>
<td>98</td>
<td>91</td>
</tr>
<tr>
<td>IV (high)</td>
<td>29</td>
<td>24</td>
<td>31</td>
</tr>
</tbody>
</table>

Therefore, the results of teaching in the experimental classes differ considerably from the results in control classes. As except for experimental interference all the other conditions of teaching were approximately identical for the experimental and control groups. That is why it is possible to assume that differences in quality of knowledge, abilities and skills of students studying in these classes are not determined by some random factors. Thus, we came to the following conclusion: application of didactic possibilities of national pedagogics at a lesson has positive influence on educational process in the experimental classes that confirms the efficiency of its application.

For proving the presence of direct influence of realization of didactic possibilities of national pedagogics at lessons on the levels of formation of cognitive interests of students within the limits of this stage of
experiment special questionnaire was offered to students. Thus the majority of students (86.4%) stated that they mostly like the lessons where the national materials are used. Only 7.3% of students state that they prefer the lessons of a traditional type where national values are not presented. 6.3% of students had difficulties in answering the questions of the questionnaire.

For the purpose of assessment of the levels of formation of cognitive interests of students by the end of the experiment the questionnaire was offered to them. On the basis of the received data the levels of formation of cognitive interests of students to natural-science disciplines were determined. For controlling the objectivity of students’ self-assessment the levels of formation of their cognitive interests were assessed also by experienced teachers of the disciplines.

The presented above data give the sufficient grounds to conclude that a higher, in comparison with the control group, level of formation of cognitive interests to such school courses as Physics, Chemistry and Biology is quite typical for the experimental groups. This level is a result of realization of didactic possibilities of national pedagogics in the course of studying these disciplines. Comparative distribution of students according to the levels of formation of cognitive interest to natural-science disciplines (table 2) also visually proves that by the end of research in the experimental group, unlike the control group, the percent of students, whose level of formation of cognitive interests corresponds to average and especially high level, is considerably higher.

Table 2. Levels of formation of students’ cognitive interest to natural-scientific disciplines at the end of the experiment

<table>
<thead>
<tr>
<th>Disciplines</th>
<th>Groups</th>
<th>Sample size</th>
<th>Levels of formation of cognitive interest</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>I (low)</td>
</tr>
<tr>
<td>Physics</td>
<td>control</td>
<td>n1=327</td>
<td>91</td>
</tr>
<tr>
<td></td>
<td>experimental</td>
<td>n2=335</td>
<td>24</td>
</tr>
<tr>
<td>Chemistry</td>
<td>control</td>
<td>n1=327</td>
<td>81</td>
</tr>
<tr>
<td></td>
<td>experimental</td>
<td>n2=335</td>
<td>39</td>
</tr>
<tr>
<td>Biology</td>
<td>control</td>
<td>n1=327</td>
<td>74</td>
</tr>
<tr>
<td></td>
<td>experimental</td>
<td>n2=335</td>
<td>53</td>
</tr>
</tbody>
</table>

Within this stage of the experiment there was held monitoring of the influence of realization of didactic possibilities of national pedagogics on formation of national values of students. Thus the students was offered the questionnaire with 3 variants of possible answers corresponding to one of three levels of formation of national values. For increasing the objectivity of diagnostics of the levels of national values’ formation a method of expert appraisal was applied. The poll of experts from among the teachers of Physics, Chemistry and Biology, and also supervising teachers was carried out on the basis of the worked out questionnaire. The subsequent summation of the points according to the expert questionnaire with the points of the students’ questionnaire the levels of display of attitude to national values were determined (table 3).

Table 3. Distribution of students of control and experimental groups according to the levels of formation of national values at the end of experiment

<table>
<thead>
<tr>
<th>Groups</th>
<th>Sample size</th>
<th>Levels of formation of national values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>I (low)</td>
</tr>
<tr>
<td>control</td>
<td>n1=327</td>
<td>133</td>
</tr>
<tr>
<td>experimental</td>
<td>n2=335</td>
<td>61</td>
</tr>
</tbody>
</table>

The received experimental data processing shows that for the experimental group, in comparison with control group, a higher level of formation of national values is typical. It allows to conclude: increasing of the level of formation of national values of students of the experimental group is up to the realization of didactic possibilities of national pedagogics at a lesson and during out-of-class activities.
Comparative percentage distribution of students according to the levels of formation of national values at the beginning and to the end of the training experiment is presented in figure 2.

![Bar chart showing the percentage distribution of students at the beginning and end of the experiment.](Image)

**Figure 2.** The dynamics of development of the levels of formation of national values with application of didactic possibilities of national pedagogics in teaching and educational process

The presented data demonstrate that to the beginning of the experiment the percentage of students of the control and experimental groups, whose skills and knowledge in national culture and attitude to it corresponded to the low (first) level, was rather high (43.2% and 39.2%). As a result of the experiment the percentage of students, whose level of proficiency in national culture corresponded to the low level, was considerably reduced in the experimental groups (by 21.1%), when in the control groups reduction was obviously not significant. The percentage of students of the control and experimental groups, whose level of mastering the national values corresponded to the average (second) level, changed insignificantly (by 3%). However in the control groups by the end of the experiment the increase in percentage of students, whose degree of proficiency in national culture corresponded to the high (third) level, practically did not occur. At the same time there was an essential increase of number of students in the experimental groups, whose skills and knowledge in national culture and attitude to it corresponded to the high level.
Thus, the results of the experiment show positive influence of realization of didactic possibilities of national pedagogics in teaching and educational process at school on quality of mastering the program material of disciplines by students, levels of their cognitive interest, formation of settled and conscious attitude to national values.

CONCLUSION

1. Historical and genetic analysis of development of the national didactic ideas in the history of development of pedagogical thought convinces once again that national pedagogics was at the background of scientific pedagogics, in particular didactics as a constituent part of pedagogical science about scientific bases of the teaching process. Scholars, thinkers of the past, borrowing the national didactic ideas and experience, exposed them to deep scientific analysis, and distinguished all the rational and irrational in them. It was their first and successful attempt to apply the didactic possibilities of national pedagogics in promotion of the progressive for that time didactic ideas.

2. With a view of modernization of the pedagogical process and development of ethnocultural education at the national school the introduction of didactic ideas and experience of national pedagogics, working out of the technology of their application in the course of teaching and during out-of-class activities are very urgent nowadays.

3. The scientific and theoretical analysis of the investigated subject gave the possibility to define the term «national pedagogics» more precisely, and to open the essence of the concept «didactic possibilities of national pedagogics».

4. Realization of didactic possibilities of national pedagogics in teaching and educational practice of the modern school proceeds in unity of educational and out-of-class activities. The revealed directions, ways and methods of realization of didactic possibilities of national pedagogics during classes, in nonacademic and out-of-class activities with students were realized through the content and technology of application of national didactic ideas and experience in school teaching and educational process.

5. The results of the experimental work show the efficiency of use of the worked out content and technology of applying the didactic possibilities of national pedagogics in school teaching and educational process.

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FORMATION OF NATIONAL IDENTITY OF KAZAKHSTAN

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Abstract

The article deals with the process of formation of Kazakhstan’s identity on the background of the transformation of the «Mangilik El» from a concept of the national idea into a comprehensive ideology. The purpose of this ideology is to unite all ethnic groups in a single nation through modernization of the public consciousness of the all people living in Kazakhstan.

Keywords: idea, integration, ideology, patriotism, unity.

Kazakhstan society, who has chosen a capitalist mode of development and democracy, is facing the task of finding or building its identity that is to be fulfilled in the broader context of economic decline, social tension, polarization of interests, and the collapse of the old value system. The task of self-identification and, therefore, of deciding on a further action plan is faced by each of those living in Kazakhstan and by the authorities of the country.

The past decades gave people some answers to the «damned» questions «Who is to blame?» and «What to do?» Now the focus is on the questions «How to survive?» and «Where to start?»

If each and every one in Kazakhstan has to and is able to decide «How to survive» independently, the «Where to start?» question, however, requires some theoretical justification. Therefore, politicians have been actively developing the methodology of modernization. In doing so, one has to rely on the own and international historical experience to get out of the «theoretical methodological quagmire». Amidst the excitement of reforms and transformation, it is easy to lose the sense of balance and measure. Moreover, it would be wasteful not to use the previous experience of the leading countries, but it would be also senseless to reject one’s own roots. On the one hand, the traditional way to get an answer putting the national idea at the centre and adjusting it to new conditions appears preferable and a number of Kazakhstan and foreign researchers have doing exactly that.

However, this is important to remember that there is a very fine line between the idea of a civic nation (integrative one) and that of a people’s nation; the latter is prone to nationalism that is much more often destructive than constructive. For multi-ethnic countries, such as Kazakhstan or Russia, the national ideas of the «Kazakhs» or «Russians» and their zealous implementation, as some excessively patriotic figures insist, may have destructive consequences destabilizing societies who already undergo rather difficult transitions.

The problems of finding the national idea are old. Dostoevsky, realising how hazardous the topic was, described the content of the «Russian Idea» in 1861 differently from the Russian nationalists of that time. For him, the Russian man is all human, the spirit of Russia is the universal one. Solovyov in 1887, in his «Justification of Goodness», developed Dostoevsky’s point. Following the Orthodox
Christian ethics, he still accepts Kant's principle of morality as a free, not forced decision to act morally. According to theory (1990, p. 572).

Berdyaev, following his predecessors, relies on morality while developing his concept of «Russian Idea» and rejects any reductionist nationalism pointing at a supra national character of Russia. For him, therefore, the «Russian Idea» goes far beyond nationalism. This is how, according to Berdyaev, Russia differs from all other countries (cited in Solovyov, 1990, p. 9).

This approach was shared by the Trubetskoy brothers, Rozanov, Shestov, Florensky, Frank, Bulgakov, and others. The fact that contemporary researchers continue this tradition, bringing it at a new level, pushing for a more integrative and civic understanding of nation, reinforces the continuity of aspirations to find in the political life some objective guidelines that will help to unite the society that finds itself on the crossroad of the eastern and western cultures. Therefore, the idea of integration, interpenetration, mutual respect for the traditions, beliefs, and the cultures of a multi-ethnic society during the difficult transition period is in the mentality of the peoples of the post-Soviet countries. It naturally complements the democratic values; in no way it hampers the each individual ethnic identity.

Russian scholars Alekseeva, Kapustin, Pantin and others believe that a deeply divided society during its transition needs to develop and implement an integrative ideology of social harmony. From the political and philosophical point of view, this means defining the boundaries and building the conditions to balance and mitigate the differences. It is necessary to include liberal individualistic aspirations into a certain moral legal system, where the clash of private interests would not degrade into a «war of all against all.» The way to create such a system is through a dialogue of competing ideologies not through domination of the one claiming to be the only truth. Technologies for the regulation and resolution of conflicts of interest are well known and implemented in a number of countries. Nevertheless, what is problematic is not to adjust these technologies to the Russian conditions. Since ideology is not just about conceptualizing and legitimizing of political regimes. It gains life only when, with the help of certain technologies, it resonates with the masses. This is only possible if there is a common semantic space that is large enough to form a broad public consensus on the basic values.

Thus, some Russian researchers come to the conclusion that an integrative ideology will not only promote the consolidation of a democratic society, but will also become a step towards the transformation into a politically and historically viable entity better integrated into the world political process.

At the same time, there are those who include «sobornost», collectivism, monarchism, orthodoxy, eschatology, patriotism, and civil concord into their «Russian Idea». According to Aksenov, Krivorotov, and Chernyshev a future ideology shall combine several components, one of which is the Russian philosophy of the third revelation, namely Fyedorov, Soloviev, Berdyaev, as a kind of spiritual, intellectual and practical tradition having some commonalities with the economic philosophy found in the early Marx's writings. Thus, people themselves must carry out something that gives meaning to their history, be able to draw a perspective from concrete stages (1996, pp. 528-529).

The position of the authors, who justify this kind of future ideology, is more than relevant. They are convinced that every action taken in accordance with such an ideology should be related, on the one hand, to the profound issues of human existence and, on the other, expressed in rather mundane practical concepts. Actually, they speak about inextricable link between theory and practice and that we will have to raise our self-awareness and find our place within the domestic and world history learning new ways of managing, new methods of governance and self-governance.

The abovementioned tendencies in the contemporary public consciousness are more or less theocraticized by social scientists. However, an integrative ideology in line with the spirit of the times, but not rejecting traditional values of a multi-ethnic Eurasian society shall be a priority.

We suggest that due to democratization of all spheres of public life in the post-Soviet space, the gap between the two value systems, the Western and the Eastern, is closing; the process is being based on the universal values. This is, perhaps, the most important, although not obvious, purpose of democracy. National narrow thinking is being replaced by something continental, integrative, and uniting. The new thinking resonates with the multicultural, multi-ethnic mentality of the Eurasians. Integration consciousness overcomes the limitations of national consciousness, which was characteristic of the period of the struggle for independence. Although such transition is only possible after the nation state's identity formation has been completed. Kazakhstan, as a Eurasian country, has been experiencing a strong influence of Russian
culture over the past two hundred years. Despite different religions, both people are close in spirit to each other. The main thing is their peacekeeping mission. At the turn of the century, the Eurasians have to work out their own contemporary system of values. The efforts taken for more than a century by great number of outstanding figures of both countries shall be continued by the contemporary researchers.

Yet, to find the common, one shall find the different. According to the well-known German political scientist Schubart, the West-Eastern conflict is a cultural one; the East and West are not only geographic but also spiritual concepts. The narrow, overcrowded divided Europe is dependent on a different kind of landscape forming its spirit than Asia with its vast boundless plains. So Europe produces a different type of man than the East, he argued (Schubart, 1993, p. 111).

There shall be some reason why all great religions came from Asia and none from Europe. Only once, a culture conditioned by religion emerged in Europe in the Gothic era, but it also encountered resistance and criticism. The problem of the East and the West was above all a matter of the soul, Schubart believed. The point was to merge one into another for the purpose of joint creativity. It is necessary to note that the German researcher back in the 1850s predicted the conflict of two cultures. In his time, it manifested, he argued, as the clash between Russia and Europe. Schubart argued for reconciliation as it was the cultural destiny of subsequent generations (Schubart 4, p. 112).

It is significant that individual researchers, having independently developed the problem of the synthesis of the European and the Asian mentalities, drew to the similar conclusions. Under Gumilev’s concept of «passionarity» there is the relationship between the geography and landscape that condition the life of individual and people and their culture. Shabelnikov argues that each type of society including its forms of economy, traditions, values and psychological makeup corresponds to the geobiospheric situation in which it was being formed (1996, p. 27).

Shabelnikov consistently develops the concept of Eurasianism. He argues that any form of cultural reflexion such as written constitutions, legal texts etc. replicating the European model do not work in the structure of traditionalist societies with its clans, tribes and groupings. Western society is a «society of reasoned principles» whereas the Central Asian one is «a society of stable links». Deviation from the behaviour pattern predetermined by these ties is seen as something exceptional and unnatural, although there are no rules without exception. Thus, it is not enough to study social and psychological mechanisms that ensure the stability of the hierarchies of traditional societies to find the ways and methods of social modernization. Moreover, interpenetration of cultures sometimes lead to rather unexpected and peculiar consequences. Once, the victory of the socialist revolution in Russia prompted Europe to come up with a social-democratic system of government that enabled the Europeans to resolve the issues posed by the Bolsheviks. In our time, the democratization of the Eurasian states will push for their future alliances; through their disintegration, they ultimately will come to a union that will eventually unite the East and the West.

Kazakhstan, being a young Eurasian state of a transitional type, is at the junction of not two but three cultures. Firstly, it is a young multicultural and multi-ethnic society and, therefore, cannot be classified as «pure» Asian. Secondly, there are still strong traditionalistic attitudes supported by the dominant form of Islam and this means the predominance of group patriotism, strong family values, greater authority of the parents and the elderly. In relations with the authorities, emotional dependence, guardianship and the prohibition of dissemination of aggression are prevailing. Additionally, the Eastern ethics do not allow the expression of any individual feelings that do not coincide with the prescribed norms. Finally, the Western influence is already quite strong due to the close interrelation of Kazakh and Russian cultures. Since the times of Abai and Valikhanov, these tendencies have been growing and having ever-broader resonance among the general public in Kazakhstan.

Thus, the paramount task facing the experts and social scientist amidst emergence of a new democracy is to gradually form the norms and values that can consolidate the society and to justify the ways they are implemented. It is important to note that the process of changing the social structure has not been complete. The previous microsocial relations have not been replaced with new ones. Nothing has acquired is final complete form. People are preoccupied within the search of new niches and development of new ways of economic and social survival. In such a situation, both forcing and neglecting the ideological problems on the part of social scientists may lead to unpredictable consequences in a society who is already affected by a number of social experiments.
Throughout the history, at the turn of the epochs, at the critical times, general ideas, which, as a rule, are rather complex and comprehensive, stipulating a program of action for the coming decades, and able to adjust to the practice, united countries, consolidated the forces of society and facilitated their transition. America and South Korea ones are good examples. In both cases, this was a gradual process of the ideological consolidation. Although the experience of more mature democracies in their «pure form» cannot be repeated here, it would be rather senseless to neglect it as it would lengthen our own journey few times.

The Americans started their search for a nationwide formula for success, of an ideological concept that would be attractive for every citizen in the first half of the nineteenth century. This was the worldwide known triad of American exceptionalism, American dream and Manifest Destiny. Nevertheless, it is not enough to develop a successful set of ideas, they must be realized. The next stage was to consolidate them in legal documents, to create a legal framework in which they could be implemented. And then, the modernization started with the joint efforts of society and state. The key to success was rightly and timely formulated values as well as consistency and purposefulness of the subsequent actions.

Similar processes occurred in South Korea. The driving force, according to Pak Dan Sung, was the economic development of nation, who managed to make a rapid leap in less than half a century.

The other factor was a particular kind of Christianity (1996, pp.159-160). The Christian Church led the transforming of the deeply disunited Korean society via building the social movement of moral revival. In the atmosphere of chaos and decay prevailing in Korea, this gave people a new impetus. The preaching of diligence, asceticism, personal responsibility for the entrusted task, as well as a healthy way of life was timely, clear and was responded positively by the people. The following stage was to introduce a clear management style. The «I can» slogan was complimented with the «I must» one. Finally, the Church guided Koreans to create a society of universal abundance.

Thus, the implementation of ethical and moral norms along with the promotion of a common goal of a society of universal abundance, provided all these norms were observed, consolidated the South Korea. Pak Dan Sung was convinced that «the healthy spiritual energy of the people» influenced greatly the economic development of the country (1996, p. 161).

In the light of the other countries' experience of successful socio-political transformation, it is important for Kazakhstan to preserve its uniqueness and self-sufficiency of the cultures of its ethnic groups alongside with the national unity, to create a large coalition of political parties, public organizations and civil society. Specificity of transition to the market relations and democracy is in activity and autonomy of individual based on the traditions of the national culture. Further implementation and consolidation of the Cultural Heritage Program is, therefore, very desirable. An ever-greater development of the culture of the people should promote their self-awareness as the socio-historical community and form a new mentality.

Speaking before the delegates at the XXII session of the People's Assembly of Kazakhstan, President Nazarbayev defined the nation of Kazakhstan according to the unshakable formula of the multi-ethnic unity of the people. He called to forever preserve our main values of independence, peace and social stability. According to President Nazarbayev, the duty of all state institutions and every Kazakhstan citizen was to guard these values. President Nazarbayev assigned the National «Kazakhstan-2050» Movement with the task to develop and adopt of the Mangilik El Patriot Act in his annual Address to the Nation of Kazakhstan entitled Kazakhstan's 2050 – Common Goal, Common Interests, and Common Future.

References

USE OF SCIENTIFIC ACHIEVEMENTS IN TEACHING PHYSICS STUDENTS OF HIGHER EDUCATIONAL INSTITUTIONS

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Abstract

The article is devoted the problem of modernization of methods of physics teaching of students of higher educational institutions in conditions of credit technology of training. Features of credit system are to cut classroom time and increase time for independent work of students. To improve the efficiency of teaching physics students of technical specialties requires a new approach based on application of modern scientific achievements. It is necessary to develop clear methodological guidelines for effective teaching physics depending on the areas of training. As this guide offers a systemic-synergetic approach, because it is a method of analysis of education systems from the standpoint of self-organization. Changes in the parameters of education, educational and information components of the environment will inevitably lead to qualitative changes in the system itself.

Keywords: high school, method, teaching, physics, teaching physics, credit technology

Nowadays the situation on the educational market has changed fundamentally, the knowledge and skills recognized as the capital of a specialist. Disappear problem of discipline and motivation of students for learning, the emphasis on independent work. But University teachers, scientists-experts in a particular subject area, without special pedagogical education, almost own methods of learning are unable to build a system of teaching his subject.

Methods of teaching physics, one of the natural Sciences, is no exception, the relevance of the using of scientific achievements in teaching physics students in higher educational institutions is not in doubt. The authors of the article for more than 30 years at the methodological level, exploring problems of development and approbation of methodical system of teaching physics to different fields of education (basic, specialized and HEI), as well as to assess their effectiveness and modernization.

The experience and the specifics of the implementation of scientific and applied research, the use of different diagnostic techniques, tests and rules allowed finding the problems of the methodical plan in teaching physics students enrolled in technical disciplines. In particular, there are no clear methodological guidance and scientific-methodical bases of teaching physics in conditions of credit technology (depending on directions of preparation of specialists of technical profile). Let’s present the main results of the methodological analysis.
Discipline of «Physics» developed in the conditions of credit technology of training, methodical system of discipline is in the development stage. Under the methodological system is the relationship of the goals and aims, approaches, results, content, principles, methods and techniques, forms and means of training [4].

For each specific technical field of study of physics is allotted a different number of credits – from one to eight, although the professional competence of future specialists of technical profile practically coincide. At times different number of practical, laboratory and lecture classes. It is logical to assume that methodical system in the development of the discipline to a particular technical specialty must be different from each other, and the teacher quite difficult to develop each of them efficiently and on time. The question here is not about creating educational-methodical complexes of disciplines or the development of guidelines for particular occupations. In our opinion, the first serious problem in the teaching of physics that stands in the way of implementation of modern methods and training technologies is the need for methodological justification, thoughtful and balanced approach, and development, introduction of literacy and correction of methodical system of teaching physics students for each technical specialty. A guidance system should be preceded by development of methodological basis [1, 3]. Not every teacher is able to do, because not everyone received methodological training. Teaching physics as a pedagogical process, there is an open, non-linear and dynamic system, affected by many of factors. On the one hand, methods of teaching based on the classical laws of didactic (linearity, place of the teacher as the only true source of information, learning outcomes of knowledge, skills, etc.), on the other – needs to be modern and to follow the changes occurring in the world (forming of professional and personal competence, critically, mobility, flexibility, functional literacy of students, etc.). Algorithms, standards, control plans and lead the system in a structured state, and any pedagogical experiments, including the active and not always in the details thoughtful and pedagogically justified the introduction of new methods and techniques of training, lead to instability. Therefore, for proper and successful development of methodical system of teaching physics teachers cannot do without the use of achievements of pedagogical science. We believe that the development of methodical system of teaching physics it is necessary to apply a system-synergetic approach, as it is a method of analyzing systems from the standpoint of self-organization [2].

Development of methodological system is accompanied by the passage through a special state, called a bifurcation, where small effects lead to the emergence of new levels of organization of the system. The content of bifurcation there is a choice of the most significant information, which will be the development and application. Changes in the parameters of education, educational and information components of the environment will inevitably lead to qualitative changes in the system itself. Because the most effective impact on the system will be exactly at the bifurcation point [2], it is necessary to create the bifurcation and make resonance, not forgetting that the impact should be adequate to the condition of the subject. In other words, the student must be on the corresponding readiness, and teacher – methodological literacy. Accordingly, in the methodological system needs to be elements contributing to the creation of the bifurcation conditions (e.g., method of problematic situations, solving non-standard tasks, the scoring of paradoxes, educational dialogues, the conditions for the successful transformation of «student-teacher», etc.).

The second direction, which can also be attributed to modern achievements of pedagogical science, is a competence-based approach [6]. If we understand authority as a set of interrelated qualities of the person and ability to carry out complex actions, competence-based approach is interpreted as a method of analysis and improvement of educational systems (including methodological) in terms of their compliance with the goals and aims of formation of competences. Competence-based approach provided a new perspective on the outcomes of education, which is now reflected not only in the knowledge-abilities-skills, but also as a readiness/preparedness of high school graduates to exercise specific professional activities [5]. Technical specialist, such as, has to design and solve complex engineering problems, develop and trouble-shoot systems, components or processes for compliance with specified requirements, and the cultural, social and environmental aspects. Undoubtedly, the results of applying the competence approach to the development of methodical system of teaching physics students will be applied in further studies. Some steps in this direction have already been made. In 2015-2017 teachers of the Department «Physics for technical specialties» of M. Auezov South Kazakhstan state University in collaboration with the teachers of the departments «Oil and gas business», «Applied mechanics», in «Industrial and civil construction» developed and approved the methodical system of teaching physics in the areas of technical specialists (engineering, oil and gas, construction). Successfully tested methodological elements of the system, from comments,
current and final evaluation, forms and means of its realization, to the ideas of applied nature, linking the physics with the technical interests of a particular industry, a particular profession. Created packages of accompanying materials, produced handouts, selected problem situations and cases, composed of a system of thematic and integrated tasks received copyrights and implemented in the educational process 11 e-books and virtual practical works. Of course, good results, but on the cessation of work on the improvement of the developed methodical system.

Currently requires the activation of scientific activity of teachers-researchers in the implementation of the learning physics students of technical specialties of new methods and technologies of training. The relevance of the task in general due to the need of modernization of the educational system, demanding improvement of quality of preparation of specialists in accordance with the development of the Republic of Kazakhstan and the progressive world experience.

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This paper considers problems of credit training system introduction into vocational technical training (VTT) and ways for realization of VTT and higher education study programs succession.

Keywords: higher education, vocational technical training, credit technology, Bologna process.

From the first days of Independence of the Republic of Kazakhstan development of education is an unchangeable state policy ensuring qualitative transition to the country’s industrial-innovative development. Therefore, improvement of the quality of education to ensure competitiveness of the graduates is of paramount importance. One of the most important factors ensuring improvement of the quality of educational process is integration of science, education and innovation. At that, increased attention of the society to the quality of education, especially to the secondary vocational training, contributes to the aim of the state to form competitive environment in the educational space of the country, thus creating serious motivation to improve the quality of educational services. Close relationship of educational institutions with employers, allowing consider constantly changing requirements of production to the middle-level specialists also has great importance for improving the quality of education.

Analysis of the world’s main trends in the development of education shows that there is internationalization in the sphere of education. There are interethnic systems of education, common academic values and requirements to the structure and content of the educational process.

Signing the Bologna process by our Republic and gradual integration of Kazakhstan’s educational system into the world educational system requires introduction of innovative and universally recognized technologies in the educational process. One of the directions of the phased entry is succession of the study programs, starting at all stages of training, in this connection, by the Decree of the Government of the Republic of Kazakhstan No. 1080 dated 23 August 2012, the state compulsory educational standards of corresponding educational levels, which will be introduced from the 1st of September, were approved. Thus, secondary vocational and higher education institutions should work in one format.

College of M. Auezov SKSU carries out step-by-step work to introduce credit training system into the educational process and implement «CollASU» electronic program.

CollASU is automated information system for management and monitoring of the quality of its educational process, which consists of virtual jobs for administration of the educational process, centralized database and computer classes of the educational institution, united in a single space through...
a corporate network. This program ensures reliability and protection of information through the system for monitoring access to the database and provides real-time information with restriction on the levels of users’ access. Introduction of this program was the first stage of transition to the credit training system. The next and main transition stage to the credit system is preparation of the regulatory and legal framework.

However, analysis of the regulatory legal documents of the technical and vocational education showed that there are a number of issues that prevent the introduction of the credit system in the technical vocational training:

- currently the state standards of specialties of the technical vocational training allocate hours mainly to the disciplines of compulsory component (about 98%) and do not consider such main principle of the credit system as possibility for students to individually plan their educational trajectory by choosing the courses offered;
- necessity to bring to the single system for labor intensity measurement – credit;
- academic period varies from 7 to 20 weeks depending on a course and specialty.

Full transition to the credit training system is impossible without solving these pressing issues necessary for introduction of the credit training system in the vocational technical training.

Therefore, we believe that it is necessary to develop a unified approach for introduction of the credit training system in the vocational technical training system. To do this, it is necessary to coordinate all the work on developing the legal framework for the transition of the credit training system, to allow pilot implementation of the credit training system in the best institutions of the vocational technical training, which will help identify and resolve the problems that arise during the transition.

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The article deals with the practical experience of studying the general course of physics in the context of credit training technology. Peculiarities of credit technology consist in reducing the classroom time and increasing the time for independent work of students. Examples of a successful solution of some methodological problems in the study of physics are given. Advantages of the analogy method will help compare the characteristics of translational and rotational motion. The recording of the harmonic sound wave equation in various forms will make it possible to apply the superposition principle to waves of any nature. The intensity of the wave must be expressed in terms of the parameters characterizing the wave itself and the medium. It is useful to shift the work on the formation of theoretical knowledge from a lecture to a laboratory lesson, which will make it possible for students to study the nature of research and creative work. In modern education, the intellectual and personal development of a student, the formation of competences is the main result of education, and knowledge is only a means. The work of the teacher to activate reflexive activities of students, which must take into account personal characteristics and the level of real analytical abilities of students is of particular importance.

**Keywords:** high school, method, teaching, physics, teaching physics, credit technology.
of training (on the example of technical programs) was revealed [8]. There is the relevance of generalization and systematization of methodical experience of teachers of physics of the higher school in the new environment.

Physics studied in the first year and holds a special place in training. The proof is the fact that physics is a prerequisite for most disciplines of engineering. The problem also exists in the human resources [7]. Every teacher has their own idea and provides training as it sees fit. Experience has shown [9] that the experts on physics do not have pedagogical education, are not always able to develop to meet all the demands of the time, the methodology of teaching physics. Because the technique of training in physics at the higher school for credit technology of training for the present is in a development stage, the problem of a research of different methodical aspects of teaching physics is actualized. Let’s give an examples of successful solutions to some methodological problems in the study of physics, with years of experience [2].

Advantages of the method of analogy clearly manifested itself in the comparison of the characteristics of translational and rotational motion. This method allowed the students, in particular, to understand that vector quantities describing the translational and rotational motion, have a different character. Displacement, velocity, force are described using polar vectors, whereas angular velocity, angular acceleration, angular momentum – with axial (axial) vectors. When setting the acceleration or speed by means of a polar vector, the students do not have problems with the direction of the acceleration vector or velocity at a given point. The direction of axial vectors defined physical quantities is not obvious. This direction is determined by the rules of the right and left vector three (rules of the right and left screw). Depending on the selection rules, axial vector will be directed in one direction or another. To determine the positive directions of the axial vectors are usually screw with the right thread. Axial vectors are introduced to formulas written in vector form, have the same form in different coordinate systems.

In the study of the laws of dynamics of rotational motion it is important to find the cause of angular acceleration of the body, which can rotate around the axis, and to experimentally calculate its numerical value. Explaining the role of torque, you should pay special attention that the cause of rotational motion is the component of the force lying in perpendicular to the axis of rotation of the plane. Since the formation of experimental skills is one of the tasks of teaching physics, it is useful for students to obtain the dependence of angular acceleration from the moment of the force and properties of the rotating body.

To form an idea about the double periodicity of the wave process (spatial and temporal) will allow entry of the equation of harmonic sound waves in various forms. When observing in one point of space the wave equation describes the change of air pressure over time, and when observed in different locations at the same time, the wave equation describes the change of air pressure depending on the coordinates.

The principle of superposition of waves brings together many of the wave phenomena. In the case of mechanical waves the principle is a consequence of the principle of independence of forces and displacements. But it is better to formulate the principle as a fundamental experimental fact: waves passing at one time through a single point of space, independent, does not amplification or quenching, is observed only the effect of the addition of independent oscillations. This technique allows applying the superposition principle for waves of any nature.

The ratio of the average in time of the energy carried by the wave in time and cross-sectional area perpendicular to the direction of propagation of the wave is the intensity. But it will be more useful to express the intensity of waves through the parameters that characterize the wave itself and the environment. For a plane wave the intensity is proportional to the density of the medium, the speed of wave propagation in the medium, the square of the frequency and amplitude of vibrations of the particles of the medium and does not depend on the distance from the source. For spherical waves (without absorption) the wave intensity decreases inversely as the square of the distance, because the surface area of a sphere is directly proportional to the square of the radius.

When designing Electromechanical alternators make sure that the law of vibrations of voltage and current was close to the law of harmonic oscillations, which in turn simplifies the calculation chains. If the circuit contains active, capacitive and inductive elements, when connected to a source of harmonic alternating voltage in each circuit element voltage and current will vary according to a harmonic law.

One of the peculiarities of the credit technology in high school is to reduce classroom time and increase the share of independent work of the student. The necessity of presenting a large volume of material
requires from the teacher the use of special instructional techniques [11]. Proposed to postpone the work on the formation of theoretical knowledge from lectures to laboratory lesson.

We show an example of studying the topic «Thermal radiation». The task was to acquaint students with practical proof of the Stefan-Boltzmann law during laboratory classes. Students received experimental task: find the dependence of the power of light emission of the incandescent lamp on temperature. Alternatively, for the work students were provided with bulb, ammeter, voltmeter, current source.

Find the power by multiplying the current voltage, because it can be assumed that practically the whole power current is converted into radiation of a heated filament lamp. The temperature of the filament lamp at different values of current can also be found at the famous students of the dependence of resistance on temperature, knowing the temperature coefficient of electrical resistance of tungsten and given its dependence on temperature. After determining the absolute temperature of the filament lamp at different values of current and radiation power, the students discover that the ratio of power to the fourth power of the temperature remains almost constant, and conclude that the radiation power heated body is proportional to the fourth power of its temperature.

So the transfer of the work on formation of the knowledge from lectures to laboratory lesson allowed the students to experimentally and practically learn the Stefan-Boltzmann law, which was useful in conditions of credit technology. As you can see, the transformation activities of a teacher of physics in modern higher education because the educational activities of the students should have the character of research and creative work. The teacher gradually takes away, and then develops independently of the task focused on the prediction of problematic situations, discussion of various solutions, finding multiple correct answers, a rationale for the lack of the ability of solving the problem because of its absurdity [6], etc. Digested system of knowledge, students operates characteristics.

Long experience has shown that traditional physics teaching skills, abilities, knowledge was acquired by students mainly through a verbal method, demonstration, practice and repetition [5, 9]. In the modern training unit of pedagogical action become the problem, the purpose and result of which – the mastery of the student in different ways of action. The teacher needs only methodically competently to push the student with a situation in which he finds the lack of knowledge and then to organize dialogical interaction, which would receive a response.

To realize this idea in practice is not easy. Due to the fact that each acquired student knowledge monotonically combinable with any other, at the first clash with a special task the student is lost. This is because the focus of traditional education on the assimilation of certain algorithms. In such circumstances, distressed, layered, absurd, interdisciplinary challenges was not raised and therefore not decided. Today there is the opposite: intellectual and personal development of the student, the formation of competences is the main result of education and knowledge is only – a means. The purpose of the training activities now lies in mastering the basics, which can be used independently to build and develop individual ways of action. The purpose of the system of action – the implementation of a series of actions for the class, not one action. This practice inevitably «pulls» for the theory, as a general principle of educational action can be removed from the method and to generalize. Mastering the way of solving the problem is more important than the fact of mastering the theoretical material itself [1, 3]. Here particular importance is the work of the teacher to enhance students’ reflexive work, considering personal characteristics and the level of real analytical capabilities of students.

To enhance reflective activities in teaching physics can offer to students tasks self-study: to determine the goals for the whole class/individual stages; to think along with the teacher or the students; to identify the main and secondary material; to learn the basic techniques of writing; to control your mental state and to manage them; to evaluate one’s own actions; to put questions, to formulate them during the lesson or at the end of it; a little ahead of the teacher or group members to find a way to solve problems or to infer, to test your cognitive capabilities, etc.

After completing either action, the student will improve their own level of reflection, and the teacher receives feedback. This information will signal about the performance of student in General and will intensify the process of formation of competences of future specialists, because reflection involves the supervision of a student for themselves, their learning activities and ways of its implementation.
References:


The article considers the state of internationalization of education in one of the leading and young universities of Kazakhstan - L.N. Gumilyov Eurasian National University (ENU). Data is reported on the position of the university in the ranking of QS World University Ranking, cohort of foreign students, academic mobility of students and internationalization of educational services are given.

**Keywords:** internationalization of education, university ranking, international cooperation.

Initially, the mission of any university is to spread knowledge beyond its territory. Until the middle of the twentieth century universities performed their traditional functions of providing knowledge to students, contributed to the development of national science and technology.

Globalization has adjusted the activities of universities. The development of international cooperation of higher education institutions implies close cooperation with the partner institution for the provision of knowledge, exchange of students and teachers, training in joint curricula and scientific cooperation.

At the forefront are indicators of competitiveness of universities. University may no longer function within the national framework. The internationalization of education lays down the law [1].

ENU was founded in 1996, and is one of the young universities of Kazakhstan. Despite its youth, ENU is a recognized educational, scientific and socio-cultural center not only in Kazakhstan, but also beyond its borders.

This confirms our progress in one of the established international rankings of QS World University Ranking, in which the university has been participating since 2009.

ENU was the first of universities in Kazakhstan to enter the 500 best universities in the world according to the rating agency QS World University Ranking in 2010. In 2012, the university was ranked 369th, 2013 – 303rd position, 2015 – 371st.

Based on the results of 2016-2017 academic year ENU took 345th position in the list of 980 recognized universities of the world. In total 8 universities of Kazakhstan are represented in the ranking [2].

Based on the results of the 2017 ranking, ENU continues to improve its position on such criteria as reputation among employers and academic experts, and number of foreign specialists.

Among Kazakhstani universities, ENU remains at the forefront in the «Citation» criteria. The total number of citations of the works of scientists of the ENU for today is 1816.
The result of the work over the years was an active internationalization, and that was reflected in growth of the number of foreign students (full course of study, within the framework of academic mobility, double diploma program); participation of scientists in international projects (Erasmus +, Mevlana, etc.); expansion of work within frameworks of associations (for example, Association of Asian Universities, Council of Turkic Universities).

**FOREIGN CONTINGENT OF ENU**

The number of foreign students is one of the indicators of the competitiveness of educational programs and the popularity of the university. In 2015-16 academic year 482 foreign students were enrolled at ENU, which is about 3% of the total contingent [3].

Figure 1 shows the geography of the countries from which students have arrived. The largest number of students came from Uzbekistan (157), China (125), Mongolia (58), Afghanistan (47) and Russia (24).

![Figure 1. Contingent of students who came from abroad](image)

Students study at 12 faculties of the university (Figure 2).

![Figure 2. Number of foreign students completing the full course of studies by faculties](image)
Figure 2 shows that the most popular major among foreign students are the specialties of the faculties of physics and technology (ФТФ), natural sciences (ФЕН), architectural and construction (АСФ), philological (ФФ), mechanics and mathematics (ММФ).

As part of 2015-16 academic mobility 66 foreign students were attracted to ENU, which is 5 times more than in 2014-2015 academic year (Figure 3).

For students from far abroad universities, the most attractive majors are of the Faculty of Information Technology and the Faculty of Economics.

For students of ENU there is an opportunity to undergo studies in partner universities on the program of academic mobility. Unfortunately, it should be noted that the percentage of past academic mobility (for a full semester) remains at a low level. Only 2% of students go to study. In 2014-15 academic year, 286 students were enrolled in academic mobility, in the 2015-16 academic year – 326 (Figure 4).
Year after year the number of students who leave and who come to study under the program of academic mobility is growing.

Internationalization of educational services

In the course of internationalization of educational services, first of all, the university is undertaking task to increase the number of disciplines taught in English (Figure 5).

Today there are 37 programs operations in the field of preparation of joint educational programs of double diplomas at the levels of bachelor’s and master’s degrees (Figure 6).
15 programs are being implemented within the framework of CIS universities with 5 Russian universities.

Within the framework of the University of the Shanghai Cooperation Organization, 11 joint educational programs with 5 universities are being implemented at ENU.

Within the frameworks of inter-university agreements, 8 educational programs are being implemented.

Foreign professors play a significant role in the development of internationalization. In 2015-16 academic year, the number of foreign specialists attracted on a long-term basis was 25 people, the number of short-term visiting professors was 47 (Japan, USA, Turkey, Germany, Russia, etc.).

INTERNATIONALIZATION OF SCIENTIFIC ACTIVITY

In the direction of internationalization of scientific activity, work is being carried out to attract international programs, as well as maintaining a constant contact with international organizations (BritishCouncil, DAAD, Volkswagen, EurasiaFoundation).

Today ENU actively cooperates with 166 universities of the world: Russia, Turkey, Poland, Belarus, etc. Our university continues its active work on internationalization of education. We hope that on this path the scientific and pedagogical team of L.N. Gumilyov Eurasian National University will achieve even greater success.

References

III. BIOTECHNOLOGY
Abstract

This paper considers the results of study of influence the electrochemical synthesis conditions and anode material on process of cross oxidative coupling reaction between Flavonoid Quercetin and Alkaloid Anabasine allowing to obtain substances with high physiological activity, uniting initial compounds. The influence of concentration ratio of initial substances, electrolyte concentration, anode material, current density, pH and temperature of medium on yield of oxidative coupling products were studied. It was established that anode material essentially does not influence on yield of oxidative coupling products, therefore the anode from Glass-carbon because of cheapness was chosen.

The study of influence the Quercetin:Anabasine concentration ratio showed that the most optimum are 4-5\times10^{-3} \text{M}: 3-5\times10^{-3} \text{M} respectively, optimum current density lies in the limits of 0,0025-0,004 \text{A/sm}^2, optimum temperature it is necessary to keep -18-25°C, because the further increasing of temperature leads to occurrence of no-purpose compounds because of destructive oxidation. Besides, the optimum area of pH values are 6,5-7,5, and LiCLO4 electrolyte concentration 0,1 \text{M}, at which the products yield is maximum. So, results of research allowed to determine the most optimum conditions of electrochemical synthesis based on Flavonoid Quercetin and Alkaloid Anabasine and obtain the new compound Quercetin -5-2-anabazinide with yield of 88-92%.

**Keywords:** electrochemical synthesis, cross oxidative coupling, quercetin, anabasine, oxidation, current density, electrode, glass carbon, current density, concentration ratio.
1. INTRODUCTION

Flavonoids and alkaloids have consistently attracted the attention of researchers because of their biological activities [1, 2]. Among the numerous biological properties of these compounds the most important are ability to inhibit oxidative enzymes, to lower vascular and vascular – tissue membranes permeability, to exhibit antiradiation and anti-tumor activity. Anticancer, antithrombotic, antioxidant and antimicrobial properties of quercetin, one of the most important flavonol, earlier were studied in some works [3-5].

Flavonoids are basically used in medicine as P-vitamine and capillary restorative means. It is established that bud of Sophora japonika L. are source for obtaining of quercetine – valuable pharmaceutical drug of P-vitamin action, because it is not synthesized in organism as opposed to other vitamins [6]. Also, flavonoids have broad prospects at treatment of liver, kidneys, gastrointestinal tract diseases, and attract interest as perspective anticancer, antiallergenic, antiviral drugs. Owing to antimicrobial properties the flavonoids are used in cosmetic preparations [7-9].

There are some early works devoted to use these compounds as a basis for electrochemical synthesis of medicine drugs [10, 11]. We hypothesized that it would be possible to use the cross oxidative coupling reaction between biological active substances to prepare compounds with increased physiological activity. Earlier some papers reported that naturally occurring bioactive compounds may act in synergy with drugs in pharmaceutical applications, and combination can be changed the concentration of drugs, enabling their use at lower concentrations but with increased efficiency. Some structural fragments play role for appearance of long-range pharmacological activity. By introduction the different substitutes can be regulated the correct aspect of activity, that depends on right choice of appropriate structural traits.

Reactions of cross anode coupling that are considered as an interaction of free or adsorbed radikals on the electrode surface or near to surface allow to significantly enhance the ability of electroorganic synthesis and to get a more wide range of compounds with physiological overactivity, combining the positive properties of the initial compounds. Reactions of cross anode coupling were studied in some works, where the special attention was given to electosynthesis conditions [1, 12].

The first example of electrochemical oxidative coupling reactions of alkyl aromatic compounds may be regarded as the oxidation of alkylbenzenes. Early have been described the oxidative coupling reaction of alkyl benzenes to form the corresponding diphenylethanes [13]. Many papers are devoted to describe the oxidative coupling of phenols [14-16].

Therefore, modification of natural flavonoids with alkaloid anabasine with purpose to give them a new properties and enhance the existing properties seems as an actual and important problem.

In this work were studied the optimum conditions of cross oxidative coupling (COC) between flavonoid quercetine (QE) and alkaloid anabasine (ANA), that allowed to get a new compound on their base with high physiological activity and yield on substance.

2. METHOD

The flavonoids quercetin, an alkaloid anabasine were as the objects of study. Quercetin (C_{15}H_{10}O_{7}, QE, powder of white color, non-hygroscopic, insoluble in water, t_mel= 316-318°C), anabasine (C_{10}H_{14}N_{2}, ANA, colorless liquid, yellowing in air, soluble in water, alcohol, benzene, ether). Preparative electrochemical synthesis was conducted in the electrolyzer, provided with a reverse refrigerator and bubbler, for the division of cathode and anodic space a diaphragm was used. Amount of the skipped electricity was determined by means of copper coulometer. Identification of product was conducted on HPLC Prominence LC – 20. Voltammetry on stationary and rotating electrodes, potentiometer for determination of potential during the electro synthesis was used in this work.

3. RESULTS

The most essential factors influencing on an yield of cross oxidative coupling is a concentration ratio of flavonoid QE and alkaloid ANA, because along with COC product the formation of dimers of initial com-
pounds is possible, such as bioflavonoids and bianabasine. Preliminary experiments showed that an yield on a substance practically did not depend on material of anode and changes depending on the conditions of electrolysis, therefore all researches were executed on the cheapest and steady anode from Glass carbon (GC–9). Therefore on the first stage of optimization the influence of concentrations ratio of QE:ANA on all finished products yield was studied. It was established that area of optimal concentrations ratio of QE:ANA is $10^{-3}:10^{-3}$, in the case of increase of initial substance concentration to $10^{-2}$ and higher the yield of its dimer is increased, at concentrations below $10^{-3}$ more effectively occur hydroxylation and deep destructive oxidization. In area of optimal value of concentrations ratio the influence of QE concentration on an yield of COC at the different fixed values of ANA concentration ($5\cdot10^{-4}$; $7,5\cdot10^{-4}$; $1\cdot10^{-3}$; $2,5\cdot10^{-3}$; $5\cdot10^{-3}$; $5,5\cdot10^{-3}$; $6\cdot10^{-3}$) was studied more in detail. From data of figure 1 it is seen, that yield of COC increases at the increase of concentration of both initial substances to $5\cdot10^{-3}$ M and then begins to fall. It is necessary to keep an optimal concentration for ANA: $3-5\cdot10^{-3}$ M, for QE: $4-5\cdot10^{-3}$ М. For determination of optimal value of concentration a method of mathematical optimization was used.

The influence of current density on yield of COC it is shown on figure 2. It is seen, that optimal current density lies in the limit of 0,0025-0,004 A/sm$^2$ in dependence on material of anode. At large and less current densities the yield of by-products is increased: (at $i_a<0,0025$A/sm$^2$ – symmetric dimers, at $i_a>0,004$A/sm$^2$ – products of deep destructive oxidization).
Change the temperature of electrolyte from 0 to 25°C does not influence on an yield of COC. At increase of temperature the yield begins to decrease, thus the amount of no-purpose compounds is increased in composition of products, including due to destructive oxidization (table 3). Therefore it is necessary to keep an optimal temperature – 18-25°C and it is possible to support it with accuracy +3-5°C.

Table 3. Influence of temperature on composition and yield of products of synthesis based on QE and ANA (10^{-3}-10^{-4}) on anode from GC – 9 at i_a = 0.0035 A/sm^2

<table>
<thead>
<tr>
<th>№</th>
<th>Temperature °C</th>
<th>COC</th>
<th>Yield on substance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>55</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>88</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td>78</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>40</td>
<td>61</td>
<td>10</td>
</tr>
</tbody>
</table>

pH of electrolyte substantially influences on yield of COC: optimal area of pH value 6,5-7,5 is determined, at which the yield is maximal. Concentration of electrolyte of LiClO4 does not essentially influence on an yield of COC.

CONCLUSION

Electrochemical modification of flavonoids quercetin and alkaloid anabasine was implemented to enhance their biological activity. We established the optimal conditions for electrosynthesis such as concentration ratio, temperature, pH of medium, current density, electrolyte concentration. By electrochemical synthesis was obtained compound quercetin – 5 – 2 – anabazinide with a yield up to 88–92%. The received compound have the antiradical properties. Anti-radiation activity of the synthesized compound was confirmed by medical-biological tests in further researches.

Thus, on the basis of the most widespread and available flavonoid quercetin and alkaloid anabasine, the new compound was received, which possesses by more wide spectrum of action and which can be used for treatment of consequences of radiating infection in zones of ecological disaster.

References

Abstract

The research results of the physical features of initial raw materials of bentonite clay, vermiculite and Darbazinsk clay of fields of the South Kazakhstan with definition of chemical and material compositions are given in the article.

The formation mechanism of the phosphoric slime, technogenic production waste of the yellow phosphorus which is formed at the phosphorus condensation stage is studied. According to modern representations, phosphoric slime represents the phosphorus emulsion in water stabilized fine firm particles.

Considering phosphoric slime as stabilized with highly active emulsion pollution in water, the way of phosphorus release is chosen from slimes, with usage firm porous and the bulk density sorbents on the basis of natural aluminosilicates.

The researches on definition of physic-chemical features of initial materials for receiving from them sorbents, were conducted with usage of modern methods of the physic-chemical analysis. The analysis of scientific results has shown that intensive ranges of absorption are characteristic to fluctuations of valent link of the aluminosilicates and hydro aluminate links. The microstructure of the studied tests is characterized by prevalence of crystals of montmorillonite in the bentonite clay and sodium-potassium-calcium minerals of feldspar in vermiculite. As a result of acid activation of sulfuric and hydrochloric acid of heat treatment has reached the high mechanical durability, bloating and bulk density of the received granules.

**Keywords:** bentonite, clay, sorbent, activation, phosphoric slime.
The environment protection against pollution with noxious emissions of the industrial enterprises and rational usage of mineral raw materials is an urgent problem of modern colloidal-chemical science and technology.

The problem of slimes utilization, despite essential shift in this question, on the acting enterprises—oil refinery still remains urgent. The utilization of phosphorus-containing slimes is carried out on given the enterprises as follows: the slime received from the furnace shop, is exposed to vapor processing, is pumped over in the capacity where it is settled for releasing of phosphorus which is used as a ready-made product in further. The slime which is remained after splitting with rather high content of phosphorus, is evaporated under vacuum and in a free flowing type goes to the furnace shop to return to the furnace [1].

Despite the considerable volume of researches on utilization of phosphorus-containing slimes, a certain research about the mechanism of a slime formation and technology solution on their processing is absent today.

The mechanism of a slime formation is represented to modern researchers as process of high-temperature adsorption and capillary condensation of vapors of phosphorus dust-like particles in a gas path which begins already on stages of phosphorus sublimation [2].

We have used phosphoric slime of the following chemical composition in the researches.

Table 1. Chemical composition of the mineral part of slimes.

<table>
<thead>
<tr>
<th>№</th>
<th>SiO₂</th>
<th>P₂O₅</th>
<th>MgO</th>
<th>Fe₂O₃</th>
<th>Al₂O₃</th>
<th>F</th>
<th>K₂O</th>
<th>Na₂O</th>
<th>C</th>
<th>CaO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40,94</td>
<td>26,18</td>
<td>2,67</td>
<td>1,22</td>
<td>2,48</td>
<td>4,55</td>
<td>1,05</td>
<td>0,32</td>
<td>5,41</td>
<td>15,18</td>
</tr>
<tr>
<td>2</td>
<td>41,83</td>
<td>31,07</td>
<td>2,36</td>
<td>1,56</td>
<td>2,17</td>
<td>2,20</td>
<td>0,65</td>
<td>0,26</td>
<td>5,08</td>
<td>12,72</td>
</tr>
<tr>
<td>3</td>
<td>34,31</td>
<td>30,31</td>
<td>5,30</td>
<td>1,97</td>
<td>2,07</td>
<td>2,92</td>
<td>3,49</td>
<td>0,50</td>
<td>3,15</td>
<td>15,98</td>
</tr>
</tbody>
</table>

The important characteristic of clay raw materials as natural ionite, is the ion-exchange capacity which is defined by mineralogical composition and colloidal-chemical characteristics of clays, and also the way of their activation. The increase in sorption capacity of the usual natural clays, which are available and widespread material, can be reached by their modifying in the various ways. At the same time works on increasing in quantity of the sorption centers on such natural materials as sand under the influence of electromagnetic radiation are known. The search of environmentally friendly and inexpensive methods of impact on clay minerals for the purpose to increase in their sorption activity is urgent. It has been suggested that impact on clays by the electromagnetic field can lead to their activation and increase in exchange capacity. It should be noted that the minimum influence of activation on cleaning efficiency is observed for the kaolinite clays. As researches have shown, it is connected with smaller sensitivity to activation of kaolinite in comparison with montmorillonite [3].

The bentonites represent, generally minerals of montmorillonite group, having composition 4,2SiO₂ Al₂O₃ 7,4H₂O. The concentration, acid consumption, temperature and time of contact influence on activation efficiency. At activation of montmorillonite clays of hot acid occurs not only replacement of exchange-capable cations ((K⁺, Na⁺, Ca²⁺, Mg²⁺ etc.) on acid hydrogen ions, but also six coordination ion of aluminum of an octahedral (central) layer together with two OH-groups are removed. The remained aluminum...
ion surrounded with four atoms of oxygen changes octahedral coordination for tetrahedral and reports to again formed structure a negative charge, which is equal to a unit.

As a result of this hydrogen ions of the activating acid become connected with a new structure for neutralization of this negative charge. The catalytic activity of the montmorillonite clay processed with acid is caused to hydrogen ions. The Bentonite activation with acid considerably changes their structural-adsorptive properties. Studying of purification of phosphorus-containing slimes was carried out for the first time on bentonite containing sorbents of the Darbazinsk field of South Kazakhstan.

The bentonite clay crushed and sifted through a sieve (0,30 mm) was filled in with 5, 10, 15, 20% of sulfuric acid or nitric acid, sustained at a temperature of 365-370K and at 335-340 K within 6 hours at constant stirring. Further clay was washed out with distilled water before full removal of sulfate ions or nitrate ions. Then clay was exposed to drying at a temperature of 365-370K within 1 hour. The received weight was formed in granules in size 2,5 x 4,5mm in the extruder. The granules after drying and calcination at a temperature of 723-773 K. As a sorbent for purification of phosphorus-containing slimes was used acid consumption 0,25-0,30g on 1 g of clay within 6 hours [4]. The adsorptive-structural characteristic of the natural and active bentonite clays are given in the table 2.

<table>
<thead>
<tr>
<th>Sample of clay</th>
<th>$\text{SiO_2/Al_2O_3}$</th>
<th>Surface (BET), $m^2/g$</th>
<th>Absorption capacity $C_6H_6$ at 200°C and ration press, $sm^3/g$</th>
<th>$\text{Density, g/sm}^3$</th>
<th>$\text{Hydration heat with water, Kkal/g}$</th>
<th>$\text{Pellet hardness, kg/mm}^2$</th>
<th>$\text{Porosity, %}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural</td>
<td>3,5</td>
<td>70</td>
<td>0,11 0,12 2,8 1,63</td>
<td>20</td>
<td>1,7</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>Processed HNO$_3$</td>
<td>4,6</td>
<td>170</td>
<td>0,12 0,15 2,8 1,30</td>
<td>66</td>
<td>1,3</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>Processed H$_2$SO$_4$</td>
<td>5,1</td>
<td>170</td>
<td>0,13 0,17 2,8 1,31</td>
<td>70</td>
<td>1,5</td>
<td>70</td>
<td></td>
</tr>
</tbody>
</table>

It is known that natural bentonite clays have small porosity in the field of porous with a radius of 1,8-2,0 nanometers. Processing of clays with acids of average concentration leads to increase in volume of porous. It occurs as due to removal of interlayered cations that causes weakening of an interlayered attraction and expansion of space between clay scales, and as a result of partial destruction of an octahedral layer (removal of ions of soluble metals, such as Al$^{3+}$, Fe$^{3+}$, Mg$^{2+}$)[1,3].

Apparently from the given in the table 2, activation of bentonite clays leads to increase in a specific surface with 70 to 170$m^2/g$, porosity in 1,8 times, but at the same time pellet hardness decreases to 1,3 times.

For efficiency research of the way of acid activation, the adsorptive properties of each received adsorbent on model solutions with the content of phosphorus-containing slimes of 30 mg/l were studied.

On the basis of analyses of the received experimental results it was shown that one of effective methods to increase in the adsorptive ability of adsorbent in processes of purification of phosphorus-containing slimes is acid activation of H$_2$SO$_4$ (10-30%).
Designations of curves: the activated bentonite: 1 – 5 % H₂SO₄; 2 – 10 % H₂SO₄; 3 – 15 % H₂SO₄; 4 – 20 % H₂SO₄.

As it is obvious from data of schedule 1 in case of adsorption of phosphorus-containing slimes bentonites activated with 5 and 10% sulfuric acid solution we observe the maximum size of adsorption of phosphorus-containing slimes, equal to respectively 0, 38 and 0, 57 mg/g, at mass concentration of solvent of 30 mg/l. The activated 15, 20% bentonite adsorbs phosphorus-containing slimes in smaller quantities (0, 26, 0, 23 mg/g) that confirms given earlier data on destruction of crystal lattice of mineral [4].

As it is shown in the schedule 2 at adsorption of phosphorus-containing slimes with bentonites activated with 10% of HNO₃ it is absorbed twice more 40mg/g, than the tests processed with 5% by HNO₃ solution and 3 times more than adsorption on samples, processed with 15 and 20% by HNO₃ solutions.

As the obtained experimental data shows a little big sorption activity was received at bentonite processing (10-30%).
Designations of curves: the bentonite activated: 1– 5% of HNO₃; 2 -10% of HNO₃; 3– 15% of HNO₃; 4– 20% of HNO₃.

The sorbent with sulfuric acid, further on activity is the clay activated with10% nitric acid bentonite clay. The optimum time of agitation 4 hours at which degree of extraction of phosphorus-containing slimes is reached respectively on the sample of the bentonite processed with 10% of H₂SO₄ – 60%, on the activated clay processed with 10% of HNO₃ – 56% in 4,5 hours, and on the natural clay – 39,5% in 5 hours [5].

Thus, activation of bentonite clay with solutions of sulfuric and hydrochloric acids (10-30%) leads to increase in adsorption size. And, increase in a concentration of acids has a positive impact on the process of removal of ions of Na⁺, Ca²⁺,Mg²⁺. As a result of activation occurs increase of specific surface with preservation of layered structure of clay minerals that is important for further modifying of the surface are received samples.

References:

SYNTHESIS OF NANOPARTICLES OF COPPER AND GOLD ON THE SURFACES OF DIELECTRIC MATERIALS

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Abstract

The article describes several methods for the preparation of nanoparticles of copper and its analogs on the surface of tissue and polymer materials. The methods of processing the phosphine gas tissue and polymer materials previously immersed in solutions of copper and its analogues. Copper nanoparticles and their analogues are formed on surfaces of tissue and polymer materials. Microscopic studies of the samples the film thickness is from 0.3 nm to 0.5 microns.

Keywords: textile materials, films of gold, dielectric materials, polymeric materials, phosphine.

INTRODUCTION

Gold coating widely used to protect base metals from corrosion and to give them a decorative look. The same gold coating have a relatively high electrical and thermal conductivity, low and stable in time, transition resistance and therefore are widely used in electronic industry.

Some known methods of gilding, successfully applied in the chemical industry. So, for example, in chemical methods of gilding were applied galvanic methods of obtaining the gold and diamond coatings. While diamond particle distributed in the volume of the coating increases the hardness of gold. The process is carried out by adding to the electrolyte the gold-plating of 0.1-5.0 g/l of particles of ultradispersed diamond. To initiate the process by electrolatrine proposes the introduction in the electrolyte gelling component is an ultra-dispersed silica [1].

Known composition of the electrolyte plating and the method of its preparation, where it was determined that the introduction of 80-90 parts by weight of ultrafine silica into 1000 mass parts of the electrolyte to provide a smooth, durable and lustrous coating when the ratio of the speeds of ultra-dispersed diamond and gold ranging from 1:100 to 1:1200 [2].

A disadvantage of the galvanic gilding methods is the use of poisonous cyanide compounds, the impossibility of coating on the inner surface, the need for a preliminary plating in the plating of dielectrics.

Known physical methods of gilding:
2. Magnetron sputtering [4] a target cathode made of precious metals or their alloys ions with enough energy for the migration of metal atoms or groups to the substrate.
Disadvantages of physical methods of gilding: the need for expensive and complex systems.

Known immersion (contact) gilding [5] that occurs in the reaction of substitution of the underlying metal of gold. The increase in coating thickness takes place until all of the coated surface will not last gold. After that, the reaction is stopped. The method is used for coating on silver, copper and Nickel. Provides high-quality coating of complex parts or internal cavities of the tubes. The method has limitations in coating thickness (no more than 0.2 microns). In addition, when the plating of dielectric surfaces prior to the application of chemical Nickel, making the process sequential.

Chemical gilding is also applied to articles of complex shape and provides a uniform coating thickness on all areas of the product. Is applied on the electro less Nickel or immersion gold to increase the adhesion.

This object is achieved in that in the method of applying a metallic gold on the surface of various materials, including chemical plating by applying a solution of gold compounds, chemical plating is carried out by immersion in the sorption solution containing 10-150 g/l of chloride of gold (AuCl₃), and gold recovery is carried out at room temperature gaseous phosphine [6].

Sorption solution may further contain a chloride divalent copper.

On the surface with a damp material after immersion in the sorption solution, the compressed air sprayed particles of synthetic diamond.

The quality of material used cotton fabric, polyvinyl chloride, polystyrene.

THE EXPERIMENTAL PART

Pre-prepared phosphine-gas handling zinc phosphide 10 % sulfuric acid (Fig. 1). The resulting phosphine gas, prior to use stored in a vinyl chloride bottles.

A sample of cotton fabric (Fig.2a) for 3 minutes, immersed in solution containing 100 g/l AuCl₃. Then by shaking and remove the excess chlorine solution of gold. Then the sample is dried at a temperature of 25 °C for one hour. The wet sample is placed in a sealed chamber to which is connected a bottle of phosphine gas. Then, using a surge vessel in the bottle with the phosphine generating excessive pressure (5 cm water column). The interaction of gold chloride with a phosphine in the chamber creates a vacuum, and a portion of the phosphine to flow from the bottle into the chamber. At the end of this reaction chamber pressure in the bottle is aligned with the phosphine, the water level in the surge vessel is not changed. Usually, the time required for the reaction was between 5 and 10 minutes. The sample are washed from by-products and dried in air. As can be seen from figure 2a on the sample surface formed a continuous film with a characteristic gold yellow color [7].
The initial sample of porous PVC (Fig. 2b). Other processes of the experiment as in experiment 1. The resulting coating consists of pure gold (Fig. 4). Darker areas correspond to pores. On the spectra of these sites (Fig. 5) you can also watch the film deposition of gold.

In the electrolyte solution is designed to create a sorptive layer on the fabric (SKU: AA010278, Fig. 2b) will introduce additional chloride divalent copper. Other processes of the experiment as in 1.

\[
6 \text{CuSO}_4 + 3\text{PH}_3 + 3\text{H}_2\text{O} \rightarrow 2\text{Cu}_3\text{P} + 6\text{H}_2\text{SO}_4 + \text{H}_3\text{PO}_3
\]

The original sample is a flat plate made of polystyrene (Fig. 2c). After the establishment of the sorption layer of a solution of chloride of gold on the surface with a wet plate with compressed air is sprayed with particles of synthetic diamond. Other processes of the experiment as in experiment 1. The particles of diamond are fixed by a film of gold in the layer formed by the surface material (Fig. 7).

**DISCUSSION OF RESULTS**

The study of the structure and composition of the films on the different samples was carried out on scanning electron microscope ISM-6490-LV (JEOL, Japan). However, due to the small coating thickness on the spectra appear the peaks of the elements constituting the base material. Percentage composition of these elements may vary depending on the thickness of the gold layer. In the analysis of the composition of the resulting films, these spectra were not considered.

Samples of various materials coated with films of gold shown in Fig. 2.

**Figure 2.** Samples of various materials coated with films of gold:

a – cotton cloth covered with gold; b – PVC covered with gold; c – cotton fabric with gold plating-copper; d – polystyrene coated gold-diamond.

So when analyzing films on cotton fabric, if not to take into account the spectra of carbon, nitrogen and oxygen included in the original tissue, the film consists of pure gold (Fig. 3).

**Figure 3.** Spectra and elemental composition of the film of gold on cotton fabric.
The resulting coating consists of pure gold (Fig. 4). Darker areas correspond to pores. On the spectra of these sites (Fig. 5) you can also watch the film deposition of gold.

Figure 4. Spectra and elemental composition of the gold layer on the surface of the sample of porous PVC.

Figure 5. Spectra and elemental composition of the gold layer in the porous of the sample from PVC.

It follows that the resulting film contains in addition to gold, copper and phosphorus (Fig. 6).

Figure 6. Spectra and elemental composition of the gold layer in the joint co-precipitation with copper.
The particles of diamond are fixed by a film of gold in the layer formed by the surface material (Fig.7).

![Figure 7. Spectra and elemental composition of the film of gold-containing deposited particles of diamond.](image)

Thus, the proposed method allows to obtain on the surface of various materials durable gold coating is from 0.3 nm to 0.5 microns.

### References:

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2. Pat. RF № 2501891, publ. 2013
3. Pat. RF № 2489230. Method of deposition of gold nanoparticles on the microspheres of silica, based on the thermal decomposition of volatile compounds of gold. Publ. 2013
IV. CHEMISTRY
RECEIVING AND RESEARCH OF THE MECHANISM OF CAPSULATION OF SUPERPHOSPHATE AND DOUBLE SUPERPHOSPHATE FOR GIVING OF STRENGTH PROPERTIES

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Abstract

In this article process of receiving and a research of the mechanism of capsulation of superphosphate and double superphosphate is considered. Influence of water-soluble polymers depending on concentration and temperature on process of capsulation and granulation of fertilizers, and also on strength characteristics is investigated. It is found out that, the mechanism of process of capsulation of fertilizers consists of several stages: polyelectrolyte adsorption, aggregation of particles of fertilizer, structurization with formation of large units and formations of the thin gel encapsulating layer. At the same time it is shown that carrying out process of capsulation of fertilizers polyelectrolytes leads to receiving the qualitative prolonged fertilizers and improvement of amelioration due to aggregation of soils, agronomical properties saline and damp terrestrial soils.

Keywords: fertilizer, superphosphate, double superphosphate, capsulation process, structurization, polyelectrolytes, statistical durability, fluidized layer, phosphoric slime.

Now before the chemical industry, the problem of utilization of large-capacity production wastes of phosphorus – phosphoric slime is particularly acute. Large volumes of this industrial waste not only considerably worsen an ecological situation in regions of Kazakhstan, but also occupy significant floor spaces. In this regard for the cardinal solution of the specified problems, ways of processing of phosphoric slimes, for the purpose of receiving polymer containing complex fertilizers are developed.

It is known that water-soluble polymers (polyelectrolytes) have unique complex properties depending on concentration in system, at low concentration have structure-forming effect, and in more concentrated solutions the pronounced stabilizing effect.

Besides, thanks to successful combination of physical and chemical properties of high-molecular connections and surfactants are widely used in various fields of the industry as regulators of stability of disperse systems, stabilizers, structurants, deemuligator, thickeners, frothers, flotoreagent, etc.

Now these polyelectrolytes are widely used in the process of capsulation of various materials (pesticides, fertilizers, medicines, etc.) for protection against the environment, for giving of the strength and prolonged properties.

Slime has smaller density, than pure phosphorus which is 1200 kg/m³. At his warming up to the temperature of 333-353K there is a division of phases. As pure phosphorus has density of
1720 kg/m³, it remains in the lower part, and slime – easier gathers above. Slime has low density because of existence of inclusions of water. By production of yellow phosphorus the spherical, shapeless granules less than 20 microns in size similar to sand which it is accepted to call “granulated” can be formed. Such slime is usually formed in sewage or at a slime warming up. The maintenance of a water phase in such slimes reaches 50%.

Under the action of dilute HNO₃ or K₂Cr₂O₇ + H₂O, the slime is destroyed with the isolation of pure yellow phosphorus and an insoluble precipitate. Part of the phosphorus is oxidized to H₃PO₄.

The chemical analysis of phosphoric slime is presented in table 1.

### Table 1. The chemical analysis of the phosphoric slime (calcinated at temperature 1273 K)

<table>
<thead>
<tr>
<th>Composition, %</th>
<th>Specific surface, m²/g</th>
<th>Loss on ignition, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P₂O₅</td>
<td>CaO</td>
</tr>
<tr>
<td>Rich slime</td>
<td>18,5</td>
<td>1,34</td>
</tr>
<tr>
<td>Theoretical</td>
<td>10,0-</td>
<td>0,7-</td>
</tr>
<tr>
<td></td>
<td>29,8</td>
<td>7,8</td>
</tr>
</tbody>
</table>

Phosphoric slime is formed as a result of the silicon fluoride hydrolysis which always is contained in small amounts in oven gases. Then fine surface-active silicon dioxide adsorbs phosphorus. At formation of slime along with phosphorus there is probably also an adsorption silicon dioxide of a part of water. The amount of the slime which is turning out on this or that mechanism depends on the content of fine disperse dust in oven gases and extent of sublimation of compounds of fluorine from phosphorite in the course of melting in the electric furnace. It is established that the probability of formation of slime on the first way makes 90-95%, on the second (through SiF₄) – 5-10%.

Phosphoric slime is cheap raw materials, however at his use as fertilizer is ineffective that is connected mainly with small contents the assimilable forms of phosphoric anhydride (Figure 1, Table 2). Results of researches have shown that the content of phosphoric anhydride in phosphoric slime has made 18,5%. Nevertheless on sour soils fine phosphoric slime of some fields is successfully applied as slowly operating fertilizer. From phosphoric slime of such fields it is possible to receive a number of qualitative fertilizers: superphosphate, double superphosphate, ammonophos, monoammonium phosphate.

In this regard the mechanism of decomposition of phosphoric slime by sulfuric acid or phosphoric acid in the presence of water-soluble polyelectrolytes is considered, and also for establishment of structure complex the polymer-containing fertilizers – superphosphate and double superphosphate and interaction of the components which are contained in them researches by the x-ray power dispersive INCAEnergy (OxfordINSTRUMENTS) microanalyzer ISM-6490LV (IED) established on a raster electronic microscope are conducted. Shooting at the SEM was carried out at an increase of 1000 and 10,000 times (Figure 1.2, Table 2.4).
Table 2. Mineralogical structure of a sample of phosphoric slime

<table>
<thead>
<tr>
<th>Element</th>
<th>Weight, %</th>
<th>Chemical composition of oxides, %</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>3.74</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Na</td>
<td>0.77</td>
<td>NaO</td>
<td>1.04</td>
</tr>
<tr>
<td>Mg</td>
<td>1.86</td>
<td>MgO</td>
<td>3.08</td>
</tr>
<tr>
<td>Al</td>
<td>0.97</td>
<td>Al₂O₃</td>
<td>1.83</td>
</tr>
<tr>
<td>Si</td>
<td>17.58</td>
<td>SiO₂</td>
<td>37.60</td>
</tr>
<tr>
<td>P</td>
<td>7.02</td>
<td>P₂O₅</td>
<td>16.08</td>
</tr>
<tr>
<td>S</td>
<td>0.87</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Cl</td>
<td>0.13</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>K</td>
<td>4.16</td>
<td>K₂O</td>
<td>5.01</td>
</tr>
<tr>
<td>Ca</td>
<td>8.86</td>
<td>CaO</td>
<td>12.4</td>
</tr>
<tr>
<td>Ti</td>
<td>0.02</td>
<td>TiO₂</td>
<td>0.033</td>
</tr>
<tr>
<td>Mn</td>
<td>0.24</td>
<td>MnO</td>
<td>0.31</td>
</tr>
<tr>
<td>Fe</td>
<td>0.52</td>
<td>Fe₂O₃</td>
<td>0.67</td>
</tr>
</tbody>
</table>

The way of receiving complex the polymer-containing fertilizers of superphosphate and double superphosphate by method of decomposition of phosphoric slime sulfuric or phosphoric acid in the presence of polyelectrolytes [1.2] is developed.

From stainless steel with a mixer and a shirt load a certain amount of phosphoric slime, sulfuric or phosphoric acids into the reactor. Process of decomposition of phosphoric slime is carried out at 60 °C at continuous hashing within 60 minutes. At the same time there is a decomposition of phosphoric slime to formation of a monokalsiyfosfat and sulfate of calcium according to the total equation:

$$2Ca_5(P_2O_5)F + 7H_2SO_4 + 3H_2O = 3Ca(H_2P_2O_5)_2·H_2O + 7CaSO_4 + 2HF$$

For improvement of qualitative characteristics and giving of strength properties are added esterifies derivatives of the hydrolyzed polyacrylonitrile (EPPAN) or polyacrylamide (EPPAA), i.e. water-soluble polyelectrolytes to complex fertilizers. Increase in strength characteristics and prolongation is explained by capsulation complex fertilizer of water-soluble polyelectrolytes.

15 minutes before the end of thermostating, 0.2-0.4 ml of EPPAN and EPPAA are added to the mixture. The resulting pastes were granulated and dried for 120 minutes at temperature of 100°C.

The resulting complex polymer-containing fertilizer – superphosphate has the following composition, presented in table 3.

Table 3. The content of phosphorus pentoxide in the final product

<table>
<thead>
<tr>
<th>Name</th>
<th>Thermo-stating, °C</th>
<th>H₂O, ml</th>
<th>BPΠЭ, ml</th>
<th>P₂O₅ total</th>
<th>P₂O₅ assimilable</th>
<th>P₂O₅ water-soluble</th>
<th>N</th>
<th>Weight of finished product, g</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 g of slime thermostated within 1 hour</td>
<td>60</td>
<td>70</td>
<td>0,2</td>
<td>13,12</td>
<td>12,75</td>
<td>9,12</td>
<td>2,0</td>
<td>70</td>
</tr>
</tbody>
</table>

In the figure 2 and the microscopic picture and mineralogical structure of samples complex the polymer-containing fertilizer of superphosphate are presented in table 4. From the obtained data it is visible that samples have generally amorphous structure with small inclusion of metals.
Figure 2. Mineralogical composition and microstructure of sample of the polymer-containing fertilizer of superphosphate

Table 4. Mineralogical structure of a sample of the polymer-containing fertilizer of superphosphate

<table>
<thead>
<tr>
<th>Element</th>
<th>Weight %</th>
<th>Chemical composition of oxides</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>44.86</td>
<td></td>
<td>–</td>
</tr>
<tr>
<td>F</td>
<td>6.55</td>
<td></td>
<td>–</td>
</tr>
<tr>
<td>Na</td>
<td>0.62</td>
<td>Na₂O</td>
<td>0.84</td>
</tr>
<tr>
<td>Mg</td>
<td>1.79</td>
<td>MgO</td>
<td>2.97</td>
</tr>
<tr>
<td>Al</td>
<td>1.11</td>
<td>Al₂O₃</td>
<td>2.1</td>
</tr>
<tr>
<td>Si</td>
<td>20.42</td>
<td>SiO₂</td>
<td>43.68</td>
</tr>
<tr>
<td>P</td>
<td>6.46</td>
<td>P₂O₅</td>
<td>14.8</td>
</tr>
<tr>
<td>S</td>
<td>4.24</td>
<td>SO₃</td>
<td>10.6</td>
</tr>
<tr>
<td>K</td>
<td>4.05</td>
<td>K₂O</td>
<td>4.88</td>
</tr>
<tr>
<td>Ca</td>
<td>9.02</td>
<td>CaO</td>
<td>12.62</td>
</tr>
<tr>
<td>Mn</td>
<td>0.25</td>
<td>MnO</td>
<td>0.32</td>
</tr>
<tr>
<td>Fe</td>
<td>0.61</td>
<td>Fe₂O₃</td>
<td>0.87</td>
</tr>
</tbody>
</table>

From figure 2 and table 4 are shows that the obtained complex polymer-containing fertilizer – superphosphate incorporates all trace elements – Mg, Al, Si, K, Ca, Mn, Fe, and phosphorus for normal growth and crop yield.

Method for the preparation of a complex polymer-containing organomineral fertilizer, double superphosphate [2] was developed, which is carried out as follows, in 100 g of sifted finely dispersed phosphorus slurry 70 ml of evaporated 43.37% H₃PO₄ are added.

The process of decomposition of phosphoric acid by phosphoric acid proceeds according to the following basic reactions:

\[
\begin{align*}
Ca_5(P_O_4)_3F + 7H_3PO_4 + 5H_2O &= 5Ca(H_2PO_4)_2 \cdot H_2O + HF, \\
CaMg(CO_3)_2 + 4H_3PO_4 &= Ca(H_2PO_4)_2 \cdot H_2O + Mg(H_2PO_4)_2 \cdot H_2O + 2CO_2, \\
R_2O_3 + 2H_3PO_4 + H_2O &= 2[RPO_4 \cdot 2H_2O]
\end{align*}
\]

The resulting mixture is incubated at 60°C for 60 minutes, 0.2 ml of hydrolysed polyelectrolyte derivatives based on PAN are added to the end of the thermostatting [3]. This produces a thick mass which is granulated and the finished granules are dried for 120 minutes at temperature of 100°C.

In the process of obtaining double superphosphate on the basis of phosphorus slime, two main stages can be distinguished. In the first stage, with continuous mixing of phosphorus slime and phosphoric acid,
the reaction proceeds in mobile suspension, the liquid phase of which contains phosphoric acid, monocalcium phosphate, and other soluble reaction products.

In the second stage, the decomposition of phosphate is accompanied by the crystallization of monocalcium phosphate, as a result of which the compositions of the liquid and solid phases of the reaction mass gradually change. The isolation of crystals deposited in part on the phosphate grains makes it difficult for H+ ions to access them, and the decomposition process slows down sharply. When the liquid phase of the suspension becomes saturated with both monocalcium phosphate and dicalcium phosphate, the decomposition reaction ceases.

The rate of dissolution of phosphates in unsaturated solutions of solutions containing phosphoric acid is limited by the diffusion of the least mobile calcium ion from the disintegrating surface of the phosphate grain into the liquid phase. The quality of double superphosphate is estimated by the content of the assimilable P2O5 in it, which is present in the form of various compounds: H3PO4, Ca(H2PO4)2, Mg(H2PO4)2, CaHPO4, MgHPO4, iron and aluminum phosphates.

The resulting polymer-containing double superphosphate fertilizer is a light gray granule that is very soluble in water, 3-5 mm in diameter, with high strength characteristics, which is necessary for the operation.

In the figure 3 and the microscopic picture and the element analysis of double superphosphate are presented in table 5. It can be seen that samples have, generally amorphous structure with small inclusion of metals. In the figure 5 presence of elementary phosphorus is shown. In terms of phosphoric anhydride the maintenance of P2O5 is generally 24.08%.

![Figure 3. Microscopic snapshot and elemental analysis of the complex polymer-containing organomineral fertilizer – double superphosphate (based on phosphate flour)](image)

<table>
<thead>
<tr>
<th>Element</th>
<th>Weight %</th>
<th>Chemical composition of oxides</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>53.67</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>F</td>
<td>2.05</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Na</td>
<td>0.68</td>
<td>Na2O</td>
<td>0.92</td>
</tr>
<tr>
<td>Mg</td>
<td>0.33</td>
<td>MgO</td>
<td>0.55</td>
</tr>
<tr>
<td>Al</td>
<td>1.67</td>
<td>Al2O3</td>
<td>3.16</td>
</tr>
<tr>
<td>Si</td>
<td>7.79</td>
<td>SiO2</td>
<td>16.66</td>
</tr>
<tr>
<td>P</td>
<td>10.51</td>
<td>P2O5</td>
<td>24.08</td>
</tr>
<tr>
<td>S</td>
<td>5.26</td>
<td>SO3</td>
<td>13.15</td>
</tr>
<tr>
<td>K</td>
<td>0.51</td>
<td>K2O</td>
<td>0.61</td>
</tr>
<tr>
<td>Ca</td>
<td>15.86</td>
<td>CaO</td>
<td>22.19</td>
</tr>
<tr>
<td>Fe</td>
<td>1.69</td>
<td>Fe2O3</td>
<td>2.42</td>
</tr>
</tbody>
</table>

Table 5. Elemental analysis of the complex polymer-containing organomineral fertilizer – double superphosphate (based on phosphate flour)
It can be seen from Fig. 3 and table 5 that the obtained complex polymer fertilizer – double superphosphate has in its composition all trace elements – Mg, Al, Si, K, Ca, Fe and phosphorus for normal growth and increase of crop yields.

This increases water retention in soil aggregates due to the structure-forming properties of the polymer, which positively affects crop yields.

Double superphosphate has the same agrochemical efficiency, as well as simple superphosphate at introduction of equal quantities of assimilable P$_2$O$_5$. His main advantage consists in rather smaller quantity of ballast. It reduces costs of transportation and storage of nutrient (P$_2$O$_5$), reduces a container expense, reduces costs of entering of fertilizer into the soil. Therefore use of double superphosphate is economically more effective, than simple superphosphate of the received product which is well influencing strength characteristics.

The processes underlying the action of modified polyelectrolyte derivatives based on PAN, PAA as structurants are in many respects similar to those occurring when they are used as a soil-forming agent for soil and soil aggregates [4, 5]. The shape of the molecules of polyelectrolytes in solution is determined by the ionic strength and pH of the solution. The polyelectrolytes of amphoteric character containing ionogenic – carboxyl, amide, imidny and radio groups [4] are effective. Obviously, for an effective action of an ionogenic polymer on the structure of fertilizer granules, some optimal content of charged groups in the molecule is necessary.

Addition of polyelectrolyte to mineral fertilizers contributes to the formation of the structure in the system and the formation of the polymer-fertilizer complex, to the retention of the assimilable P$_2$O$_5$ in the fertilizer composition, and subsequently, when used, leads to the aggregation of soil aggregates, these aggregates retain moisture, which has a beneficial effect on the preservation of soil moisture for a long time. Thus, these polyelectrolytes contribute to improvement of melioration due to aggregation of soils, but also agronomic properties of solonchakous and damp soils.

Application by production of superphosphate and double superphosphate of the modified derivative polyelectrolytes on a basis the PAN, PAA promotes not only improvement of operational properties of mineral fertilizers, but also increase in productivity of crops.

The relative maintenance of water-soluble P$_2$O$_5$ is influenced significantly by presence of the modified derivative polyelectrolytes on a basis the PAN, PAA, fiber waste Nitron which considerably improve this indicator, thereby increasing enrichment of the soil useful elements.

Capsulation of the received superphosphate is carried out in two ways:

The first is method of soaking, the received complex polymer-containing fertilizer 0.2% solution of polyelectrolyte and further drying at 105°C and granulation. As polyelectrolyte esterified derivatives of the hydrolyzed polyacrylonitrile are used.

The second is a capsulation method, at the same time capsulation and drying of complex polymer-containing fertilizer it is carried out by a dusting method polyelectrolyte in a fluidized layer. Capsulation is carried out by a dusting method fertilizer polyelectrolyte in the mounted multisection device in fluidized layer.

Results of a research of the influence of the drying temperature on durability of granules complex the polymer-containing fertilizers in the process of capsulation by EPPAN polyelectrolyte are presented in table 6.

**Table 6. Influence of temperature on durability of granules**

<table>
<thead>
<tr>
<th>Capsulation mode</th>
<th>Temperature, °C</th>
<th>25</th>
<th>50</th>
<th>75</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before capsulation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Static durability of granules, kg</td>
<td>0</td>
<td>0</td>
<td>1,0</td>
<td>1,87</td>
<td></td>
</tr>
<tr>
<td>Capsulation with 0.25% solution of EPPAN</td>
<td>Static durability of granules, kg</td>
<td>2,75</td>
<td>1,87</td>
<td>15,8</td>
<td>2,86</td>
</tr>
<tr>
<td>Capsulation with 0.5% solution of EPPAN</td>
<td>Static durability of granules, kg</td>
<td>2,98</td>
<td>7,10</td>
<td>18,27</td>
<td>2,10</td>
</tr>
<tr>
<td>Capsulation with 1.0% solution of EPPAN</td>
<td>Static durability of granules, kg</td>
<td>8,50</td>
<td>4,75</td>
<td>13,78</td>
<td>3,78</td>
</tr>
</tbody>
</table>
As can be seen from the table the statistical durability of the granules of fertilizers which aren’t encapsulated by polyelectrolyte (before capsulation) is in limits of 0 – 1.87 kg, and at capsulation durability of granules increases up to 18.27 kg. Statistical durability of granules depends not only on concentration of polyelectrolyte, but also on capsulation process temperature. The optimal condition for the process of mineral fertilizer encapsulation corresponds to the content of a 0.25-0.5% solution of EPPAN at a temperature of 75°C, as evidenced by micrographs.

CONCLUSIONS

Methods of receiving the polymer-containing complex mineral fertilizers – superphosphate and double superphosphate are developed. Influence of water-soluble polymers depending on concentration and temperature on process of capsulation and granulation of fertilizers is investigated. It has been established that the mechanism of process of capsulation of fertilizers consists of several stages: polyelectrolyte adsorption, aggregation of particles of fertilizers, structurization with formation of large units and formation of the thin gel encapsulating layer. It has been established that the process of encapsulating mineral fertilizers with polyelectrolyte EPPAN leads to complex properties such as an increase in strength characteristics (18 kg) and elongation, as well as improvement of reclamation through aggregation of soils and soil aggregates.

References:

Abstract

The given article contains the research results of technical table salt purification from impurity with barium carbonate application. High-purity sodium chloride is widely used in medicine for obtaining physiological and hypertensive solutions, and also as an auxiliary substance for formulation of various drugs. With this purpose we have studied a table salt purification process consisting in its mixing with barium carbonate at temperature of 90-1000С during 25-30 minutes. At implementation of analyses the standard techniques of sodium, calcium, magnesium and sulphate ion determination such as flame photometry, atomic absorption spectroscopy and others have been applied. On the basis of the research results a manufacturing scheme of sodium chloride purification with use of barium carbonate has been developed.

Keywords: sodium chloride, table salt, barium carbonate.

INTRODUCTION

The world geological table salt reserves are practically inexhaustible. The greatest sodium chloride quantity is contained in the sea and ocean water in which approximately 6,5\times10^{16} tonnes of various salts are dissolved. The table salt part makes about 76% from the total amount, i.e. 3,9\times10^{16} t [1, p.6].

Kazakhstan according to the table salt reserves holds the 7th place in the CIS [2]. Sodium chloride application in various branches of the national economy is well-known. One of the basic consumers of high-purity sodium chloride is the pharmaceutical industry.

Sodium chloride is used for preparation of physiological and hypertensive solutions, and also for obtaining of various medical products.

Having huge rock salt reserves Kazakhstan imports the medicine-purpose salt from other countries; it is connected with absence of developed technologies of pharmacopoeia-purity sodium chloride manufacture.

In connection with the above-stated studying of sodium chloride solubility diagrams in the presence of different impurities contained in the natural table salt of various Kazakhstan deposits is actually as these data are necessary for the development of natural salts’ deep purification techniques and high-clean sodium chloride production.
A RESEARCH PART

Technical sodium chloride usually contains impurity of K⁺, Ca²⁺, Mg²⁺, CO₃⁻, SO₄²⁻ ions, etc. The data on a chemical composition of the brines and rock salt of the «Tasty-tuz» deposit (South Kazakhstan region) mentioned in different references differ very strongly from each other. In connection with a wide scatter of the data first of all we have determined an accurate chemical composition of the rock salt sampled in the specified deposit.

The chemical composition of the «Tasty-tuz» deposit's salt samples is represented in table 1 and in figures 1,2.

Table 1. Chemical composition of the «Tasty-tuz» rock salt

<table>
<thead>
<tr>
<th>№</th>
<th>An ion, mass %</th>
<th>A compound, mass %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ca²⁺</td>
<td>Mg²⁺</td>
</tr>
<tr>
<td>1</td>
<td>0,115-0,79</td>
<td>0,001-0,039</td>
</tr>
<tr>
<td>2</td>
<td>0,046</td>
<td>0,033</td>
</tr>
<tr>
<td>3</td>
<td>0,047</td>
<td>0,034</td>
</tr>
<tr>
<td>4</td>
<td>0,048</td>
<td>0,036</td>
</tr>
</tbody>
</table>

Three test samples in volume of 1 liter have been sampled at room temperature from saturated technical table salt water solutions. Their density and concentration have been determined [tab.2].

Table 2. Concentration of Ca²⁺, Mg²⁺ and SO₄²⁻ ions in saturated technical sodium chloride solutions

<table>
<thead>
<tr>
<th>Experiment</th>
<th>The saturated solution volume, l</th>
<th>ρ, g/cm³</th>
<th>Weight, g</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Ca²⁺</td>
<td>Mg²⁺</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1,158</td>
<td>1,12</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1,187</td>
<td>1,08</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1,1897</td>
<td>1,14</td>
</tr>
</tbody>
</table>
Determination of the rock salt and brine chemical compositions has been realized by known methods [3, p.29-135]. Sodium and potassium have been determined by a flame photometry technique; chlorine – by means of a Floggard method; calcium, magnesium and sulphate ions – by a gravimetric method. The sulphate-ions have been precipitated from the hot weak-acid (pH = 4-6) filtered brine by a barium chloride solution as barium sulphate, washed with distilled water, dried and weighed. The calcium-ions have been precipitated from the alkaliescent (pH = 7-8) brine by a sodium carbonate solution as calcium carbonate. The magnesium has been deposited as Mg(OH)$_2$ from the alkaline (pH = 10-12) brine by a sodium hydrox-ide solution (tab.1 and 2).

The brine’s analysis results denote the high calcium, magnesium and sulphate-ions content; it does not satisfy the requirements qualifying to medical sodium chloride.

For the purpose of obtaining the high-purity sodium chloride used for medicine applications the hot (90-100°C) filtered brine containing impurity of Ca$^{2+}$, Mg$^{2+}$, SO$_4^{2-}$-ions has been added the calculated quantity ($\approx$ 20-25 mg/l) of sparingly soluble barium carbonate at constant hashing within 25-30 minutes. The precipitate containing BaSO$_4$, CaCO$_3$ and MgCO$_3$ has been separated from the solution by filtration. It is obvious, that following chemical reactions take place at the BaCO$_3$ addition:

\[
\begin{align*}
\text{BaCO}_3 + \text{CaCl}_2 &= \text{CaCO}_3 + \text{BaCl}_2 \\
\text{BaCO}_3 + \text{MgCl}_2 &= \text{MgCO}_3 + \text{BaCl}_2 \\
\text{BaCO}_3 + \text{CaSO}_4 &= \text{CaCO}_3 + \text{BaSO}_4 \\
\text{BaCO}_3 + \text{MgSO}_4 &= \text{MgCO}_3 + \text{BaSO}_4 \\
\text{BaCl}_2 + \text{CaSO}_4 &= \text{CaCl}_2 + \text{BaSO}_4 \\
\text{BaCl}_2 + \text{MgSO}_4 &= \text{MgCl}_2 + \text{BaSO}_4
\end{align*}
\]

The formation of insoluble CaCO$_3$ and BaSO$_4$ deposits is based that CaCO$_3$ solubility ($PS=5 \times 10^{-9}$) is much less, than CaSO$_4$ solubility ($PS=6 \times 10^{-5}$); in turn BaSO$_4$ solubility ($PS=1 \times 10^{10}$) is less, than BaCO$_3$ solubility ($PS=8 \times 10^{-9}$) [1]. The equation (2) can be referred to equilibrium reactions as BaCO$_3$ is less soluble than MgCO$_3$, but in the BaCl$_2$ and BaCO$_3$ reaction zone the equation (2) takes place.

The saturated sodium chloride solution separated from the deposits is evaporated at 100-108°C to 1/2 of its initial volume. The precipitated crystalline end product is separated from the hot solution on a Buchner funnel at small vacuum, dried at 25-110°C within 25-30 minutes, weighed and screened through a sieve. The mother solution is again evaporated to 1/2 volume; the sodium chloride precipitated crystals are separated, dried, weighed and screened. The experimental results are represented in table 3 and in figures 3-4. On the basis of the received results it is possible to tell, that the sodium chloride obtained with output of 75-81,5% has purity of 99,5-99,68% and meets standard requirements.

<table>
<thead>
<tr>
<th>№</th>
<th>$\rho$, g/cm$^3$</th>
<th>BaCO$_3$, g</th>
<th>NaCl output, g/%</th>
<th>Purified NaCl composition, %</th>
<th>Ca$^{2+}$</th>
<th>SO$_4^{2-}$</th>
<th>Na$^+$</th>
<th>Cl</th>
<th>Purity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1,185</td>
<td>11,45</td>
<td>427/75</td>
<td></td>
<td>–</td>
<td>0,003</td>
<td>39,33</td>
<td>60,30</td>
<td>99,58</td>
</tr>
<tr>
<td>2</td>
<td>1,187</td>
<td>11,50</td>
<td>465,3/80</td>
<td></td>
<td>–</td>
<td>–</td>
<td>39,75</td>
<td>60,25</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>1,1897</td>
<td>11,53</td>
<td>484,8/81,5</td>
<td></td>
<td>–</td>
<td>–</td>
<td>39,68</td>
<td>60,32</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>1,19</td>
<td>11,55</td>
<td>482,5/79,5</td>
<td></td>
<td>–</td>
<td>–</td>
<td>39,7</td>
<td>60,30</td>
<td>100</td>
</tr>
</tbody>
</table>

Mg$^{2+}$, Ba$^{2+}$ are absent.
The sodium chloride hot solution after termination of the hashing is separated from the deposit (BaSO₄, CaCO₃, MgCO₃) by filtration. The filtrate is neutralized with hydrochloric acid to pH = 6-7,6 using a brom-thymol blue indicator and evaporated to 1/2 of its initial volume. The precipitated sodium chloride crystals are separated on a vacuum-filter, dried at 100-110°C within 25-30 minutes, screened through a sieve with mesh diameter of 0,5-1 mm. The product yield makes 75%.

Taking into consideration the research results we suggest a manufacturing diagram of table salt purification with use of barium carbonate.

**CONCLUSION**

The performed research have allowed to show a possibility of the high-purity sodium chloride production by means of evaporation of its saturated solutions at the raised temperature and preliminary full or partial removal of Ca²⁺, Mg²⁺, SO₄²⁻ ions.

A special feature of the barium-carbonate purification of technical table salt is the application of poorly soluble barium carbonate as a precipitating agent of impurity ions (tab.3).

As follows from the above reactions a result of solid BaCO₃ interaction with the impurities is the calcium carbonate and barium sulphate insoluble in saturated sodium chloride solutions.

Irreversibility and high reaction rates are promoted not only rise in temperature, but the formation of almost insoluble quick-formed BaSO₄ and CaCO₃ crystals as well, and also their well soluble chlorides, which in turn are the reagents for CaSO₄, MgSO₄ and Na₂SO₄ sedimentation (reactions 5, 6).

An insignificant disadvantage of the barium-carbonate cleaning method is formation of the precipitate represented a mixture of solid calcium, magnesium and barium carbonates and sulphates, which, however, can be easily dissolved in acid medium and separated from each other as individual components.

**References**

2. http://www.marketing-services.ru/shop_online/industry/factory/chemical/?good=847
Abstract

The acetylationing reaction of acetylene in the presence of nanocatalysts \((\text{ZnO})_x \ast (\text{CdO})_y \ast (\text{ZrO}_2)_z\) has been studied. By changing partial pressure of initial substances in a wide interval of parameters’ change the objective laws were studied. On the basis of experimental and literature data stage scheme of reaction mechanism and various options of kinetic equations of acetylation reaction of acetylene have been offered and evaluated their adequacy. On the basis of adequate kinetic equation optimum conditions of synthesis of vinyl acetate from acetylene were chosen: \(T = 180-2200\text{C}, V_{\text{kat}} = 100 \text{ ml}; C_2H_2 : CH_3COOH = 4:1; = 280 \text{ h}^{-1} \text{ cat.}\) According to experimental data technological scheme of vinyl acetate preparation by catalyst acetylation of acetylene was offered.

Keywords: acetylene, vinyl acetate, acetic acid, acetylation, heterogeneous catalysis, basic organic synthesis, heterogeneously catalytic acetylation, zinc acetate, cadmium acetate, zirconium dioxide, nanocatalyst, chromatography, chromatographic analysis.

INTRODUCTION

In the production of basic organic chemistry and petrochemistry among obtained oxygen containing vinyl esters vinyl acetate is the most important.

In industry, vinyl acetate is widely used as a monomer. One of the important properties of the vinyl acetate is its ability to be polymerized. Among the polymeric products obtained from vinyl acetate, are commonly used polyvinyl acetate, polyvinyl alcohol and polyvinyl acetics. High adhesion and the elastic properties of polyvinyl acetate determine its increased adhesive capacity. Therefore, it is widely used in the production of water-soluble latex paints, adhesives, fibers, and others.

More in large amounts vinyl acetate is used in the production of polyvinyl alcohol and polyvinyl acetics.

In connection with the abovementioned, the study of the catalytic acetylationing reaction of acetylene and for this process searching a catalyst, which has a high activity, selectivity and high efficiency and stability, as well as the study of the kinetic objective laws of the reaction is important.

Several works [1-3], devoted to problems of the vapor phase synthesis of vinyl acetate were published.
The process is conducted in the presence of zinc acetate impregnated on activated carbon at a 170-230°C in molar ratios of acetylene : acetic acid = from 2: 1 to 10: 1 at atmospheric pressure. Partial or complete replacement of zinc acetate into cadmium acetate results in increased catalyst activity. One of the parameters affecting the yield of vinyl acetate and catalyst life is the composition of the carrier [4].

On the basis of the abovementioned a nanocatalyst with the structure core/shell was selected. The nanocatalyst has been prepared on the following scheme.

The synthesis scheme of the nanoparticles with the structure core/shell ZnO:CdO:

The specific surface of the obtained sample was calculated by the BET method, the average mesoporous size was determined by BJH. The phase composition was determined by X-ray diffraction using DRON-3 diffractometer (CuKα radiation). Disperse properties of the catalyst have been studied by the scanning electron microscope (JSM-6510 LV).

The catalytic activity of the obtained sample was studied in the acetylating reaction of acetylene.

**PRACTICAL PART**

The synthesis products were analyzed with a flame ionization detector by gas-liquid chromatography under the following optimum conditions: particle size of the stationary liquid phase 0.250-0.315 mm on Tsvetochrom – 545% with 15 % lestosyl, the glass column with the size of 2x0.004 m, the column temperature of 100°C, the nitrogen carrier gas flow rate 30 ml/min. Qualitative analysis was conducted by «witnesses», the quantitative by the method of internal normalization.
In the reaction of gas phase catalytic acetylation of acetylene was studied the activity of the catalysts made from d-elements salts.

The table shows that the catalyst (№4) containing oxides of zinc, cadmium, zirconium has high selectivity and efficiency. On this catalyst was studied the effect of various factors (temperature, volumetric rate, the mole ratio of C_2H_2:CH_3COOH, a method of preparing a catalyst) to the yield of vinyl acetate, the selectivity of the process, the conversion of starting materials.

Table 1. Dependence of the catalyst activity of the reaction of catalytic acetylation of acetylene on the composition (t = 180°C, C_2H_2:CH_3COOH = 4:1, V_с_2h_2 = 280 h^-1)

<table>
<thead>
<tr>
<th>№</th>
<th>Composition of the catalyst</th>
<th>Conversion of CH_3COOH,%</th>
<th>Selectivity, S %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>In vinyl acetate</td>
</tr>
<tr>
<td>1</td>
<td>ZnO</td>
<td>60,0</td>
<td>43,0</td>
</tr>
<tr>
<td>2</td>
<td>ZnO:CdO</td>
<td>80,6</td>
<td>73,5</td>
</tr>
<tr>
<td>3</td>
<td>ZnO:ZrO_2</td>
<td>51,4</td>
<td>38,2</td>
</tr>
<tr>
<td>4</td>
<td>ZnO:CdO:ZrO_2</td>
<td>85,4</td>
<td>79,8</td>
</tr>
<tr>
<td>5</td>
<td>ZnO:CrO_3</td>
<td>46,2</td>
<td>30,6</td>
</tr>
<tr>
<td>6</td>
<td>Cr_2O_3:ZnO:CdO:ZrO_2</td>
<td>67,8</td>
<td>49,2</td>
</tr>
<tr>
<td>7</td>
<td>ZnO:CrO_3:ZrO_2</td>
<td>72,1</td>
<td>51,9</td>
</tr>
<tr>
<td>8</td>
<td>ZnO:Fe_2O_3:CrO_3</td>
<td>70,9</td>
<td>48,0</td>
</tr>
</tbody>
</table>

When studying the effect of the ratio of C_2H_2:CH_3COOH on acetate output and selectivity of the process, it was found that the optimum ratio is 4:1.

Table 2. Effect of the ratio of C_2H_2:CH_3COOH on acetate output (t = 180°C, catalyst № 4)

<table>
<thead>
<tr>
<th>№</th>
<th>Mole ratio of C_2H_2:CH_3COOH</th>
<th>Conversion of acetic acid, %</th>
<th>Selectivity, S %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>In vinyl acetate</td>
</tr>
<tr>
<td>1</td>
<td>1:3</td>
<td>48,0</td>
<td>18,4</td>
</tr>
<tr>
<td>2</td>
<td>1:2</td>
<td>63,4</td>
<td>48,5</td>
</tr>
<tr>
<td>3</td>
<td>1:1</td>
<td>78,8</td>
<td>63,2</td>
</tr>
<tr>
<td>4</td>
<td>2:1</td>
<td>82,0</td>
<td>70,7</td>
</tr>
<tr>
<td>5</td>
<td>3:1</td>
<td>83,8</td>
<td>75,4</td>
</tr>
<tr>
<td>6</td>
<td>4:1</td>
<td>85,4</td>
<td>79,8</td>
</tr>
<tr>
<td>7</td>
<td>5:1</td>
<td>92,5</td>
<td>72,0</td>
</tr>
<tr>
<td>8</td>
<td>6:1</td>
<td>96,2</td>
<td>65,4</td>
</tr>
</tbody>
</table>

The table shows that with the increase of acetylene amount in the reaction mixture the total conversion of acetic acid increases. When the ratio of the starting materials is more than 4:1, due to formation of by-products (ethylidenediacetate) vinyl acetate yield decreases.

Deactivation of the catalyst is explained by the decomposition of zinc acetate from the nucleus on the following reaction:

\[
\text{Zn}(\text{CH}_3\text{COO})_2 \rightarrow \text{ZnO} + \text{CO}_2 + \text{CH}_3\text{C(O)CH}_3
\]

In the synthesis of vinyl acetate the following side reactions occur:

\[
\begin{align*}
2\text{CH}_3\text{COOH} & \rightarrow \text{CH}_3\text{C(O)CH}_3 + \text{H}_2\text{O} + \text{CO}_2 \\
\text{C}_2\text{H}_2 + \text{H}_2\text{O} & \rightarrow \text{CH}_3 - \text{CHO} \\
2\text{C}_2\text{H}_2 + \text{H}_2\text{O} & \rightarrow \text{CH}_2 - \text{CH} = \text{CHCHO} \\
\text{CH}_3\text{COOH} + \text{CH}_3\text{COOCH}=\text{CH}_2 & \rightarrow \text{CH}_3\text{CH(OOCCH}_3)_2
\end{align*}
\]
To investigate the mechanism and kinetics of the reaction of catalytic acetylation of acetylene on selected catalysts the effect of the partial pressures of the starting materials in a wide range was studied.

The experiments were conducted at a constant gas flow rate, which was achieved by adding inert gas—argon. As a result of the researches it was established that with increasing portion of the acetic acid and decreasing the partial pressure of acetylene, vinyl acetate yield decreases.

The experiments were performed in changing over a wide range the parameters providing the reaction proceeding in the kinetic region: temperature, partial pressures of the reactants and the specific rate of acetic acid. Influence of partial pressures of the initial and final substances on the kinetic objective laws of acetylation of acetylene was studied under the condition of change of the partial pressure of one component at a constant partial pressures of the other components. To maintain a constant feeding rate of the initial substances in case of need, an inert gas (nitrogen) is fed to the reaction zone. It is proved that within the parameters, in which the process is studied, the vinyl acetate yield increases with the increase of the concentration of acetylene and decreases with an increase of the partial pressure of acetic acid. Addition of vinyl acetate to the reaction medium does not affect to the rate of its formation. At temperatures above 210°C addition of water enhances the hydrolysis of vinyl acetate, but does not alter the activity of the catalyst. In molar ratio of acetylene: water = 10:1, the temperature of 200°C and contact time of 4 seconds acetic acid conversion reaches 100%. In the same ratio of the components (10:1) and maintaining the temperature 200°C, reduction of contact time from 4 to 2 seconds vinyl acetate output reaches 95-96%.

On the basis of experiments and chromatographic analyzes carried out, as well as literature data the following reaction mechanism has been offered:

\[
\begin{align*}
I. & \text{CH}_2\text{COOH} + Z \rightarrow \text{CH}_2\text{COOH} \star Z \\
II. & \text{CH} + Z \rightarrow \text{CH} \equiv \text{CH} \star Z \\
III. & \text{CH}_2\text{COOH} \star Z \rightarrow \text{CH}_2\text{COO}^{-} \star Z^+ \text{H}^+ \\
IV. & \text{CH} \equiv \text{CH} + Z \rightarrow \text{CH}_2 = \text{CH} \star Z \\
V. & \text{CH}_2 = \text{CH}^+ + \text{CH}_2\text{COOH} \rightarrow \text{CH}_2 = \text{CHOCH}_3 \star Z + \text{H}^+ \\
VI. & \text{CH}_2 = \text{CHOCH}_3 \star Z \rightarrow \text{CH}_2 = \text{CHOCH}_3 + Z \\
VII. & \text{CH}_2 = \text{CH}^+ + \text{Z} + \text{CH}_2\text{COOH} \star Z \rightarrow \text{CH}_2 = \text{CHOH} \star Z + \text{CH}_2\text{C}^+\text{O} \star Z \\
VIII. & \text{CH}_2 = \text{CHOH} \star Z \rightarrow \text{CH}_2\text{CHO} + Z \\
IX. & \text{CH}_2\text{C}^+\text{O} \star Z + \text{CH}_2\text{CHO} \rightarrow \text{CH}_2\text{O}\text{COCH(CH}_3\text{)}\text{O}^- \star Z \\
X. & \text{CH}_2\text{O}\text{COCH(CH}_3\text{)}\text{O}^- \star Z + \text{CH}_2\text{C}^+\text{O} \star Z \rightarrow \text{CH}_2\text{CH(O}\text{COCH}_3\text{)} + 2Z \\
\end{align*}
\]

Z-active center of the catalyst.

The reaction mechanism offered above, corroborates and supplements the theory available in the scientific literature. It is shown from the mechanism that ethylidene diacetate is not formed from vinyl acetate. With the increase of the partial pressure of acetic acid the formation rate of acetaldehyde increases. It, in its turn, leads to an increase of the output of ethylidene diacetate.

Studying the effect of the partial pressures of the initial substances on the reaction rate of the acetylation of acetylene and the results of chromatographic analysis allowed to propose the following kinetic equation:

\[
W = kP_{\text{C}_2\text{H}_2} \bullet P_{\text{CH,COOH}}^n
\]

Here, \( n \) – increases with increasing temperature.

From the experimental results the reaction of acetylation of acetylene satisfies the following equation:

\[
W = \frac{k(P_{\text{C}_2\text{H}_2} \bullet P_{\text{CH,COOH}})}{(1 + b \bullet P_{\text{CH,COOH}})}
\]
Catalytic acetylation of acetylene is an exothermic process and \( \Delta H_{298}^0 = -98 \) kJ/mol. The reaction is reversible.

The equilibrium constant of the reaction and the temperature are related as follows:

\[
\lg K_p = \frac{4400}{T} - 7.22 \cdot \lg T + 2.47 \cdot 10^{-3} + 11.3
\]

Here, \( T \) – the temperature in K.

### Table 3. The yield of vinyl acetate and equilibrium constants

<table>
<thead>
<tr>
<th>T, °C</th>
<th>T, K</th>
<th>lgKp</th>
<th>Kp</th>
<th>α</th>
</tr>
</thead>
<tbody>
<tr>
<td>180</td>
<td>453</td>
<td>1,53</td>
<td>58.5</td>
<td>0.80</td>
</tr>
<tr>
<td>243</td>
<td>516</td>
<td>0.88</td>
<td>7.2</td>
<td>0.55</td>
</tr>
</tbody>
</table>

Based on the studies conducted, a technological scheme for the synthesis of vinyl acetate in vapor phase was proposed.

**CONCLUSIONS**

1) In catalytic acetylation of acetylene for obtaining vinyl acetate the most active and effective is a nanocatalyst with the composition \((\text{ZnO})^x \cdot (\text{CdO})_y \cdot (\text{ZrO}_2)^z\).

2) The mechanism and kinetics of catalytic acetylation of acetylene on selected catalysts were studied.

3) On the basis of experimental data and results of chromatographic analysis taking into account the literature data the mechanism of the reaction was offered.

4) Based on the studies proposed the technological scheme of the vapor-phase synthesis of vinyl acetate was offered.

**References**

V. FOOD ENGINEERING
CHARACTERIZATION OF MICROBIOLOGICAL INDICATORS AND SAFETY CANNED RABBIT BASED ON FRUITS JIDA

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Abstract

In the development of canned rabbit meat with the addition of fruit jida special attention given safety parameters and retaining all the nutrients and their ratio. Developed a sample of canned «Rabbit diet with fruits cide» a relatively high content of nutrients, including carbohydrates compared to its counterparts in the market of Kazakhstan, as the formula includes the fruits of the Russian olive. The Russian olive (Elaeagnus Elaeagnus L.) possesses antimicrobial, anti-inflammatory, anesthetic, antitussive, diuretic properties, regulates metabolism in the body, has restorative effect. Analysis of finished products indicate accordance with the requirements of food safety for microbial contamination and lack toxic elements, as well as lower the cost of the product compared to its counterparts.

Keywords: rabbit meat, fruits jida, food safety, toxic elements, microbial contamination, preventive product.

The main factors determining human health, is the structure, conditions and eating habits. Food should have high organoleptic qualities, contain all components required for human life, but also to be absolutely safe for human.

Currently, there is a tendency of pollution of the main and auxiliary raw materials arriving at the meat-packing production of various kinds of toxic substances (heavy metals, arsenic, pesticides, antibiotics, dioxins, polychlorinated belinelli, polycyclic aromatic hydrocarbons, pathogenic microorganisms I and II groups of pathogenicity) which may have carcinogenic, mutagenic, teratogenic the effect on the human body, and can lead to food toxicity and poisoning [1].

Canned meat are the most stable among ready to eat meat products from the point of view of preservation of quality indicators. This is due, first, high temperature sterilization, destroying putrefactive microflora and the main inactivating enzyme system; second, the presence of sealed packaging prevent the ingress of microorganisms and oxygen, which reduces the likelihood the processes of putrefactive spoilage and lipid oxidation. In compliance with health requirements of production, modes of sterilization, availability of material cans with sufficient chemical resistance and mechanical strength canned food can be stored long time and transported in the most adverse conditions [1-2].

Rabbit meat has long been considered a valuable dietary product. In the distant times rabbit cost was equivalent to the carcass of a pig. And at present foreign countries realize the rabbit two to three times more expensive than poultry meat, other meat products.
Rabbit meat is a source of complete protein, minerals, vitamins. At the content of nitrogenous substances rabbit meat is second only to the meat of rabbit and Turkey, and fat content, fatty beef, fatty pork, and fatty duck and goose. At dietary indicators rabbit meat close to chicken, and in the percentage of protein and fat is superior. In the meat of mature animals, the water content is 60-67%, protein - 20-21 and fat - 3-18. A significant difference in the chemical composition of different rabbit breeds discovered. Chemical composition of meat depends more on the age of the animal and level of feeding. On food (biological) values of rabbit meat are judged by the content of a full and adective proteins and their amino acid composition.

Vitamin and mineral composition of meat of rabbits, almost can not be associated with other kind of raw meat. Thus, in the rabbit contains vitamins B6, B12, PP much more than beef, lamb, pork. Much of it is iron, phosphorus and cobalt, insufficient amount of manganese, fluorine and potassium. At the same time, rabbit meat is poor in saltssodium, which makes it indispensable in the diet [3, 4].

The fruits of Elaeagnus angustifolia contain sugar, fructose, glucose, proteins, salts of potassium, phosphorus, tannin, coloring matter, organic acids. Valuable therapeutic and prophylactic properties of Loja has long been known in folk medicine in many Asian countries and the Caucasus. The fruits of local species are used in the treatment of diseases of the gastrointestinal tract, as they have astringent, anti-inflammatory, enveloping action. They are used as an expectorant (bronchitis), diuretic (when ascites, edema), anthelminetic and vitamin remedy. The infusion of the fruit showshypotensive, and easy analgesic effect.

The need in the consumption of delicious food dietary, medical-prophylactic use in Kazakhstan is increasing every year, therefore, the development of cooking techniques and safe food products with high content of useful substances is an actual problem of processing industries.

The fruits of Russian olive is used as a food and as a medicine. Eat them cheese, sun-dried, milled, dried and canned form. Use of fruits in the diet particularly beneficial for the elderly that there is a tendency to constipation.

It should also be noted that the fiber of the fruit promotes the excretion of toxic substances, excess cholesterol, heavy metals. It also stimulates the process of selection bile [5].

The aim of the research is the development of canned meat diet purpose high quality indicators and meeting the requirements of food safety.

**OBJECTS AND METHODS OF RESEARCH**

The objects of study served as a meat rabbit, diluted in Almaty region the Kargaly urban settlement, farm «Krol», and developed the samples of canned rabbit «Rabbit in Almatinsky» on the basis of the fruits of the Russian olive (Elaeaginus Elaeaginus L.), «Rabbit in tomato sauce with flour jida» and «Rabbit diet with taste jida». As a control sample was take canned «Rabbit in its own juice» produced by Saint-Petersburg, JSC «MKK «Baltic».


RESULTS AND DISCUSSION

Research performance food safety of raw meat held in Laboratory of Hygiene, inspection and quality control of products (Spain, Lugo., at the University Santiago de Compostela), the fruits of the Russian olive and prototypes of canned – in open company «nutritest» on the basis of The Kazakh Academy Of Nutrition. The content of toxic elements and microbiological indicators of meat of rabbit presented in tables 1-2.

### Table 1. Results of toxic elements in rabbit meat

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Results</th>
<th>Methods or the test procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>As, mg/kg</td>
<td>&lt;0,0084</td>
<td>ICP-OES</td>
</tr>
<tr>
<td>Cd, mg/kg</td>
<td>&lt;0,0038</td>
<td>ICP-OES</td>
</tr>
<tr>
<td>Cr, mg/kg</td>
<td>–</td>
<td>ICP-OES</td>
</tr>
<tr>
<td>Hg, mg/kg</td>
<td>–</td>
<td>ICP-OES</td>
</tr>
<tr>
<td>Pb, mg/kg</td>
<td>&lt;0,0022</td>
<td>ICP-OES</td>
</tr>
<tr>
<td>Sr, mg/kg</td>
<td>–</td>
<td>ICP-OES</td>
</tr>
<tr>
<td>U, mg/kg</td>
<td>–</td>
<td>ICP-OES</td>
</tr>
<tr>
<td>V, mg/kg</td>
<td>–</td>
<td>ICP-OES</td>
</tr>
</tbody>
</table>

Analysis of table data shows that raw meat meets the requirements Technical regulations of the Customs Union «On safety of meat and meat products» (TR TC034/2013) and GOST 27747-88.Meat rabbits. Specifications.

### Table 2. Results of microbiological indicators for meat rabbit

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Results</th>
<th>Methods or the test procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salmonella in 25 g</td>
<td>Not detected</td>
<td>ISO 6579:2003</td>
</tr>
<tr>
<td>Listeria, in 25g</td>
<td>Not detected</td>
<td>ISO-EN 11290:1</td>
</tr>
<tr>
<td>Escherichia coli (E. coli), CFU/g</td>
<td>&lt;10</td>
<td>ISO 16649-2:2001</td>
</tr>
<tr>
<td>Staphylococcus, CFU/g</td>
<td>&lt;50</td>
<td>UNE-EN 68888-1:1999</td>
</tr>
<tr>
<td>Clostridium, CFU/g</td>
<td>&lt;10</td>
<td>ISO 7937:2004</td>
</tr>
<tr>
<td>Mesophilic bacteria, CFU/g</td>
<td>1,2x10^6</td>
<td>ISO 4833-2003</td>
</tr>
<tr>
<td>Enterobacteria, CFU/g</td>
<td>5,5x10^4</td>
<td>ISO 21528/2:2004</td>
</tr>
</tbody>
</table>

The study of food safety of the fruits of the Russian olive was carried out in the direction identify the following indicators: toxic elements, pesticides. The results are presented in table 3.

### Table 3. Results of safety performance indicators crushed jida

<table>
<thead>
<tr>
<th>Name indicators units measurements</th>
<th>Valid standards for ND</th>
<th>Actually received</th>
<th>The designation ND methods test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toxic elements: Lead, mg/kg</td>
<td>0,4</td>
<td>0,228</td>
<td>GOST R 51301-99</td>
</tr>
<tr>
<td>Cadmium, mg/kg</td>
<td>0,03</td>
<td>0,21</td>
<td>GOST R 51301-99</td>
</tr>
<tr>
<td>Arsenic, mg/kg</td>
<td>0,2</td>
<td>Not detected</td>
<td>GOST 26930-86</td>
</tr>
<tr>
<td>Mercury, mg/kg</td>
<td>0,02</td>
<td>Not detected</td>
<td>GOST 26927-86</td>
</tr>
<tr>
<td>Pesticides, mg/kg, more: GHC (α,β,γ isomers)</td>
<td>0.05</td>
<td>Not detected</td>
<td>MH USSR MU 2142-80</td>
</tr>
<tr>
<td>DDT and its metabolites</td>
<td>0.1</td>
<td>0.02</td>
<td>MH USSR MU 2142-80</td>
</tr>
</tbody>
</table>
From table 3 it can be seen that the indicators correspond to the security TR TS 021/2011 and within the specified tolerance.

The result of the common studies is to study security prototypes canned rabbit meat with the addition of fruit jida (table 4).

Table 4. Results of studies on the safety of canned rabbit meat with the addition of cide

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Control</th>
<th>Experiment 1</th>
<th>Experiment 2</th>
<th>Experiment 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toxic elements:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead, mg/kg</td>
<td>0.48</td>
<td>0.37</td>
<td>0.42</td>
<td>0.34</td>
</tr>
<tr>
<td>Cadmium, mg/kg</td>
<td>0.04</td>
<td>0.030</td>
<td>0.034</td>
<td>0.023</td>
</tr>
<tr>
<td>Arsenic, mg/kg</td>
<td>0.09</td>
<td>0.06</td>
<td>0.078</td>
<td>0.066</td>
</tr>
<tr>
<td>Mercury, mg/kg</td>
<td>0.03</td>
<td>Not detected</td>
<td>Not detected</td>
<td>Not detected</td>
</tr>
<tr>
<td>Pesticides, mg/kg hexachlorocyclohexan</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(α,β,γ-isomers)</td>
<td>0.1</td>
<td>Not detected</td>
<td>Not detected</td>
<td>Not detected</td>
</tr>
<tr>
<td>DDT and its metabolites</td>
<td>0.03</td>
<td>0.018</td>
<td>0.02</td>
<td>0.019</td>
</tr>
</tbody>
</table>

According to table 4, the prototype meet the requirements of the food and sanitary safety in the maintenance of toxic elements.

**CONCLUSION**

Thus on the basis of these studies it was shown that the investigated samples of raw materials and prototypes of canned rabbit meat using the fruit jida on the time of the research corresponded to hygienic requirements for safety GOST R 51301-99 allowable content of toxic elements and microbiological indicators.

**References**

5. Velikanov V. V. Influence of the drug ecofiltro on meat quality of rabbits / V. V. Velikanov, T. Bondar V., Malkov A. A. // proceedings of the Orenburg state agrarian University. – 2011. – N 3 (31), part 1, – P. 120-121
Abstract

This scientific paper is devoted to the study and definition of the chemical composition of meat camel. The article compares the chemical composition of meat and camel meat of beef, which shows that camel meat is characterized by at least a high nutritional value than beef, and thus perfectly suited for the production of meat.

Keywords: camel, biological and food value, cholesterol.

INTRODUCTION

Meat industry – one of the most important branches of country agriculture, providing the population with basic foodstuffs. No wonder the consumption of meat and meat products that contain complete proteins of animal origin, is widely recognized in the world as one of the criteria for the well-being of the people.

The work carried out in our country and abroad underscore the prospects for non-conventional types of meat for the production of food products, semi-finished products. The main obstacle to widespread use of camel is a coarse-fibered structure (stiffness meat) and the lack of evidence-based methods and modes of processing.

In the republics of Central Asia, some regions of the Russian Federation and some other countries, an additional source of animal protein is meat camels. On the quality indicators and nutritional value camel successfully compete with traditional meat of slaughtered animals.

Currently Kazakhstan is a large base of camel herd. Meat industry of our country in an average year started processing 48-50 ths. heads of camels, of which 70-80% are young.

Camel for thousands of years has been the link that connects people to the desert. Currently, the desert, especially in our country, learn to develop untold wealth hidden in the depths. The development of large food resources desert camel prominently. No animal has a biological adaptation to the conditions of the desert and semi-desert, like a camel. He makes good use of bad eaten or not eaten by other farm animals desert flora plants – prickly shrubs, many species of thistle, wormwood, saxaul and other content with the salt and bitter salt water, can tolerate a long thirst and starvation. All the deserts of the world, except the US and South America are verblyudovodcheskim territories.

Of all the animals only provides camel wool, meat, milk, and is used as a traction force. In countries with well-developed industry and a high level of mechanization of agricultural production and transport camel «ship of the desert» is gradually losing its meaning and becomes a highly productive mjashosherstnyh and dairy animal. From a population of desert receives the essentials.
According to rough estimates, world production of camel annually about 1 million. Tons of meat in live weight, of more than 100 thous. Tons of wool and 1.2 mln. Tons of milk. So, as of January 1, 2014, population of camels in the public sector totaled 115.6 thousand units, farms – 28.4 thousand., Agricultural enterprises of all forms of economic activity – 21,1 thous. Heads, while the remaining 78.9 thous. are concentrated in private households.

At the same time, camels in the economy of many countries is regarded not only as a tractive force in the areas of breeding, but also used as animal and meat productivity. Therefore, the study of the biological characteristics of camels and meat productivity pays great attention both in our country and abroad. For the first time the study of the meat productivity of camels started Lakoza I.I.

As you know, the food reflects the full value of the beneficial properties of the product, characterized by the presence of components required for the synthesis and biological cover the energy costs of the human body, as well as their taste and culinary qualities.

The thickness of the muscle fibers and an increased content of connective tissue in the muscle is a specific character, develop camels as a result of greater mobility in desert conditions and centuries of use as a vehicle (working) animal. These capabilities give the muscle meat of adult animals a certain density and rigidity. The use of camels as a working animal caused low prices for their meat. The minimum cost of rearing camels and their content, high yield prduktstii meat, fat and other products of sufficiently high quality merchandise and health enables a real increase in their livestock and the formation of the livestock industry, as one of the main suppliers of commodity meat, dairy products.

**OBJECTS AND METHODS OF RESEARCH**

At the moment, the traditional steel products from camel such as cooked sausages, ie wide use in the meat processing industry meat of camels did not find. Therefore, further study of camel with the subsequent application in the production of meat products.

These data (Table 1) show that the chemical composition of camel on the chemical composition are consistent with traditional meats – beef [3, 5].

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Content, %</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Camel meat</td>
<td>Beef meat</td>
<td></td>
</tr>
<tr>
<td>moisture</td>
<td>70,1±0,36</td>
<td>70,4±0,52</td>
<td></td>
</tr>
<tr>
<td>protein</td>
<td>18,4±0,17</td>
<td>19,0±0,33</td>
<td></td>
</tr>
<tr>
<td>fat</td>
<td>9,9±0,15</td>
<td>9,6±0,18</td>
<td></td>
</tr>
<tr>
<td>ash</td>
<td>1,05±0,19</td>
<td>1,1±0,17</td>
<td></td>
</tr>
<tr>
<td>extractives</td>
<td>1,6</td>
<td>1,7</td>
<td></td>
</tr>
<tr>
<td>minerals, mg%:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>calcium</td>
<td>8,65</td>
<td>10,2</td>
<td></td>
</tr>
<tr>
<td>magnesium</td>
<td>25,1</td>
<td>22,1</td>
<td></td>
</tr>
<tr>
<td>phosphorus</td>
<td>186,5</td>
<td>188</td>
<td></td>
</tr>
<tr>
<td>iron</td>
<td>1,8</td>
<td>2,9</td>
<td></td>
</tr>
<tr>
<td>Vitamins mg%:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Riboflavin (B2)</td>
<td>0,18</td>
<td>0,2</td>
<td></td>
</tr>
<tr>
<td>niacin (B1)</td>
<td>0,12</td>
<td>0,1</td>
<td></td>
</tr>
<tr>
<td>niacin (PP)</td>
<td>2,24</td>
<td>0,3</td>
<td></td>
</tr>
<tr>
<td>Calories, calories</td>
<td>191</td>
<td>171</td>
<td></td>
</tr>
</tbody>
</table>
Despite the fact that in comparison with camel beef meat lowest ash content, it should be noted that the camel has the highest magnesium content – 25.1 mg%.
Meaning of meat as the protein product is determined primarily protein and a well balanced amino acid profile.

Table 2. The amino acid composition of raw meat (by reference data)

<table>
<thead>
<tr>
<th>Amino acids</th>
<th>Content, g / 100 g protein</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Beef meat</td>
</tr>
<tr>
<td>Essential:</td>
<td></td>
</tr>
<tr>
<td>valine</td>
<td>4,98</td>
</tr>
<tr>
<td>leucine</td>
<td>7,73</td>
</tr>
<tr>
<td>isoleucine</td>
<td>4,11</td>
</tr>
<tr>
<td>lysine</td>
<td>8,14</td>
</tr>
<tr>
<td>methionine</td>
<td>3,17</td>
</tr>
<tr>
<td>threonine</td>
<td>4,62</td>
</tr>
<tr>
<td>tryptophan</td>
<td>1,40</td>
</tr>
<tr>
<td>phenylalanine</td>
<td>4,42</td>
</tr>
<tr>
<td>Interchangeable:</td>
<td></td>
</tr>
<tr>
<td>tyrosine</td>
<td>3,21</td>
</tr>
<tr>
<td>histidine</td>
<td>0,93</td>
</tr>
<tr>
<td>aspartic acid</td>
<td>7,79</td>
</tr>
<tr>
<td>hydroxyproline</td>
<td>0,29</td>
</tr>
<tr>
<td>glutamic acid</td>
<td>3,12</td>
</tr>
<tr>
<td>arginine</td>
<td>6,62</td>
</tr>
<tr>
<td>alanine</td>
<td>5,82</td>
</tr>
<tr>
<td>serine</td>
<td>1,89</td>
</tr>
<tr>
<td>glycine</td>
<td>5,77</td>
</tr>
</tbody>
</table>

Figure 1. Comparative analysis of amino acid composition (essential amino acids), beef and camel.
Analysis of the data presented in Table 2 and Figure 1, indicating that the camel present the same set of amino acids that have beef, among them 8 essential. As the amount of essential amino acids camel inferior beef.

Significant differences were observed in species composition as the essential and nonessential amino acids: the highest content of leucine different camel (8.43 g / 100 g of protein).

Camel differs from beef a high tryptophan content (5.7%), histidine (more than 4 times), aspartic acid (12.8%), hydroxyproline (2 times), glutamic acid, arginine, serine and glycine.

The presence of hydroxyproline, which is present in very few proteins, allows the content of this amino acid to judge the quantity of collagen in the meat. Peculiarities of structure of collagen fibers define their high swelling capacity and a high mechanical strength, which in turn affects the consistency of the meat.

Taking into account the content of hydroxyproline in the traditional raw materials (beef) in a non-traditional raw materials (camel), we can conclude that this figure could be a criterion characterizing the rigidity of the meat. Protein usefulness of 4.78 (beef), 2.9 (camel).

Fat raw divided into higher and first grade. Produce his specifications for the fat of cattle, sheep and pigs in compliance with veterinary and sanitary rules. In grade oil must comply with accepted organoleptic and physico-chemical requirements. Comparative constant fat camels and other farm animals are shown in Table 3.

Specifications include rules for admission and laboratory methods of physical, chemical and organoleptic characteristics as well as the packaging and labeling of fat.

Table 3. Comparative constant fat camels and other livestock

<table>
<thead>
<tr>
<th>Type of fat</th>
<th>Temperature (°C)</th>
<th>iodine index</th>
<th>absolute weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>melting</td>
<td>chilling</td>
<td></td>
</tr>
<tr>
<td>camel</td>
<td>48,5-48,7</td>
<td>35,5-36,8</td>
<td>35,5-36,8</td>
</tr>
<tr>
<td>beef</td>
<td>42,0-50,0</td>
<td>27,0-38,0</td>
<td>35,0-48,0</td>
</tr>
<tr>
<td>Baranja</td>
<td>43,0-55,0</td>
<td>31,0-41,0</td>
<td>33,0-46,0</td>
</tr>
<tr>
<td>horse</td>
<td>15,0-39,0</td>
<td>20,0-48,0</td>
<td>71,0-90,0</td>
</tr>
</tbody>
</table>

Fat camels as seen from Table 10, different from other agricultural animal fat so that its melting temperature and solidification is much higher than with other species.

In its energy value of 100 kg of fat corresponds to approximately 250 kg of starch.

All the evidence suggests that non-traditional types of meat can be used for processing the food products.

**RESULTS AND DISCUSSION**

Thus, analyzing the data it is clear that the camel on the chemical composition and quantitative content of essential amino acids, characterizing their biological value, are consistent with widely used beef and can be used for the production of food products subject to the application of technological methods of softening hard on the structure of meat.

The color, texture and appearance of meat is non-working, well-fed, and especially young camels is similar to beef, with a well-fed animals intramuscular fat gives the meat marbled appearance, improving its taste and nutritional value.

Camel meat, as well as any other animals, it is suitable for the production of conventional meat in boiled and fried.

The old, the workers and lean camel meat is naturally tougher, a coarse, roasted so bad, but because of the larger content of glycogen it successfully used to prepare a variety of canned and sausage products [5,6].
VI. TRANSPORT AND ENGINEERING
All sectors of national economy have warehouses of different types and for different purposes. They play an essential role in regard to production, distribution and consumption when arranging cargo traffic, consequently efficiency improvement of warehouses and cargo terminals through their professional integrated design will be positively reflected on national economy.

The object of the research is VIVAPHARM pharmaceutical company.

Kazakh pharmaceutical company VIVAPHARM is one of the most dynamically developing pharmaceutical companies in the Central Asia and Kazakhstan, which is a top ten largest pharmaceutical distributors of the RoK. Due to a clear development strategy and operational excellence of the employees, the Company has made real progress. Today VIVAPHARM company can be justifiably called as a center of introduction of pharmaceuticals and healthcare products at the market of Kazakhstan.

 Customs warehouse of VIVAPHARM company is listed in the Register of Owners of Open-Type Customs Warehouses and features three freestanding buildings. Let us consider their properties:

1. A-Class Euro warehouses for storage and distribution of pharmaceutical products.
2. Total occupied area of warehouses is 1000 sq. meters.
3. Warehouse premises at temperature range from +15°C to +25°C allow storing with racking arrangement up to 1200 euro pallet places.
4. Refrigerating chamber for 20 euro pallet places with storage temperature requirements from +2°C to +8°C.
5. Customs warehouse is equipped with advanced equipment. The latest technologies allow ensuring regular and qualitative services for clients.
6. Warehouses are equipped with modern HVAC system, autonomous heating is available that allows observing all the necessary requirements on medical supplies storage. Twenty-four hour temperature and humidity control is available.
7. Daily wet cleaning and a cleaning day once a month are carried out in the warehouses.
8. Disinfestation/ deratization measures are regularly carried out.
9. Twenty-four hour video monitoring is available; warehouses are equipped with fire and security alarm system.
10. The subject of the research is optimum design calculation of racking equipment at the enterprise warehouse.

The objective of the research is to calculate the most optimal design of racking equipment for finished products storage at stock.

To achieve the set aim it is necessary to develop a design decision which will allow arranging storage of the highest quantity of cargo at stock with due account for existing restrictions.

Optimum space arrangement in warehouses is the most important task in warehousing facilities. Efficiently positioned racks allow creating extra space and optimizing vacancies in
warehouses. When using a relevant type of racks, one can avoid unnecessary expenditures for additional premises, payment of manual labor, as well as shorten time for deciding other warehouses assignments.

It is very important racks to be selected with due account for warehouse space parameters. Herewith, volume of goods, their specific character, storage conditions and shipment periodicity are also very important.

This project proposes two types of racking equipment for rational arrangement of warehouse space of VIVAPHARM Company: frontal pallet and drive-in pallet (Push Back).

The main purpose of frontal racking system is palletized storage of all and any types and sizes.

Frontal racking systems are made as metal structures consisting of demountable load frames, horizontal cross beams and additional accessories which also include false decks from wood particle board (at customer’s option – from metal sectional shelves), specialized holders for narrow rolls, barrels and vessels, protection of column bases and frames.

It is possible to place cargo of any size using loading frontal racks as well as EURO (1200x800x150 mm) and FIN (1200x1000x150 mm) shipping skids in warehouses.

The advantages of loading frontal racking system are as follows:
- Possibility of warehousing and further storage of single-type or composite palletized cargo of EUR and FIN standard sizes;
- Possibility of further construction on the basis of storage rack systems of automatic and prefabricated warehouses with maximum beneficial use of premise restricted area;
- Wide range of dimensions for loading frames, beams and other structure members with the help of which on can select the most optimum racking structures for warehouses with due account for loading and quantity of warehousing levels;
- Direct access to the whole list of stored cargo;
- Possibility of optimum use of storage area sections;
- Ease control maintenance of stock resources as well as possibility of operational computer accounting application with the use of storage locations marking of front-loaded pallet racks in warehouses (Table 1, 2, 3).

Table 1. Allowances for frontal racking systems

<table>
<thead>
<tr>
<th>Height level (Yh mm)</th>
<th>Class 400*</th>
<th>Class 300A**</th>
<th>Class 300B***</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X3 X4 Y3</td>
<td>X3 X4 Y3</td>
<td>X3 X4 Y3</td>
</tr>
<tr>
<td>3.000</td>
<td>75 75 –</td>
<td>– –</td>
<td>– –</td>
</tr>
<tr>
<td>6.000</td>
<td>75 100 75</td>
<td>75 100 100</td>
<td>100 100 100</td>
</tr>
<tr>
<td>9.000</td>
<td>75 125 75</td>
<td>75 125 125</td>
<td>125 125 125</td>
</tr>
<tr>
<td>12.000</td>
<td>– – 75 150</td>
<td>– – 75 150</td>
<td>– – 125 125</td>
</tr>
</tbody>
</table>

* - loading racks for frontal loading by forked warehousing machinery (electric stackers, front loaders, reach trucks)
** - loading racks to serve by narrow electric stackers with three-side cargo handling and operator’s movable cab (operator’s cab moves alongside with carriage and fork of VNA truck)
*** - loading racks to serve by narrow electric stackers with three-side cargo handling and operator’s fixed cab (operator’s cab is below)
Table 2. Crossbeams dimensions (expertclass 300B), mm

<table>
<thead>
<tr>
<th>Shipping skid (pallet)</th>
<th>L (crossbeam length)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>800</td>
<td>1200</td>
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<td>1000</td>
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<td>1200</td>
<td>1200</td>
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</tbody>
</table>
To achieve the maximum storage capacity in a modern warehouse, one of the most widely used and cost-effective solutions is the use of storage rack system for deep storage (Figure 2).

Pushback racks are designed for accumulated storage from two to six pallets at transverse direction of transportation of goods. To be sure, it is possible to build up a warehouse complex concept designed also for higher storage density of cargo.

Due to a flexible and fast loading trolley, this system is initially suitable for various storage units, such as metal containers, any wooden and plastic pallets, and by agreement with the client, any specially designed structures.

Though Pushback racks feature a self-contained back-action system designed for warehousing according to LIFO system, they can be used as a buffer store for intermediate storage of goods prior to their placing in the warehouse of «sequenced-flow storage» which operates on FIFO principle. This would mean that the lot of goods placed the latest in Pushback racks will be loaded first to the gravitational warehouse and also will be the first unloaded.

There is a transverse way of pallets storage (euro pallets). When picking up cargo, the loaded pallet moves back along the channel due to new load. Pallets are placed on permanent roller load trolleys which can transport various types of pallets. Unloading to be carried out exclusively from the front side of the rack.

**Pushback racking system has its advantages:**

- Maximum use of size in height;
- Possibility of pallets storage with different SKU on the same level;
- High-grade system security achieved due to availability of the centralizer for pallets and locking mechanisms;
- Possibility of fast installation and subsequent system upgrade.
- Each rack system has its apparent advantages. An important role in this case play the properties of warehoused goods and general warehouse concept (Table 4). Nevertheless, differences which are deemed as subtle may have crucial significance.

### Table 3. Options of false decks for crossbeams (shelves) of frontal racks for shipping skids

<table>
<thead>
<tr>
<th>False Decks Options</th>
<th>Crossbeams (Beams) Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Galvanized metal decking (composite shelves) for 2C-type beams</td>
<td>Galvanized metal decking (composite shelves) ZS-60-type beams</td>
</tr>
<tr>
<td>Decking from welded metal mesh for beams of types J or Z</td>
<td></td>
</tr>
<tr>
<td>Wood decking (wood particle board, wood particle board + melamine)</td>
<td>Wood decking (wood particle board, wood particle board + melamine) for 2C-type beams</td>
</tr>
<tr>
<td>Fastening of wood decking to the beams</td>
<td></td>
</tr>
</tbody>
</table>

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Table 4. **Advantages and disadvantages of rack systems**

<table>
<thead>
<tr>
<th>PALLET RACKS:</th>
<th>DRIVE-IN RACKS</th>
<th>PUSH BACK RACKS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>advantages:</strong></td>
<td><strong>advantages:</strong></td>
<td><strong>advantages:</strong></td>
</tr>
<tr>
<td>– quick access to all articles</td>
<td>– economy in storage areas</td>
<td>– economy in storage areas</td>
</tr>
<tr>
<td>– economical efficiency</td>
<td>– for slow moving consumer goods</td>
<td>– high filling degree (80-95% of volume use)</td>
</tr>
<tr>
<td>– for slow moving consumer goods</td>
<td></td>
<td>– large quantity of handling operations for fast moving consumer goods</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– articles are available from the front side of the rack, no need for loader inside the rack</td>
</tr>
<tr>
<td><strong>disadvantages:</strong></td>
<td><strong>disadvantages:</strong></td>
<td><strong>disadvantages:</strong></td>
</tr>
<tr>
<td>– small quantity of handling operations of the goods</td>
<td>– availability of one type of goods in the channel</td>
<td>– inapplicable for slow moving consumer goods</td>
</tr>
<tr>
<td>– large quantity of loaders in the aisles</td>
<td>– risk of rack damage by a loader</td>
<td></td>
</tr>
<tr>
<td>– storage areas wastage (50-60%) due to large quantity of working aisles</td>
<td>– necessity of using specialized fork loaders</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>– small quantity of handling operations of the goods</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– low filling degree</td>
</tr>
</tbody>
</table>

Optimum space arrangement in warehouses is the most important task in warehousing facilities. Efficiently positioned racks allow creating extra space and optimizing vacancies in warehouses. When using a relevant type of racks, one can avoid unnecessary expenditures for additional premises, payment of manual labor, as well as shorten time for deciding other warehouses assignments. [1].

It is very important racks to be selected with due account for warehouse space parameters. Herewith, volume of goods, their specific character, storage conditions and shipment periodicity are also very important.

To calculate optimal design of racking equipment for storage of the highest quantity of finished products, it is necessary to work out a technical assignment to the project (Table 5).

Table 5. **Technical Assignment to the Project**

<table>
<thead>
<tr>
<th>Purpose of warehouse</th>
<th>Warehouses of the pharmaceutical factory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warehouse diagram</td>
<td>Warehouse consists of L-shaped warehouse facility with operating height of 7500 mm</td>
</tr>
<tr>
<td>Restrictions of design include</td>
<td>Special requirements for arrangement of pharmaceutical warehouses; Availability of hot-air heating system in warehouses; Availability of air ventilation system with the use of air conduits in warehouses.</td>
</tr>
<tr>
<td>Sizes of room No. 1 – 4:</td>
<td>18350×17200×22850×9000 mm</td>
</tr>
<tr>
<td>Ceiling height:</td>
<td>6000 mm</td>
</tr>
<tr>
<td>Pallet size:</td>
<td>EurPal, mm – 1200×800×800</td>
</tr>
</tbody>
</table>
Maximum weight of palletized cargo: 500 kg
Maximum height of cargo with shipping skid: 1400 mm
Height of the rack to the first loaded tier: 1400 mm
Total rack height: 4200 mm
Quantity of shipping skids on the tier: 3.
Quantity of storage tiers (floor incl.): 4-5;
Quantity of pallets to the deep: 2;
Type of loading machinery used in warehouses: electric stacker; rated load capacity – 1600 kg; residual capacity – 870 kg; height of lift – 5800 mm; width of working aisle (ast) – 2230 mm

Additional accessories: none

The author of the article has developed 4 versions of space-planning and technological solutions with respect to warehouse sites layout of VIVAPHARM company, transport accesses, combinations of types and parameters of cargo stock articles, and racking equipment.

### Version No. 1 – frontal racks

<table>
<thead>
<tr>
<th>Rack height</th>
<th>4500 mm (floor incl.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity of pallet positions</td>
<td>356</td>
</tr>
</tbody>
</table>

Advantages of this version «+»
access to each pallet;
large and convenient area for mail expediting section (cargo acceptance and formation).

Disadvantages of this version «-»
insufficient quantity of pallet positions;
wide aisles between racks, on the basis thereof the storage volume is considerably reduced.
Storage rack system is arranged in four rows (two double rows and two single rows) crosswise the longest wall. Such height allows containing four storage tiers, three pallet positions at each tier. When calculating this version of racks arrangement, the total quantity of pallet positions is 356.

**Version No. 2 – frontal racks**

<table>
<thead>
<tr>
<th>Rack height</th>
</tr>
</thead>
<tbody>
<tr>
<td>4500 mm (floor incl.)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quantity of pallet positions</th>
</tr>
</thead>
<tbody>
<tr>
<td>360</td>
</tr>
</tbody>
</table>

**Advantages of this version «+»**

- increase of pallet positions quantity in comparison with version No. 1
- large and convenient area for mail expediting section (cargo acceptance and formation).

**Disadvantages of this version «-»**

- Availability of aisleways complicates warehouse operations since the loader may have problems with electric stacker in the area of the aisleway when working.

In this version, racking system is arranged in four rows (two double rows and two single rows) along the longest wall. The height of the rack is 4500 mm (including the floor). This height allows containing four tiers of storage, three pallet positions at each tier. With such arrangement of the racking system, it is necessary to have a passway to access the last row, which considerably complicates operations of the warehouse. Based on this arrangement of frontal racks, the total number of pallets was 360.
Version No.3 – Pushback

<table>
<thead>
<tr>
<th>Rack height</th>
<th>4500мм (floor incl.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity of pallet positions</td>
<td>480</td>
</tr>
</tbody>
</table>

Advantages of this version «+»

- High cargo capacity;
- Convenient location of racks;
- Wide aisleways;
- Large and convenient area for mail expediting section (cargo acceptance and formation).

Disadvantages of this version «-»

- Push-Back racks are designed for identical products.
- Given that the goods produced in this pharmaceutical company are multifarious, consequently this version is inappropriate.

In the third version the Pushback racks were considered. Arrangement of racks was selected along the longest wall with due account for access plan of the loaders. Height of racks is 5000 mm; number of tiers is four. Total length of the rack has increased and this has allowed increasing the storage volume up to 480 pallet positions.
Version No. 3 – frontal racks

<table>
<thead>
<tr>
<th>Rack height</th>
<th>4500мм (floor incl.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity of pallet positions</td>
<td>535</td>
</tr>
</tbody>
</table>

Advantages of this version «+»
- substantial increase of storage volume;
- possibility of permanent ventilation that is of critical importance for pharmaceuticals storage;
- a deliberate evacuation plan of personnel through the escape way in case of emergency arisen in stock;
- availability of racks over the area of mail expediting section that allows offloading this area from temporary cargo.

Disadvantages of this version «-»
- Major deficiencies when developing this version were not revealed.

Frontal racks were used in this version. Racks were arranged as follows: four racks crosswise the longest wall (three double, one single) and one rack along the longest wall. This row of racks allows increasing the storage volume of products on the mail expediting section. Due to convenient and regular arrangement of racking system, the operation in warehouse will be smooth and number of pallet positions will increase up to 535.

When arranging and planning warehouses of VIVAPHARM company, a number of factors were taken into account with respect to scope and structure of warehouse commodity circulation and commodity stocks, physical-chemical properties of goods, storage process technologies, etc. In this regard, when developing the design of warehouses the below stated was taken into account:
- process requirements determining the compliance of area and warehousing capacity, nature, peculiarity, content and scope of warehousing activities;
- fire-fighting and general technical capacities – design requirements to the warehouse and its premises, lighting, heating, ventilation, electric power supply, fire safety.

Conclusions: Thousands of versions of space-planning and process engineering solutions are possible for each combination of initial data: warehouse sites layout, transport access ways, combinations of types
and parameters of cargo stock articles, racking and piling equipment, systems of cargo selection and order batching, mechanical rates and appliances, automation of warehousing operations, etc.

In the case under consideration on the set technical assignment, the optimum space-planning and process engineering solution for VIVAPHARM company warehouse is version No. 4.

References

Abstract

The existing course of dynamics contains dynamic research of mechanisms with one degree of freedom and with one input. Only such mechanisms are used in mechanical engineering. However, recently essentially new so-called adaptive mechanisms – gear variators have been developed. The adaptive gear variator represents the one-drive wheelwork with two degree of freedom which is independently adapting for variable force loading by change of motion speed. Action of an adaptive variator is described by dynamics. In the paper the dynamics of transitive modes of the adaptive mechanism with two degrees of freedom is investigated. The received results are a basis of essentially new course of dynamics named «Dynamics of adaptive mechanisms».

Keywords: gear variator, power adaptation, dynamics of adaptive mechanisms.

INTRODUCTION

The existing course of dynamics contains dynamic research of mechanisms with one degree of freedom and with one entry. Only such mechanisms are used in engineering industry. However, recently brand new so-called adaptive mechanisms – gear variators have been developed. The gear variator represents the mechanism with two degree of freedom. The main difference of a gear variator from all mechanisms existing in the world: the gear variator has only one entry. It means that on a way of actuating the gear variator is the usual one-drive mechanism. But on behaviour of act the gear variator implements a discovery – «Effect of force adaptation in the mechanics».

The adaptive gear variator represents a wheelwork with constant engagement of the toothed wheels and having ability to be adapted for variable force loading at the expense of independent (without a control system) change of motion speed.

Attempts to create a gear variator (the adaptive gearing) were undertaken by many inventors [1, 2, 3, 4]. In the basis of Ivanov’s invention the two-mobile planetary kinematic chain [3, 4] was used. It has been proved [5, 6, 7] that if the kinematic chain contains the mobile closed contour at traffic with two degree of freedom then the closed contour imposes additional communication on traffic of links and provides definability of traffic. At the same time the kinematic chain gets property of power adaptation to a variable load. Such property takes place in traffic operating condition at a relative uniform motion of all links.
However on the start (in the motion beginning) the output link is motionless, and the kinematic chain has one degree of freedom. Transfer cannot to transfer force to a target link for a beginning of motion. Definability of motion is absent. The using of brake on one of mobile links [2] demands a control and deprives autonomy transfer. Use of dynamic inertia parameters on the start [3] provides a small starting moment and is not reliable.

Reliable start with overcoming of the high starting moment can be provided by creation of the dead center position of the closed contour at chosen sizes of links [8]. Starting communication is created by choosing of matching sizes of links and is eliminated after start. For elimination of starting communication after the beginning of motion of all links the additional transfer which wedges out the closed contour is used [8]. This additional transfer takes place in parallel with the basic two-mobile planetary kinematic chain and does not obstacle to its motion. The wedging out of additional transfer can be created on the basis of coincidence of linear speeds of some links [9].

The developed kinematic analysis and force analysis of an adaptive variator in a uniform motion with two degree of freedom [10, 11 and 12] install analytical regularity of interconnection of the kinematic and force parameters according to mechanics laws. Numerical instances prove the found regularity.

However autonomy of motion on start at transition from a condition with one degree of freedom into a two-mobile condition, and also in operating condition at loading change should be analyzed. It is necessary to describe and investigate dynamic transient for an estimation of reliability of autonomy and an efficiency of gear variator.

Work is devoted to description and research of dynamics of transients of adaptive gear variator.

The received results are a basis of essentially new course of dynamics named «Dynamics of adaptive mechanisms».

2. DESCRIPTION OF ADAPTIVE GEAR VARIATOR

At the description of the device and work of the adaptive gear variator we will use following designations:

\[ M_9, M_{10} \] – external moments on input 9 and output 10 carriers,

\[ F \] – input impellent,

\[ R \] – output force of resistance,

\[ r_9, r_{10} \] – radiuses of input 9 and output 10 carriers,

\[ u_{9\rightarrow5}^{pl} \] – transfer ratio of a planetary kinematic chain from the input carrier 9 to the output satellite 5,

\[ u_{9\rightarrow5}^{ad} \] – transfer ratio of additional transfer from the input carrier 9 to the output satellite 5,

\[ z_i \quad i = 1, 2, 3, \ldots, 8 \] – numbers of teeth of wheels,

\[ \omega_9, \omega_{10} \] – angular velocities of input 9 and output 10 carriers.

![Adaptive gear variator](Figure 1)
The adaptive gear variator (fig. 1) contains following details: input carrier 9, input satellite 2, block of solar wheels 1-4 fixed on intermediate shaft, block of ring wheels 3-6 leaning against satellites, output satellite 5 and output carrier 10.

Input 9 and output 10 carriers are executed with equal sizes (radiuses) \( r_9 = \eta_9 \) and \( r_{10} = \eta_{10} \), that matches to the formula connecting numbers of teeth of wheels 1, 2 and 4, 5
\[
z_1 + z_2 = z_4 + z_5.
\]
It leads to transfer wedging on start.

Additional transfer is executed in the form of the gearing from the input carrier 9 to the output satellite 5 containing a toothed wheel 8 connected to the input carrier 9 by means of disk 11 and a wheel 7 rigidly connected to the output satellite 8. Additional transfer provides the wedging out of the kinematic chain after the motion beginning. Additional transfer in the form of wheels 8 and 7 has transfer ratio \( u_{9-5}^{ad} \) and doubles a planetary kinematic chain from input carrier 9 to output satellite 5 with transfer ratio \( u_{9-5}^{pl} \). The equality \( u_{9-5}^{ad} = u_{9-5}^{pl} \) takes place, where

\[
u_{9-5}^{ad} = -\frac{z_8}{z_7}, (1)
\]

\[
u_{9-5}^{pl} = \frac{u_{13}^{(9)} - u_{46}^{(10)}}{u_{36}^{(10)}(u_{13}^{(9)} - 1)}, (2)
\]

Here \( u_{8}^{(9)} = -\frac{z_3}{z_1} \) – the transfer ratio of wheels 1 and 3 at the motionless carrier 9, \( u_{10}^{(46)} = -\frac{z_6}{z_4} \) – the transfer ratio of wheels 4 and 6 at the motionless carrier 10, \( u_{36}^{(10)} = \frac{z_6}{z_5} \) – the transfer ratio of wheels 5 and 6 at the motionless carrier 10.

After substitution of these values in (2) we will gain

\[
u_{9-5}^{ad} = \frac{z_3 z_4 z_5 - z_1 z_3 z_6}{z_3 z_4 z_6 + z_1 z_4 z_5}.
\]

From a condition of equality of the transfer ratios expressed by formulas (1) and (2), we will gain a condition of interconnection of numbers of teeth of wheels of the mechanism allowing synthesizing the mechanism

\[
-\frac{z_8}{z_7} = \frac{z_3 z_4 z_5 - z_1 z_3 z_6}{z_3 z_4 z_6 + z_1 z_4 z_5}, (3)
\]

The adaptive gearing works as follows.  

In the motion beginning (at start) the output carrier 10 is motionless, transfer has one degree of freedom and can be in free move at relative mobility of wheels 1-4, 2, 3-6, 5 of closed contour. Force interacting of links of transfer is presented on a side view (fig. 2). The load 11 with weight \( G \) and mass \( m \), attached by a flexible filament to shaft \( A \) of output carrier 10, creates a tractive resistance. Relative motion of links on the start is possible generally when carriers 9 and 10 have different radiuses, and transfer has eccentricity \( e = r_9 - r_{10} \), allowing creating moment \( M = Fe \) turning the satellite 5 around motionless point \( K \) of the output carrier 10.

Thus closed contour from toothed wheels gets internal relative mobility. However at equal radiuses of carriers 9 and 10 the kinematic chain of transfer appears wedged because the line of acting of impellent \( F \) from of the party of the input carrier 9 in point \( B \) passes through point \( K \) of the output carrier 10 and force \( F \) is directed oppositely to resistance force \( R \). Eccentricity is equal \( e = 0 \), and the driving moment which rotates the output satellite 5 and all closed contour in relative motion is absent. As a result of wedging the kinematic chain loses one degree of freedom and can begin motion only in the chocked condition, overcoming force of resistance \( R \) and an output starting moment of resistance on the carrier 10. Start from a place becomes absolutely reliable (as in the usual mechanism with one degree of freedom).

![Figure 2. An adaptive gear variator on a side view](image)
After start from a place additional (parallel) transfer (fig. 1) through wheels 8 and 7 provides transfer of the driving moment directly from the input carrier 9 on the output satellite 5, providing its relative motion in the closed contour, and eliminates wedging. The mechanism passes into a condition with two degree of freedom with relative mobility of links of a contour. In this condition the equilibrium of the mechanism is carried out by a principle of possible works with adaptation to a variable output moment of resistance by formula which is resulted in [6]

$$\omega_{10} = \frac{M_5}{M_{10}} \omega_2 . \quad (4)$$

Thus, the offered design provides automatic overcoming of high starting resistance and definability of motion in two mobile condition.

### 3. DYNAMICS OF TRANSIENT OF GEAR VARIATOR IN STAGE OF RUNNING START

For the dynamic analysis we will use the theorem about change of kinetic energy: change of a kinetic energy of the mechanism within some interval of a time is equal to work of external forces.

$$A_M - A_R = T - T_0 . \quad (5)$$

$T, T_0$ – kinetic energy in end and in beginning of motion interval, $A_M, A_R$ – work of an impellent and work of force of resistance.

Conveniently instead of works $A_M, A_R$ to use powers of an impellent and force of resistance $P_M, P_R$. For this purpose we will divide the equation (5) into an interval of time $t$, we will gain

$$P_M - P_R = (T - T_0) / t . \quad (6)$$

On initial transient two kinds of transitive motion take place: 1) Start – overcoming of the starting moment of resistance during time of start $t_s$, 2) Acceleration – before transition into an operational mode of uniform motion during time $t_a$. General time of initial transient $T_b = t_s + t_a$.

Let’s determine parameters of the start. Kinetic energy of the mechanism can be determined under formula $T=0.5mV^2$, where $m$ – the reduced mass of all links, $V$ – speed of a point of reduction. However for decision simplification it is possible to neglect masses of links of the mechanism as they are small in comparison with mass of moving load. Then

$$T=0.5mV^2, \quad \text{where} \quad m = \text{mass of a load} \quad (\text{fig.} 2), \quad V_s = \text{the given starting initial speed of motion of load} \quad V_s,$$

$V_s = \omega_0/\omega_{10} \quad \text{starting initial angular speed,} \quad V_s = \omega_0/\omega_{10} \quad \text{output shaft radius}.$

Power of resistance on start $P_R + GV_s$, where $G$ – a load weight ($G=mg$).

From the formula (6) we will determine a required power of the engine for start providing.

Let’s determine parameters of the acceleration after the start. Interconnection of parameters of acceleration in matching with formula (6) has following format

$$P_M - P_R = (T_a - T_s) / t_a . \quad (7)$$

where $t_a$ – time of acceleration.

From here

$$P_M = P_R + 0.5m(V_a^2 - V_s^2) / t_a = P_R + 0.5m(V_a - V_s)(V_a + V_s) / t_a = P_R + 0.5ma_a(V_a + V_s) / t_a \quad \text{or}$$

$$P_M = P_R + 0.5ma_a(V_a + V_s) . \quad (8)$$

where $a_a = (V_a - V_s) / t_a$ – given (allowable) initial acceleration.
On driving power it is possible to select the engine (propeller) with matching angular velocity $w_M$ and to determine the driving motion moment

$$M_M = \frac{P_M}{w_M}, \quad (9)$$

The driving moment must be checked on a condition of serviceability of transfer [8] using radiuses of toothed wheels 1, 4, 9, 10 and the given moment of resistance $M_{R_s} = P_{R_s}/\omega_{0s}$

$$M_0 \geq M_{R_s} \frac{R_4R_9}{R_1R_{10}}, \quad (10)$$

After that it is possible to determine the start time under the formula received from the equation (7)

$$t_s = \frac{mV_s^2}{2(P_M - P_{R_s})}. \quad (11)$$

After the start the acceleration begins – the sped up motion with transition into motion operating condition. The equation (6) becomes

$$P_M - P_{R_s} = 0.5m(V^2 - V_s^2)/t_a, \quad (12)$$

where $t_a$ – acceleration time, $V$ – the given speed of motion of a load in the end of initial transient. The acceleration proceeds before achievement of equality of powers of impellents and forces of resistance. We will determine acceleration time

$$t_a < \frac{0.5m(V^2 - V_s^2)}{P_M - P_{R_s}}. \quad (13)$$

Further the motion operating condition begins. At equality of powers of an impellent and force of resistance ($P_R = P_M$) the uniform motion without kinetic energy change occurs. At instant change of a moment of resistance the transitive regime with change of a kinetic energy before achievement of equality of powers of impellents and forces of resistance at the expense of change of output angular speed according to the formula (6) occurs. In this case driving power $P_M$ remains without change, power of resistance matches to the changed moment resistance $R_M$ at former angular velocity $w_{R0}$, that is $P_R = M_Rw_{R0}$, and the kinetic energy in the end of transient will match to new angular speed $w_R = P_M/M_R$. Then from the formula (6) it will be possible to determine time $t$ of transient to the changed moment of resistance in motion operating condition. The further motion will be uniform.

4. Numerical Instance of Dynamic Calculation

Let’s execute dynamic calculation of the mechanism (fig. 1, fig. 2).

Initial data:
- Load weight and mass of load.
- The kinematic parameters of the beginning of motion $G = 10000 \, Nm, m = 1000 \, Ns^2/m$

$$V_s = 0.1 \, m/s, V_a = 1 \, m/s, a_s = 7.27m/s^2.$$  

Geometrics. $R_1 = 0.044, R_4 = 0.012, R_9 = R_{10} = 0.056, r_{10} = 0.010$

To determine: a time of start $t_s$, acceleration time $t_a$, a time of the beginning of motion $T_b$ for transition into motion operating condition with $V = V_a = 1m/s$ $V = V_a = 1m/s$ and with operating condition motion parameters $M_R, w_R$. Numerical results we will show on the diagram of a tractive characteristic of a gear variator (fig. 3) for visualization.

The solution
1. Output angular velocity on start $\omega_{0s} = V_s/r_{10} = 0.1/0.01 = 10s^{-1}$.
2. A output moment of resistance on start $M_{R0} = Gr_{10} = 10000 \cdot 0.01 = 100 Nm$.
3. Power of resistance on start $P_{R_s} = M_{R_s}\omega_{0s} = 100 \cdot 10 = 1000 Nm/s$. – Points $A$ and $B$. 
4. The driving power consumed for overcoming of starting resistance and acceleration on the equation (8)

\[ P_M = P_{Ra} + 0.5ma_s(V_a + V_i) = 1000 + 0.5 \cdot 1000 \cdot 7.27 \cdot (1 + 0.1) = 5000 \text{ Nm} / \text{s}. \]

We select the electric motor: power of 5 kW, a rotational speed of 1500 rpm \((w_M = w_9 = 150 \text{s}^{-1})\).

5. Driving moment

\[ M_M = M_9 = \frac{P_M}{w_M} = \frac{5000}{150} = 33.3 \text{ Nm}. \]

Check of the driving moment on possibility of start \( M_9 \geq M_{Ra} \cdot \frac{R_s R_9}{R_1 R_{10}} = 100 \cdot \frac{0.012 \cdot 0.056}{0.044 \cdot 0.056} = 27.2 \text{ Nm} \).

6. A start time (getaway) by formula (11)

\[ t_s = \frac{mV_a^2}{2(P_M - P_{Ra})} = \frac{1000 \cdot 1^2}{2(5000 - 1000)} = 0.00125 \text{ s}. \] Start is presented by section AB.

7. Acceleration time after start

\[ t_a = \frac{m(V_a^2 - V_s^2)}{2(P_M - P_R)} = \frac{1000 \cdot (1^2 - 0.1^2)}{2(5000 - 1000)} = 0.123 \text{ s}. \] Dispersal is presented by piece AB.

8. A time of the beginning of motion – transition from start into motion operating condition

\[ T_b = t_s + t_a = 0.00125 + 0.123 = 0.12425 \text{ s}. \]

5. DYNAMICS OF TRANSIENT OF GEAR VARIATOR IN STAGE OF STEADY MOTION

After the beginning of motion in operating condition with a constant resistance moment the uniform motion with constant angular velocity takes place. Power of resistance is equal in the beginning of operating condition to driving power \( P_R = P_M = 5000 \text{ Nm} \). Parameters of power of resistance are equal \( M_R = 100 \text{ Nm}, \omega_{90} = 50 \text{ s}^{-1} \) the point C.

In motion operating condition at a process with decrease of a moment of resistance there is an increase of angular velocity and kinetic energy increase according to the formula (6). For example, with decrease of a moment of resistance to meaning \( M_R = 50 \text{ Nm} \) we will gain

\[ \omega_{90} = \frac{P_M}{M_R} = \frac{5000}{50} = 100 \text{ s}^{-1} \] point D.

In this case in a transitive regime on formula (13) it is necessary to use following parameters.

In point C initial speed is equal \( V_s = \omega_{90} r_{10} = 50 \cdot 0.01 = 0.5 \text{ m} / \text{s} \), in point D matching to new amount of moment of resistance \( M_R = 50 \text{ Nm} \) the terminal speed is matching to angular velocity \( \omega_{10} = 100 \text{ s}^{-1} \) and is equal \( V = \omega_{10} r_{10} = 100 \cdot 0.01 = 1 \text{ m} / \text{s} \). Driving power \( P_M \) is remaining invariable. Power of resistance is equal

\[ P_R = M_R \omega_{10} = 50 \cdot 50 = 2500 \text{ Nm} / \text{s}. \]

Then by formula (13) we will gain time of acceleration and of transition into a new regime of motion with changed moment of resistance \( M_R \) and with power \( P_R \)

\[ t_a = \frac{0.5 m(V^2 - V_s^2)}{P_M - P_R} = \frac{0.5 \cdot 1000 \cdot (1 - 0.5^2)}{5000 - 2500} = 0.15 \text{ s}. \]

In the end of this transitive regime (point D) input and output powers will be made equal again, and there will be further a regime of a uniform motion with parameters of point D.
Generally transitive process in operating condition occurs at change (decrease or increase) a moment of resistance and power of resistance that leads to respective alteration of speeds of motion of links and kinetic energy of a mechanism.

When the minimum moment of resistance which equals to driving moment \( M_R = 33.3 \text{ Nm} \) takes place we will gain \( \omega_R = \frac{P_M}{M_R} = \frac{5000}{33.3} = 150 \text{ s}^{-1} \) – point \( E \).

### 6. NUMERICAL INSTANCE OF DYNAMIC CALCULATION

Initial data match to the previous instance.

Power of resistance is equal in the beginning of operating conditions to driving power \( P_R = P_M = 5000 \text{ Nm} \).

Parameters of power of resistance are equal in the beginning of a stage of installed motion \( M_{Rb} = 100 \text{ Nm} \), \( \omega_{10b} = 50 \text{ s}^{-1} \) – point \( C \). New value of resistance moment \( M_{Rn} = 50 \text{ Nm} \).

To determine the output angular velocity \( \omega_{10e} \) in the stage of the installed motion operating condition at end of motion interval and transition time in a new regime of motion \( t \).

Solution
1. According to the formula (6) final angular velocity \( \omega_{10e} = \frac{P_M}{M_{Rn}} = \frac{5000}{50} = 100 \text{ s}^{-1} \) in point \( D \).

An initial winding speed of load in point \( C \) \( V_b = \omega_{10b} r_{10} = 50 \cdot 0.01 = 0.5 \text{ m/s} \). Speed in end of an interval \( V_e = \omega_{10e} r_{10} = 100 \cdot 0.01 = 1 \text{ m/s} \).

2. Power of resistance in the beginning of an considered interval of motion – in point \( C \)

\[ P_{R0} = M_{R0} \omega_{10b} = 50 \cdot 50 = 2500 \text{ Nm/s} \]

3. Transition time in a new regime of motion

\[
\frac{m(V_e^2 - V_b^2)}{2(P_M - P_{Rn})} = \frac{1000 \cdot (1^2 - 0.5^2)}{2(5000 - 2500)} = 0.15 \text{s}
\]

4. At the new minimum moment of resistance equal to driving moment \( M_{Rn} = 33.3 \text{ Nm} \), we will gain

\( \omega_{10n} = \frac{P_M}{M_{Rn}} = \frac{5000}{33.3} = 150 \text{ s}^{-1} \) – point \( E \). The speed of load \( V_e = \omega_{10n} r_{10} = 150 \cdot 0.01 = 1.5 \text{ m/s} \).

5. Transition time in a regime of motion from position in point \( C \) with the minimum resistance – point \( E \).

\[
\frac{m(V_e^2 - V_b^2)}{2(P_M - P_{Rn})} = \frac{1000 \cdot (1.5^2 - 0.5^2)}{2(5000 - 2500)} = 0.4 \text{s}
\]

![Figure 3. Tractive characteristic of gear adaptive variator](image-url)
Parameters of tractive characteristic:

Point $A$ – start with parameters $\omega_0 = 0, M_R = 100 \, Nm$. $AB$ – transitive motion regime on start with overoming of starting resistance (parameters of point $B$: $\omega_B = 10 \, s^{-1}, M_R = 100 \, Nm$). $BC$ – a section of a regime of acceleration and of increase of kinetic energy. Point $C$ – the beginning of operating condition of motion with two degree of freedom (parameters of point $C$: $\omega_C = 50 \, s^{-1}, M_R = 100 \, Nm$). $CD$ – transitive regime of operational motion in a condition with the reduced moment of resistance (angular velocity and a kinetic energy are increasing). Point $D$ – an intermediate state of operating condition of motion (parameters of point $D$: $\omega_D = 100 \, s^{-1}, M_R = 50 \, Nm$). The return motion (for example, from point $D$ to point $E$) takes place when moment of resistance is increasing with decreasing of angular velocity and a kinetic energy.

**CONCLUSION**

The gear variator is created on the basis of a kinematic chain with two degrees of freedom that determines its basic difference from existing transfer mechanisms. Research of dynamics of an adaptive gear variator allows presenting a full picture of its action in all regimes of motion. The elementary method based on the theorem of change of kinetic energy is used for dynamic research.

The start transitive regime of motion provides the start from place and acceleration of mechanism. The start takes place when the motion power is exceeding power of force of resistance. Reliability of the beginning of motion provides the starting wedging of a kinematic chain. The gear variator overcomes the maximum starting resistance in the accelerated motion with increase in kinetic energy.

Operational motion regime (after breaking) occurs at equality of motion power and power of resistance force. Motion is uniform. At change of balance of power the corresponding transitive regime changing parameters of motion and kinetic energy takes place. Here the closed contour of the mechanism gets the compelled internal mobility and provides adaptation to variable loading.

The made dynamic analysis confirms the efficiency and reliability of work of the two-mobile mechanism containing necessary additional constraints, in all regimes of motion.

In the paper the dynamics of transitive modes of the adaptive mechanism with two degrees of freedom is investigated. The received results are a basis of essentially new course of dynamics named «Dynamics of adaptive mechanisms».

**References**

KazNU adopting Bologna process determined significant changes in education system. Most notably, education transferred to three level system: Bachelor’s program, Master’s program, and PhD’s studies. In that case, the issues of integrating education process with European universities—parties to the Bologna convention and establishing unified system of assuring education quality are of primary importance [1, p. 64; 2, p. 3].

At present time, KazNU, being the chief university in the republic of Kazakhstan, dictates main trends in development of education. In the QS University ranking of 2015-2016 the KazNU improved its position from 275 to 236 rank. Advances of the university are based on constant improving and modernization of education process, including work on typical and main curriculums, and system of assessment of lecturers’ work quality and students’ knowledge. Academic mobility plays an important role in assuring education quality. Students of KazNU and other Kazakhstan universities are able at all three levels of education to undergo education or training for a semester in the leading American and European universities.

Expenses of students on travelling, accommodation, and studying are covered by the Kazakh National University. Furthermore, postgraduate students—Master’s degree and PhD’s students—are obliged to undergo training abroad by curriculum, which is stipulated via corresponding components and credits [3, p. 4]. Due to that, hundreds of students of KazNU travel abroad to study and conduct research yearly. That said, it’s quite difficult to discuss the issue of academic mobility within the whole university or any of its faculties. Furthermore, the issues are within sphere of departments. That’s why, we shall focus on academic mobility of students majoring in colloid chemistry and studying at the chair of analytical and colloid chemistry and technology of rare elements of the faculty of chemistry and chemistry technology of the KazNU.

The personnel on the chair of analytical and colloid chemistry and technology of rare elements include 45 lecturers. They teach students on more detailed specializations within three large spheres: analytical chemistry, colloid chemistry, and technology of rare elements (TrE).

KazNU has been developing colloid chemistry since 1973, first at a separate chair of colloid chemistry, which is currently merged with the chair of analytical chemistry and TrE. Eleven lecturers, including four Professors, Doctors of Chemistry, three associated professors, and four chief lecturers with degree of Candidate of Chemistry, specialize on colloid chemistry.

Research is mainly focused on complexes of natural and synthetic polymers and surfactants and their use as flocculants, flotation agents, emulgators, structuring agents, etc. Research on special nutritive colloids, biological dispersals, anti-microbial compounds, and sewage treatment is also actively carried out [4, p. 19].

Mainly, researches are executed within programs sponsored by the Ministry of Education and Science of the Republic of Kazakhstan (RK). Students take active part in performing studies. Also, our foreign fellows greatly help us in our research by receiving our students in their laboratories. The chair maintains close links with leading centers of colloid chemistry in European universities who receive our Master’s and PhD students. At the same time, professors in these universities are academic advisers for our PhD students’ theses.

Table 1 lists universities where our PhD students performed their research. PhD School was established in KazNU in 2005, and first students graduated in 2008. The first five PhD students on faculty of chemistry and chemical technology, who graduated in 2008, include Nurlan Stamkulov, a specialist in colloid chemistry, who performed his studies on stabilization of emulsions with polymer compounds in the laboratory of Colloid Chemistry in Imperial College (London, UK).

Table 1. Training of PhD students on profile «colloid chemistry»

<table>
<thead>
<tr>
<th>№</th>
<th>Name</th>
<th>Date</th>
<th>Internship Place</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Stamkulov Nurlan</td>
<td>2008</td>
<td>Imperial College of London (London, United Kingdom)</td>
</tr>
<tr>
<td>2</td>
<td>Bolatova Didar</td>
<td>2009</td>
<td>Imperial College of London (London, United Kingdom); University of Szeged (Szeged, Hungary); research center «Demokrit» (Athens, Greece)</td>
</tr>
<tr>
<td>3</td>
<td>Rakhimbayeva Dinara</td>
<td>2011</td>
<td>Imperial College of London (London, United Kingdom)</td>
</tr>
</tbody>
</table>

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